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Inventory Control Analysis of Sticker Raw Materials Using Continuous (Q) and Periodic Review (P) Methods at PT Adiguna Label Indonesia

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A B S T R A C T

PT Adiguna Label Indonesia is one of the manufacturing industries engaged in producing label stickers. To produce label stickers, this company requires the main raw material, one of which is substrate. PT Adiguna Label Indonesia is presently having trouble managing the supply of substrate type Raflacoat 22.5 cm. This type of substrate often fluctuates in the amount of demand, so it is not uncommon to experience stockouts that cause many customers to cancel orders due to insufficient material supplies. To reduce the susceptibility to out-of-stock and overstock situations along with the overall cost of inventory at PT Adiguna Label Indonesia, this study intends to manage the inventory of raflacoat substrate 22.5 cm. The method used is Continuous Review (Q) Lost Sales and Periodic Review (P) Lost Sales. The calculation results obtained that the total cost of minimal inventory is the method of Continuous Review (Q) Lost Sales of IDR. 2,160,302,178 with the company method of IDR.2,326,322,927, resulting in cost savings of IDR. 166.020.750.- or 7.14%. After forecasting in March 2023 – February 2025, the total need reached 2304 rolls, then the inventory control of Raflacoat 22.5cm substrate raw materials obtained a number of orders of 193 rolls / one order with a total inventory cost of IDR. 2,739,423,128,-.

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1. INTRODUCTION

One factor that affects a company's productivity is effective inventory management. Today, in any enterprise, inventory management is considered a key element in lowering the cost of the plant (Prachuabsupakij, 2019). Both directly and indirectly, inventory management affects the company's expenses. These costs include the cost of ordering, storage, capital, stock-outs, and backorders (Sheikh-Zadeh et al., 2021). Inventory management is one of the most dominant concerns in the supply chain due to its similarity to service levels. Inventory is a significant factor in a highly competitive environment (Due, Nguyen Trong Tri, Tai

Pham Doe, Buddhakulsomsiri, 2020). For supply chain management, maintaining proper inventory control can be difficult, especially when demand is fluctuating and unpredictable (Puka et al., 2021).

PT Adiguna Label Indonesia is one of the manufacturing industries producing label stickers. To create label stickers, the company requires the primary raw materials, including substrate, ink, foil, laminate, and supporting raw materials, namely plate. PT Adiguna Label Indonesia has difficulty managing the supply of substrate type Raflacoat 22.5 cm. This type of substrate is often subject to fluctuations in demand. Uncertain demand and a fixed order period cause frequent shortages of raw materials (out of stock) which drives consumer demand cannot be met due to having to delay the production process. The impact of this delay causes an increase in the waiting time of the production process and not infrequently many customers choose to place their orders with competitors instead. According to (Kenneth & Lizbeth, 2022), inventory is key to achieving customer fulfillment by providing a product available at the appropriate time (Wieczorek & Ignaciuk, 2019).

The suggested method is the continuous (Q) and periodic (P) review method, which is based on the issues that the organization experiences. The approach used by the company will contrast with these two methods, and the one with the lowest overall cost will be chosen. Research conducted by (Pratiwi et al., 2020) proved that the method of Continuous (Q) and Periodic (P) Review could result in a lower total cost of inventory compared to the actual company. The advantage of this method is that it can include the state of lost sales in its formulation, which impacts the level of Service and the overall cost and leads to more precise outcomes.

This research aims to offer the most effective option to reduce the incidence of out-of-stock and over-stock situations, particularly for the raw material substrate raflacoat 22.5 cm, which can affect the company's minimum total inventory cost. It Expects to simplify the business's production procedures to enhance the supply chain. Improved inventory control results in higher sales, lower expenses, and greater customer satisfaction (Nya et al., 2022).

2. LITERATURE REVIEW

A. Inventory Control

Inventory control is an activity that maintains conditions where the amount of inventory is at an optimal level in the sense of no more and less. Inventory control is an activity to maintain the availability of goods well with the number and type to support other processes that require inventory. The fundamental goal of inventory control is to ensure the appropriate amount and timing of raw materials so that there is never an inventory shortage (out of stock) or an excess inventory (over stock), which would hinder the effective and efficient production process operation. According to (Moleli & De La Harpe, 2019), Inaccurate or outdated data in an inventory might result in out-of-stock situations, which can lead the business to miss the delivery date it had committed. Optimizing the production process can avoid lost sales due to out-of-stock. In addition, the increase in inventory expenses prevents not making excessive orders (Demizu et al., 2023).

Pradana (2020) revealed that there are several objectives of inventory control as follows:

a. Eliminate the risk of delays in the arrival of goods or materials needed by the company.
b. Eliminate the risk of the material ordered is not good so it must be returned.
c. Maintain the stability of the company's operations or ensure the smooth flow of production.
d. Provide the best service to customers where customer wishes at one time can be fulfilled or provide guarantees for the continued availability of finished goods.

B. Inventory Cost

According to (Pradana & Jakaria, 2020), inventory costs can be divided as follows:

1. Holding cost/carrying cost
   Is one of the costs incurred in inventory management, to condition inventory to avoid damage, wear or tear, and loss. Thus storage costs can be further broken down as follows: (a) Cost of storage facilities (lighting, cooling, heating), (b) Opportunity cost of capital, (c) Cost of obsolescence and wear (amortization), (d) Cost of inventory insurance, (e) Cost of physical calculations

and consolidation of reports, (f) Cost of loss of goods, and (g) Inventory handling cost

2. Order Cost / Procurement Cost
   Costs that arise during the order process until the goods are in the logistics stage of the supplier include: (a) Expedition costs, (b) Cost of wages, (c) Telephone charges, (d) Correspondence fees, (e) Raw material inspection fee.
3. Set up cost
   Are the costs incurred in preparing machinery and equipment for use in the conversion process, including the following: (a) Cost of idle machines, (b) Labor setup costs, (c) Scheduling fee, (d) Expedition costs
4. Out-of-Stock Costs
   Costs incurred due to stockouts caused by miscalculations etc. (a) Cost of lost sales, (b) The cost of losing customers, (c) Special booking fees, and (d) Expedition costs

C. Inventory Method

One commonly used inventory control method is the probabilistic method, which is useful when demand or delivery times cannot be ascertained with certainty. There are two types of methods of controlling probabilistic inventory as follows: (1) Continuous Review Inventory Method Continuous Review (Q) method controlling inventory levels continuously (Hafizh Alim & Suseno, 2022). This system will place the order when the inventory level has reached the reorder point (r). (2) Periodic Review Inventory Method The Periodic Review (P) method is a method of inventory management by determining the amount of stock at regular and fixed or periodic ordering intervals (Susanto & Amruloh, 2020).

Table 1. Comparison of Q method and P method

No	Q Method	P Method
1.	The time between two consecutive bookings is not fixed	The time between two consecutive bookings is fixed
2.	The number of bookings is always the same for each booking	The number of bookings changes for each booking
3.	Relatively fewer items stored	Requires greater safety stock

D. Continuous Review Method

The continuous review method is a method that controls inventory levels by reordering when the inventory has reached the reorder point or below which is carried out continuously. The characteristic of the continuous review inventory system is the number of items ordered at the time of fixed order. Orders will continue until the inventory amount reaches the maximum inventory point (S). The value of S is obtained from the addition of order point and order quantity. The advantage of this system is that supplies will always be available so that demand will always be met. The Q method is usually beneficial for ordering or shipping in batches and allows inventory locations to replenish when stock is low (Berling et al., 2023). Graphically Method Q can be explained as in Fig. 1.

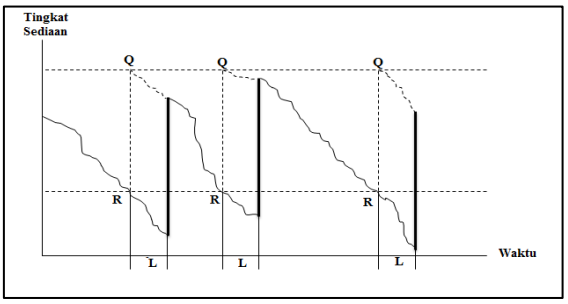

Fig. 1. Continuous review (Q) graphic
Source: (Prayogik & Ernawati, 2021)

E. Periodic Review Method

Method P reorders with an arbitrary number of orders but with a fixed time interval between two consecutive orders (Rahayu & Safirin, 2020). According to (Wang & Wan, 2020), fixed interval ordering has become a typical supply chain practice to facilitate shipment consolidation and logistics/production schedules. Periodic review inventory schemes are crucial in warehouse operations as they enable savings in ordering and shipping costs and simplify the handling of ordering and shipping operations (Dreyfuss & Giat, 2019). Prevent a significant loss of sales by optimizing the number of recharges, and order points should be increased (Herbon, 2019). Graphically Method Q can be explained as in Fig. 2.

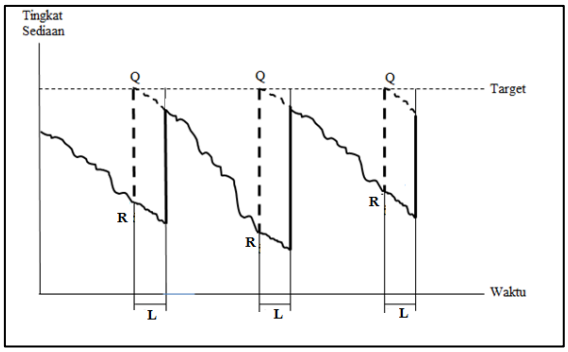

Fig. 2. Periodic review (Q) graphic
Source: (Prayogik & Ernawati, 2021)

F. Forecasting

Forecasting is an activity to estimate or predict future events, of course, with the help of preparing plans in advance, where this plan is made based on the capability and ability of demand/production that has been carried out in the company. Determine the amount of forecasting the total inventory cost in the next year. The time series forecasting type is SES, WMA, and ARIMA. The SES method is a method that assigns exponentially decreasing weights to increasingly recent observations (Yuniarti, 2020). In comparison, the WMA forecasting method has a weight based on recent history. These include the moving average method and approximating the exponential smoothing method by taking the most significant observation in the past (Nakade & Aniyama, 2019). At the same time, ARIMA is a model that completely ignores independent variables in forecasting. However, this method requires that the data used is stationary. Because Stationary is the basic assumption for time series analysis, especially when using the ARIMA method (Salman & Kanigoro, 2021).

3. RESEARCH METHOD

This study was conducted in February 2023 at a manufacturing company engaged in printing label stickers, namely PT. Adiguna Label Indonesia. The company is located in the city of Surabaya, Indonesia. This study has two variables: the dependent variable and the independent variable. The dependent variables in this study are the data consumption and raw material requirements of raflacoat substrate 22.5 cm, raw material pricing data, raw material inventory cost data, frequency data, inventory quantity data, and lead time data. In comparison, the lowest overall inventory cost serves as the independent variable. Here are some stages of data processing from this study: (1) Data Collection. The required Data consists of data on the use and fulfillment of raw material demand Raflacoat Substrate 22.5 cm, ordering costs, inventory costs, average inventory, storage costs, order frequency data, lead time data, and shortage costs, (2) Calculate the total cost of inventory by the method of the enterprise. It aims to determine the company's total expenditure during the period March 2021 – February 2023, (3) Data processing using the model of Continuous Review (Q) and Periodic Review (P) lost sales. This process involves processing the data collected utilizing the formulation of each existing approach to generate optimal results, (4) Compare the Total cost of the company's inventory method, Continuous Review (Q), and Periodic Review (P) of lost sales. It aims to determine and establish which methods are suitable for forecasting the need for raw materials in the next year, (5) Approach Several Forecasting Methods. Forecasting is done if the suggested approach yields more significant savings in overall inventory cost than the company's method. Calculate forecasting using the chosen approach based on the MSE value with the most negligible value. Forecasting to figure out how much raw material will be requires in the future. Demand forecasting is crucial to the effectiveness of production systems, just like it is in the manufacturing sector (Altendorfer & Felberbauer, 2023), (6) Raw material inventory control Substrate raflacoat 22.5 cm for the next two years. After obtaining the forecast for the next period, the calculation of raw material inventory control Substrate Raflacoat 22.5 cm with the most optimal proposed method to determine the total cost of the minimum inventory.

4. RESULT AND DISCUSSION

Data Data collection was collected by researchers by direct observation and based on company documents regarding raw material data Substrate Raflacoat 22.5 cm at PT Adiguna Label Indonesia. The Data used in this study are as follows :

Table 2. Data on needs and usage of substrate raflacoat 22.5 cm

Month	Initial Stock (roll)	Total Purchase (roll)	Total Need (roll)	The Remaining Amount Stock (roll)	Shortage Stock (roll)
March 2021	69	54	88	35	0
April 2021	35	50	105	0	20
May 2021	0	80	46	34	0
June 2021	34	55	108	0	19
July 2021	0	135	104	31	0
August 2021	31	69	138	0	38
September 2021	0	98	129	0	31
October 2021	0	151	136	15	0
November 2021	15	140	87	68	0
December 2021	68	65	144	0	11
January 2022	0	44	65	0	21
February 2022	0	87	70	17	0
March 2022	17	59	44	32	0
April 2022	32	46	107	0	29
May 2022	0	56	54	2	0
June 2022	2	30	57	0	25
July 2022	0	89	28	61	0
August 2022	61	48	80	29	0
September 2022	29	54	98	0	15
October 2022	0	46	59	0	13
November 2022	0	95	97	0	2
December 2022	0	88	105	0	17
January 2023	0	79	102	0	23
February 2023	0	107	97	10	0
Total	**393**	**1825**	**2148**	**334**	**264**

Table 3. Price of substrate raflacoat 22.5 cm

Material	Price
Substrate Raflacoat 22,5cm	IDR. 1.179.884

Table 4. Inventory cost of substrate raflacoat 22.5 cm

Material	Ordering Cost	Holding Cost	Shortage Cost
Substrate Raflacoat 22,5cm	IDR. 285.000 / order	IDR. 35.397 / roll	IDR. 579.830 / roll

Table 5. Data of order frequency, average of inventory, and lead time

Material	Order Frequency	Average of Inventory	Lead Time (Year)
Substrate Raflacoat 22,5cm	68 times	16 roll	1/51

A lead time is a lag time in a replenishment order that is sent in the same order as when it was issued (Johansen, 2021).

A. Total Inventory Cost Using the Company's Method

- Purchasing Cost (O_b)
  $= D.p$ (1)
  = Procurement Amount Expectations × Raw Material Prices
  = 1825 × IDR.1.179.884,-
  = IDR. 2.153.288.300,-
- Ordering Cost (O_p)
  $= f \times A$ (2)
  = Order Frequency × Ordering Cost
  = 68 × IDR.285.000
  = IDR.19.380.000,-

- Holding Cost (O_s)
  $= h \times m$ (3)
  = Holding Cost × Average of Inventory
  = IDR. 35.397 × 16 roll
  = IDR. 579.830,-
- Shortage Cost (O_k)
  $= N_T \times C_u$ (4)
  = Shortage Cost × Average of Shortage Stock
  = IDR. 579.830 × 264
  = IDR. 153.075.009
  Based on the data above, the total inventory cost of raw material needs is generated using the following formula:
- $O_T = O_b + O_p + O_s + O_k$ (5)
  = IDR. 2.153.288.300 + IDR. 19.380.000 + IDR. 579.830 + IDR. 153.075.009
  = IDR. 2.326.902.545,-

B. Calculation of Total Inventory Cost Using Continuous Review (Q) Lost Sales Method

- Calculate the average total need of substrate raflacoat 22,5cm
  $\bar{X} = \frac{\sum(Xi)}{n}$ (6)
  $= \frac{2148}{24} = 90$ Roll
- Calculating standard deviation
  $\sigma = \sqrt{\frac{\sum(Xi - \bar{X})^2}{n-1}}$ (7)
  $\sigma = \sqrt{\frac{\sum((88-90)^2 + (105-90)^2 + \cdots + (97-90)^2)}{24-1}}$
  σ = 31 Roll
- Iteration calculations
  Calculate the value of q_{01}^* equal to q_{0w}^* with Wilson's formula:
  $q_{01}^* = q_{0w}^* = \sqrt{\frac{2AD}{h}}$ (8)
  $q_{01}^* = \sqrt{\frac{2(285.000)(2148)}{35.397}}$ = 186 roll
- Determine the amount of inventory shortage (α) then calculate the reorder point (r_1^*)
  $\propto = \frac{hq_{01}^*}{C_u D + hq_{01}^*}$ (9)
  $\propto = \frac{(35.397)(186)}{(579.830)(2148)+(35.397)(186)}$ = 0,00526
  With a value of α of 0.00526, it can be seen from the normal distribution table that the value of $z_\propto$ is 2.56 so that the value of r_1^* can be searched.
- Then find the reorder point value r_1^* with the following formulas:
  $r_1^* = D_L + Z_\propto S\sqrt{L}$ (10)
  $r_1^* = (2148)(1/51) + (2,56)\left(90\sqrt{\frac{1}{51}}\right)$
  r_1^* = 53 roll
  A reorder point for quantity Q can be performed when the inventory level falls below a predetermined level, known as a reorder point (r) (Taleizadeh et al., 2020).
- Calculate the value based on the formula q_{0w}^*:
  Based on Table B the value of $f(Z_\propto)$ is 0.0154 and the value of $\Psi(Z_\propto)$ is 0.0183 so that N and q_{02}^* are obtained as follows:
  $N = S_L[f(Z_\propto) - Z_\propto \Psi(Z_\propto)]$ (11)
  $N = (90)(1/51)[(0,0154) - (2,56)(0,0017)]$
  $N = 0,0068$
  Then, the calculation of the value of q_{02}^* is as follows:
  $q_{02}^* = \sqrt{\frac{2(2148)[(285.000)+(579.830)(0,0068)]}{35.397}}$
  q_{02}^* = 187 roll

Recalculation the value of α and r_2^* :

$\propto = \frac{hq_{02}^*}{C_u D + hq_{02}^*}$ (12)

$\propto = \frac{(35.397)(187)}{(579.830)(2148)+(35.397)(187)}$ = 0.00529

Based on the normal distribution table, the value of α=0.00529 has a $z_\propto$ value of 2.555.
Based on Table B the value of $f(Z_\propto)$ is 0.0154 and the value of $\Psi(Z_\propto)$ is 0.0017
And further will be searchable r_2^* used the formula below:

$r_2^* = D_L + Z_\propto S\sqrt{L}$ (13)

$r_2^* = (2148)(1/51) + (2,555)(90\sqrt{1/51})$

r_2^* = 53 roll

Compare the value of r_1^* and r_2^* after iteration obtained the value of r_1^* of 53 rolls where the result is the same as r_2^* which is 53 rolls. Thus, the optimal inventory policy, service level and total inventory cost expectations can be obtained as follows:

- Optimal Inventory Policy
  $q_0^* = q_{02}^*$ = 187 roll per order
  $r^* = r_2^*$ = 53 roll
  $s = Z_\propto S\sqrt{L}$ (14)
  s = $(2,555)\ (90\sqrt{1/51})$ = 32 roll
- Service Level
  $\eta = 1 - \frac{N}{D_L} \times 100\%$ (15)

$\eta = 1 - \frac{0{,}0068}{(2148)(1/51)} \times 100\% = 99.99\%$

- Total Inventory Cost Expectations

$$OT = bp + \frac{AD}{q_0} + h\left(\frac{q_0}{2} + r - D_L\right) + \left(\frac{C_u D}{q_0}\right) N \quad (16)$$

$$OT = (1825)(1.179.884) + \frac{(285.000)\times(2148)}{187} + 35.397\left(\frac{187}{2} + 53 - (2148)(1/51)\right) + \left(\frac{(579.830)(2148)}{187}\right) x\ 0{,}0068$$

OT = IDR. 2.130.302.178,-

From the above calculation, the total cost of Substrate Raflacoat 22.5cm inventory with a continuous review (Q) lost sales method is IDR.2.130.302.178.

C. Calculation of Total Inventory Cost Using Periodic Review (P) Lost Sales

- Calculate the average total need of substrate raflacoat 22.5 cm

$$\bar{X} = \frac{\sum(Xi)}{n} = \frac{2148}{24} = 90 \text{ Roll} \quad (17)$$

- Calculating standard deviation

$$\sigma = \sqrt{\frac{\sum(Xi - \bar{X})^2}{n-1}} \quad (18)$$

$$\sigma = \sqrt{\frac{\sum((88-90)^2 + (105-90)^2 + \cdots + (97-90)^2)}{24-1}}$$

σ = 31 Roll

- Calculating the value of T_0:

$$T_0 = \sqrt{\frac{2A}{Dh}} \quad (19)$$

$$T_0 = \sqrt{\frac{2(285.000)}{(2148)(35.397)}} = 0.087 \text{ year}$$

- Determine the amount of inventory shortage (α):

$$\propto = \frac{Th}{Th + c_u} \quad (20)$$

$$\propto = \frac{(0{,}087)(35.397)}{(0{,}087)(35.397) + 579.830} = 0{,}00528$$

With a value of α of 0.00526, it can be seen from the normal distribution table that the value of $z_\propto$ is 2.56 so the value of R can be searched

- Then find the maximum inventory (R) value using the following formula:

$$R = DT + D_L + Z_\propto \sqrt{T + L} \quad (21)$$

$$R = (2148)(0{,}087) + (2148)(1/51) + 2{,}56\sqrt{0{,}087 + (1/51)}$$

R = 255 roll

R is the maximum desired inventory. If the inventory is at level y, the quantity R-y is ordered to fulfill the inventory of R (Taleizadeh et al., 2020).

- Calculate the possible shortage value (N) and $(O_T)_0$:

Based on Table B the value of $f(Z_\propto)$ is 0.0154 and the value of $\Psi(Z_\propto)$ is 0.017 so that N and $(O_T)_0$ are obtained as follows:

$$N = S\sqrt{T + L}[(f(z_\propto) - z_\propto \psi(z_\propto)] \quad (22)$$

$$N = 31\sqrt{0.087 + (1/51)}(0{,}0154 - (2{,}56)(0{,}0017))$$

$$N = 0{,}114$$

Then, the calculation of the value of $(O_T)_0$ is as follows:

$$O_T = Dp + \frac{A}{T} + h\left(R - D_L + \frac{DT}{2}\right) + \left(\frac{c_u}{T}\right)\int_R^\infty (z - R) f(z) dz \quad (23)$$

$$(O_T)_0 = (2.148)(1.179.884) + \frac{285.000}{0{,}087} + 35.397\left((225 - (2.148)(1/51))\right)\left(\frac{(2.148)(0.087)}{2}\right) + \left(\frac{579.830}{0.087}\right) 0{,}114$$

$(O_T)_0$ = IDR. 2.549.270.264,-

Thus, the optimal inventory policy, service level and total inventory cost expectations can be obtained as follows:

- Optimal inventory policy

T_0^*= 0.087 year

R^*= 255 roll

$$ss = Z_\propto S\sqrt{T + L} \quad (24)$$

$= (2{,}56)(31\sqrt{0{,}087 + 1/51}) = 26$ roll

- Service Level

$$\eta = 1 - \frac{N}{D_L} \times 100\% \quad (25)$$

$$\eta = 1 - \frac{0{,}114}{(2148)(1/51)} \times 100\% = 99.99\%$$

- Total Inventory Cost Expectations

$$OT = bp + \frac{A}{T} + h\left(\frac{q_0}{2} + r - D_L\right) + \left(\frac{C_u D}{q_0}\right) N \quad (26)$$

$$OT = (1825)(1.179.884) + \frac{285.000}{0{,}087} + 35.397\left(\frac{187}{2} + 53 - (2148)(1/51)\right) + \left(\frac{(579.830)(2148)}{187}\right) x\ 0{,}0068$$

OT = IDR. 2.168.178.650,-

From the above calculation, the total cost of

Substrate Raflacoat 22.5cm inventory with the periodic review (P) lost sales method is IDR.2.130.302.178.

D. Comparison of Total Inventory Cost of the Methods Used

In this step, a comparison will be made between the total inventory cost of the company's method, the total inventory cost of the continuous review (Q) lost sales method, and the total inventory cost of the periodic review (P) lost sales method. This comparison will determine which proposed method has the minimum total cost and will be used in forecasting calculations.

Table 6. Inventory cost of substrate raflacoat 22.5 cm

Company's Method (IDR)	Continuous Review Method (IDR)	Periodic Review Method (IDR)
IDR. 2.326.322.927	IDR. 2.160.302.178	IDR. 2.168.178.650

Based on Table 6, the total inventory cost in the continuous review (Q) method is IDR. 2,160,302,178. Meanwhile, the total inventory cost in the periodic review method is IDR. 2,168,178,650. Therefore, the total inventory cost of the proposed method that will be compared with the current condition of the company is the continuous review (Q) method because it has the minimum total inventory cost. Based on the table above, it shows that the total inventory cost in the continuous review (Q) method is smaller than the company's current condition with a cost decrease of IDR. 166,020,750 or 7.14%. Based on Table 2, the material requirements for Substrate Raflacoat 22.5 cm in March 2021 – February 2023 can be visualized into a graph as follows:

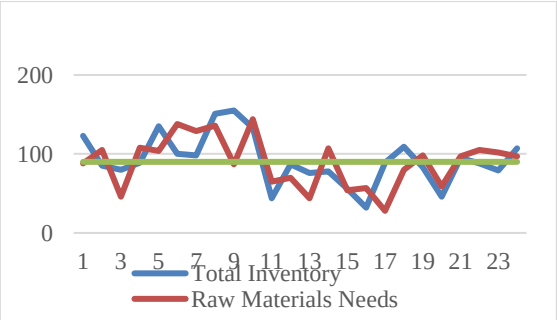

Fig. 3. Substrate raflacoat 22.5cm substrate requirement graph

Based on Fig. 3, it can be concluded that the material requirements of Substrate Raflacoat 22.5cm are fluctuating or unstable. Then from the requirement data of Substrate Raflacoat 22.5 cm for March 2021–February 2023, the calculation of Mean Square Error (MSE) is carried out, so the results are obtained in the following table:

Table 7. MSE value results of substrate raflacoat 22.5 cm forecasting in March 2023 - February 2025

Material	Mean Square Error (MSE)		
	Single Exponential Smoothing (SES)	Weighted Moving Average (WMA)	ARIMA
Substrate Raflacoat 22.5 cm	1013.452	1041.17	1107

From Table 7, the forecasting results for March 2023 – February 2025 are the Single Exponential Smoothing (SES) method ($\alpha = 0.4$) with the smallest Mean Square Error (MSE), which is 1013.452, so the next step is to verify the data using the Single Exponential Smoothing (SES) method forecasting data ($\alpha = 0.4$).

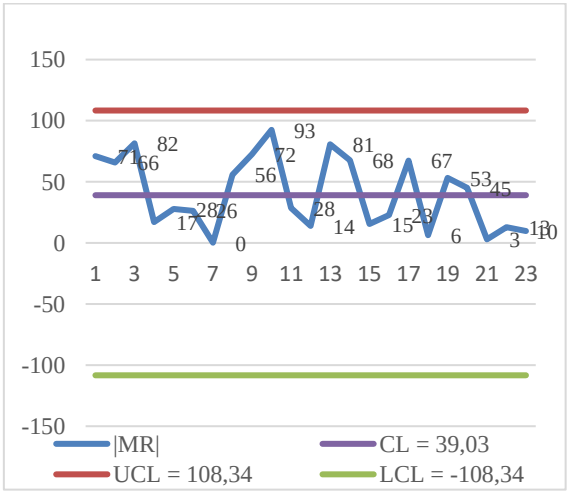

Fig. 4. Moving range chart value of forecast substrate raflacoat 22.5 cm

From Fig. 4, it is concluded that data within the interpreted control limits can be used to forecast the need for a 22.5 cm Raflacoat Substrate March 2023 – February 2025. With the results in Table 7.

Table 8. Substrate raflacoat 22.5 cm requirement forecasting

No	Month	Forecast
1.	March 2023	96
2.	April 2023	96
3.	May 2023	96
4.	June 2023	96
5.	July 2023	96
6.	August 2023	96
7.	September 2023	96
8.	October 2023	96
9.	November 2023	96
10.	December 2023	96
11.	January 2024	96
12.	February 2024	96
13.	March 2024	96
14.	April 2024	96
15.	May 2024	96
16.	June 2024	96
17.	July 2024	96
18.	August 2024	96
19.	September 2024	96
20.	October 2024	96
21.	November 2024	96
22.	December 2024	96
23.	January 2025	96
24.	February 2025	96
	Total	**2304**

It can be concluded from Table 7 that the results of forecasting the needs of the substrate raflacoat 22.5cm obtained a total of 2304 rolls and every month it has a constant demand of 96 rolls. The forecast results obtained are indeed contrary to the company's historical data which shows fluctuating raw material needs. This is because the method chosen in forecasting is Single Exponential Smoothing (SES) which has a way of forecasting by processing the calculation of alpha values with one previous value. If the forecasting requested is 24 months ahead, then the forecasting value of the 2nd month will refer to the forecasting value of the first month and so on. This causes the forecasting value to be constant. However, the forecasting results obtained have been confirmed to be valid because the value is at the control limit and has the smallest MSE value compared to other forecasting methods. Then can be continued by calculating the Continuous (Q) Review lost sales model. With the Hadley-Within solution for the calculation of the lost sales model (Q) carried out with several stages of iteration, the needs of the substrate raflacoat 22.5 cm March 2023–February 2025 are as follow:

- Calculate the average total need of substrate raflacoat 22,cm

$$\bar{X} = \frac{\sum(Xi)}{n} = \frac{2304}{24} = 96 \text{ Roll} \quad (27)$$

- Calculating standard deviation

$$\sigma = \sqrt{\frac{\sum(Xi - \bar{X})^2}{n-1}} \quad (28)$$

$$\sigma = \sqrt{\frac{\sum((96-96)^2 + (96-96)^2 + \cdots + (96-96)^2)}{24-1}}$$

σ = 0 Roll

- Iteration calculations
  Calculate the value of q_{01}^* equal to q_{0w}^* with Wilson's formula:

$$q_{01}^* = q_{0w}^* = \sqrt{\frac{2AD}{h}} \quad (29)$$

$$q_{01}^* = \sqrt{\frac{2(285.000)(2304)}{35.397}} = 193 \text{ roll}$$

- Determine the amount of inventory shortage (α) then calculate the reorder point (r_1^*)

$$\propto = \frac{hq_{01}^*}{C_u D + hq_{01}^*} \quad (30)$$

$$\propto = \frac{(35.397)(193)}{(579.830)(2304)+(35.397)(193)} = 0{,}00509$$

With a value of α of 0.00509, it can be seen from the normal distribution table that the value of $z_\propto$ is 3.285 so that the value of r_1^* can be searched.

- Then find the reorder point value r_1^* with the following formulas:

$$r_1^* = D_L + Z_\propto S\sqrt{L} \quad (31)$$

$$r_1^* = (2304)(1/51) + (3{,}285)(0\sqrt{1/51})$$

r_1^* = 45 roll

- Calculate the value based on the formula q_{0w}^* :
  Based on Table B the value of $f(Z_\propto)$ is 0.0017 and the value of $\Psi(Z_\propto)$ is 0.00013 so that N and q_{02}^* are obtained as follows :

$$N = S_L[f(Z_\propto) - Z_\propto \Psi(Z_\propto)] \quad (32)$$

$$N = (0)(1/51)[(0{,}0017) - (3{,}285)(0{,}00013)]$$

$$N = 0$$

Then, the calculation of the value of q_{02}^* is as follows

$$q_{02}^* = \sqrt{\frac{2(2304)[(285.000)+(579.830)(0)]}{35.397}}$$

q_{02}^* = 193 roll

Recalculation the value of α and r_2^*:

$$\propto = \frac{hq_{02}^*}{C_u D + hq_{02}^*} \quad (33)$$

$$\propto = \frac{(35.397)(193)}{(579.830)(2304)+(35.397)(193)} = 0.00508$$

Based on the normal distribution table, the value of α=0.00508 has a $z_\propto$ value of 3.285.
Based on Table B the value of $f(Z_\propto)$ is 0.0017 and the value of $\Psi(Z_\propto)$ is 0.00013
And further will be searchable r_2^* used the formula below:

$$r_2^* = D_L + Z_\propto S\sqrt{L} \quad (34)$$

$$r_2^* = (2304)\left(\frac{1}{51}\right) + (3{,}285)\left(0\sqrt{\frac{1}{51}}\right)$$

$$r_2^* = 45 \text{ roll}$$

Compare the value of r_1^* and r_2^* after iteration obtained the value of r_1^* of 45 rolls where the result is the same as r_2^* which is 45 rolls. Thus, the optimal inventory policy, service level and total inventory cost expectations can be obtained as follows:

- Optimal Inventory Policy
  $q_0^* = q_{02}^*$ = 193 roll per pesan
  $r^* = r_2^*$ = 45 roll
  $s = Z_\propto S\sqrt{L}$ (35)
  = (3,285) $(0\sqrt{1/51})$= 44 roll
- Service Level
  $\eta = 1 - \frac{N}{D_L} \times 100\%$ (36)
  $= 1 - \frac{0}{(2304)\left(\frac{1}{51}\right)} \times 100\% = 100\%$
- Total Inventory Cost Expectations
  OT = $bp + \frac{AD}{q_0} + h\left(\frac{q_0}{2} + r - D_L\right) + \left(\frac{C_u D}{q_0}\right)N$ (37)
  = $(2316)(1.179.884) + \frac{(285.000)\times(2034)}{193} + 35.397\left(\frac{193}{2} + 45 - (2304)(1/51)\right) + \left(\frac{(579.830)(2304)}{193}\right)x\ 0$
  = IDR. 2.739.423.128,-

From the calculation above, the total cost of Substrate Raflacoat 22.5cm inventory from March 2023 to February 2025 with the continuous review (Q) lost sales method is IDR. 2.739.423.128,-

Obtained the size of the number of orders Substrate Raflacoat 22.5 cm using the method of continuous review proposal (Q) lost sales of 187 rolls/once, and the total needs of the Substrate Raflacoat 22.5 cm is equal to 2304 rolls. Based on the calculation of forecasting PT. Adiguna Label Indonesia must issue a total inventory cost of in March 2023-February 2025 of IDR. 2.160.302.178,-. From the point of view of inventory management, there are four main questions if there is a possibility of supply-side disruption: (1) How much should be ordered from suppliers to avoid unwelcome shortages; (2) under what circumstances the shortage is going to occur; (3) What is the ratio of unfulfilled demand to be met (pure reorder/lost sales, or partial reorder); and (4) How does this decision affect the entire long-term cost of the inventory system (Taleizadeh et al., 2021). As a result, it is suggested that the organization implement the continuous review approach for its inventory system due to the importance of the inventory system to the day-to-day functioning of storage facilities. It is important to choose when to make an order and how much to order for each product (Gutierrez & Rivera, 2021).

5. CONCLUSION

Based on the calculation results, it was found that from March 2021 to February 2023, the total cost of raw material inventory of Raflacoat 22.5 cm Substrate using the company's method was IDR.2.326.322.927,-. While the total cost of inventory using the method of continuous review (Q) lost sales are IDR. 2.160.302.178,-. From both results obtained, the cost savings of IDR. 166.020.750.- or about 7,14%. Therefore, continuous review (Q) lost sales is chosen to calculate the total inventory cost from forecasting needs using the Single Exponential Smoothing (SES) method. From the forecasting results, raw material inventory control Substrate Raflacoat 22.5 cm with the number of orders of 193 rolls / once the message and the total needs reached 2304 rolls. So that PT. Adiguna Label Indonesia must issue a total inventory cost from March 2023 to February 2025 is IDR. 2.739.423.128.

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