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Optimizing Raw Material Inventory Control with Continuous and Periodic Review

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Abstract

PT XYZ is a plywood processing firm confronted with issues related to raw material inventory management since the demands for such materials are probabilistic in nature and the orders could not be ordered based on the needs of the company's production line. This often leads to problems such as overstock and stockout hence increasing the overall cost of inventory. This research is going to find ways on supply management of sengon wood to be used in PT XYZ by identifying the difference between the existing inventory management technique that the company is using, the continuous review (Q) back order method and the periodic review (P) back order method to retail total inventory costs. From the findings, it is established that employing continuous review back order method (Q) bring in total stocks cost to the tune of IDR 28,829,527,844 which is cheaper than the total costs obtained under current firms method resulting to the tune of IDR 32,502,564,700 in the process giving an 11.3% cost savings. Moreover, based on the estimated demand of sengon wood from May 2024 to April 2025 as 42,109 m³, another improvement called the continuous review method helped to optimize the use of inventory. This research validates the effectiveness of such inventory tracking systems as the continuous inventory monitoring system particularly for businesses that operate in volatile markets hence the implication of great savings when compared to the conventional systems of inventory control.

Introduction

In the modern era, every company will be faced with global market competition, where companies must be able to face intense competition with other companies. Optimal products will be available if the production process is carried out smoothly (Kholil et al., 2020). Every company has various goals, one of which is to make a profit and maintain a smooth production process. However, achieving this goal is not easy because it is influenced by various factors. One important factor is the management and control of the stock of raw materials that will be used in the production process (Pradana & Jakaria, 2020). Availability of raw materials is the main and very important factor that can influence the size of inventories. Raw materials have a direct impact on the company's production volume and profitability (Suseno & Fathony, 2022). Companies need to plan and control raw material inventory effectively to achieve a balance between raw material stock and production needs in accordance with demand. This can reduce raw material inventory costs, including storage costs in warehouses (Hoswari et al., 2020). Inventory control is the main focus because this can significantly reduce operational costs in the company (Alrasheedi et al., 2022). Inventory control is the process of a series of production activities that are adjusted to planning related to quantity, time, quality

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and costs which are interrelated with each other (Ghasemi et al., 2023). This aims to optimize inventory costs by making purchases in accordance with production plans, avoiding shortages or excesses in inventory (Hidayat et al., 2020).

According to Rohman in a quote from Subekti & Nusyanti (2023), the definition of inventory is divided into two based on the type of company operations. For manufacturing companies, inventory refers to reserves of raw materials and semi finished goods that will be processed into finished goods with greater economic added value to be sold to consumers. Meanwhile, for trading companies, inventory is a collection of finished goods that are ready to be sold to consumers. Inventory refers to assets in the form of goods owned by a company that will be marketed within a certain period, or goods and raw materials that are still awaiting use or processing in the production process (Ruidas et al., 2023). From this description, it can be concluded that inventory is a material component or ingredients that are stored deliberately, waiting to be processed or processed in the production process, aimed at as a strategy to anticipate demand uncertainty (Hany & Khairani, 2023; Bendig et al., 2018). In order to achieve optimal inventory levels, a company must maintain a balance between several variables, such as product life, storage costs, and risks associated with inventory (Kadafi & Delvina, 2021; Zhang et al., 2021).

According to Kasmir in a quote from Song et al. (2021) inventory management describes the inventory of goods in a company that is used for production activities. Inventory management as the main part of the work model is a rotating asset that is constantly undergoing change. Changes in inventory are a ratio used to measure how many times funds embedded in inventory can rotate in one period. Inventory management plays an important role in managing inventory so that it is at optimal levels. With inventory management, it is hoped that companies can reduce possible risks, such as mismatches between raw material orders, delays in delivery, and shortages or excess stock (Rini & Ananda, 2021; Kouvelis et al., 2023).

PT. XYZ is a manufacturing company that operates in the field of processing plywood with various variations. Based on company data and interviews, this company often experiences problems, namely ordering raw materials that are uncertain, ordering raw materials because of probabilistic demand with uncertain periods and the quantity of raw materials that does not match the needs used in the production process so that it often experiences remaining raw materials (overstock) and experiencing events where raw materials are not available (stockout). This causes a buildup of raw materials and shortages of raw materials which can affect the total inventory costs that must be incurred by the company (Haryadi & Bramasto, 2023). Therefore, it is necessary to control the supply of plywood raw materials in the form of sengon wood at PT. XYZ so that it can minimize total inventory costs.

A probabilistic inventory model is an inventory model in which demand characteristics and order lead times are uncertain (Hansen et al., 2023; Tai et al., 2021). Probabilistic inventory control models are more suited to real situations than deterministic models that assume all data is known with certainty. Nevertheless, quantity, distribution patterns and demand variances can be predicted and approximated using probability distributions. In other words, a probabilistic inventory model allows predictions of future demand by utilizing demand data from previous periods (Dewi et al., 2022). The probabilistic inventory method is divided into two, namely the continuous review system method and the periodic review system method (Wati et al., 2023). In this inventory model, there are two policies that can be applied when inventory cannot meet customer demand, namely back orders and lost sales (Agatha & Sunarni, 2020).

The assumptions of this research are that the goods that arrive are of the desired quality, the price of raw materials does not change during the research, ordering costs and holding costs are constant, and lead time is the same every time raw materials are ordered. The aim of this

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research is to control the optimal supply of sengon wood at PT. XYZ so that it can minimize the total inventory costs of sengon wood which is the raw material for plywood. In order to ensure that the research is carried out carefully, the author needs to determine the boundaries of the problem, including that the plywood raw material studied is sengon wood and the variable that will be tested, namely minimum raw material inventory costs.

Methods

This research uses quantitative research methods conducted at PT. XYZ. There are dependent variables and independent variables in this research. The dependent variable in this research is the minimum total inventory cost. Meanwhile, the independent variables in this research include data on the purchase and use of sengon wood, the price of sengon wood, the cost of ordering sengon wood, the cost of storing sengon wood, the cost of shortages of sengon wood, the frequency of ordering sengon wood, and the lead time for sengon wood from March 2023 to April 2024. In this research, analysis was carried out on the company's historical data by applying the continuous review system inventory method and the periodic review system method. The data used in this research comes from two sources, namely secondary data and primary data. Primary data was obtained from the company's raw materials department, while secondary data came from company records which included information regarding the purchase and use of sengon wood, the price of sengon wood, the cost of ordering sengon wood, the cost of storing sengon wood, the cost of shortages of sengon wood inventory, the frequency of ordering sengon wood , and lead time for ordering sengon wood.

To overcome this problem, the data analysis techniques used include: (a) calculating total inventory costs using the company's internal approach, and (b) calculating total inventory costs by applying the proposed methods, such as the continuous review (Q) back order method and the backorder method. periodic review (P) back orders (Pulungan & Fatma, 2018). At the calculation stage using the continuous review (Q) back order method using several formulas as follows: (1) Calculate the initial q_{01} value equal to the q_{01} value using the equation: $q_{01} = \sqrt{(2AD/h)}$; (2) Based on the q_{01} value obtained, it can be used to find possible inventory shortages α, the equation $\alpha = hq_{01}/CuD$; (3) The calculation of r_1 can be found using the equation: $r_1 = DL + Z\alpha S\sqrt{L}$; (4) After searching for r_1, you can calculate q_{02} with the equation $q_{02} = \sqrt{((2D(A+CuN))/h)}$; (5) Recalculate the value of α using the equation $\alpha = hq_{01}/CuD$ and calculate the value of r_2 with the equation $r_2 = DL + Z\alpha S\sqrt{L}$; (6) Compare the values of r_1 and r_2 if the price of r_2 is relatively the same as r_1. The iteration is complete and you will get $r_1 = r_2$ and $q_{01} = q_{02}$. If not, you will return to step 3 by changing the values $r_1 = r_2$ and $q_{01} = q_{02}$; (7) Expected total costs per year can be calculated with the equation: $OT = Dp + AD/qo + h((qo+r-DL)/2) + Cu(D/q0) \times N$; (8) At the calculation stage using the periodic review (P) back order method using several formulas, including: (a) Calculate the value of T0 in the equation $T0 = \sqrt{(2A/Dh)}$; (b) Calculate the values of α and R with the equation: $\alpha = Th/Cu$ and $R = D(T0 + L) + Z\alpha S\sqrt{(T+L)}$; (c) Calculate total inventory costs with the equation: $OT = Dp + A/T + h(R-DL+ DT/2)+(Cu/T\times N)$; (9) Repeat step 2 by substituting $T_0 = T_0 + \Delta T_0$; (a) If the new $(OT)_0$ result is greater than the initial $(OT)_0$, the T_0 addition iteration is stopped. Then try reducing iteratively ($T_0 = T_0 - \Delta T_0$) until the value $T = T_0$ is found which gives the minimum total cost value; (b) If the new $(OT)_0$ result is smaller than the initial $(OT)_0$, the addition iteration ($T_0 = T_0 + \Delta T_0$) continues and will stop if the new $(OT)_0$ is greater than the previously calculated $(OT)_0$. The price T_0 which gives the smallest cost (OT) is the optimal time interval; (c) Compare the total inventory costs that have been calculated using the company method and the proposed method. Then we find which method produces the minimum total inventory costs; (d) Carry out inventory forecasting using forecasting methods based on data patterns; (e) Carry out raw material inventory planning based on forecasting using the proposed method.

Results and Discussion

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Company Method

Purchase Cost (Ob) = 33,560 m^3 x IDR 857,690 = IDR 28,784,076,400

Order Cost (Op) = 296 m^3 x IDR 370,000 = IDR 109,520,000

Storage Cost (Os) = 113.38 m^3 x IDR 35,000 = IDR 3,968,300

Shortage Cost (O_K) = 721 m^3 x IDR 5,000,000 = IDR 3,605,000,000

Total inventory costs = Ob + Op + Os + Ok = IDR 32,502,564,700

Continuous Review (Q) Back Order Method

The calculation of the average and standard deviation is as follows:

$$\bar{X} = \frac{33.560}{12} = 2{,}797 \text{ m}^3$$

$$S\ (\sigma) = \sqrt{\frac{\Sigma((0-2.797)^2+(2.933-2.797)^2+(4.144-2.797)^2+\ldots\ldots+(3.572-2.797)^2)}{12-1}} = 1{,}488 \text{ m}^3$$

Iteration 1

Determine the order lot size (q_{01})

$$q_{01} = \sqrt{\frac{2\,(370.000)(33.560)}{35.000}} = 842 \text{ m}^3$$

a. Determine the amount of inventory shortage (α)

$$\alpha = \frac{(35.000)(842)}{(5.000.000)(33.560)} = 0.000175$$

Determines the reorder point value

r_1 = (33.560) (0,0027) + (3,575) (1.488) ($\sqrt{0{,}0027}$) = 367,02 m^3

Based on the table, the values for f (Zα) = 0.006 and Ψ(Zα)) = 0.00009 are obtained.

N = SL (f ((Zα)) - Zα (Ψ(Zα)) = ((1.488) (0.0027) (0.006)) – (2.92) (0.00009) = 0.0236

Determine the order lot size q_{02}

$$q_{02} = \sqrt{\frac{2D(A+CuN)}{h}} = \sqrt{\frac{2(33.560)((370.000 + (5.000.000 \times 0{,}0236))}{35.000}} = 967 \text{ m}^3$$

Recalculate the values of α_2 and r_2

$$\alpha_2 = \frac{hq02}{CuD} = \frac{(35.000)(962)}{(5.000.000)(33.560)} = 0.00020$$

Next, look for the Zα value using the normal distribution table and get the Zα value for the value α = 0.00020 which is 3.54.

$r_2 = DL + Z_\alpha S\sqrt{L}$ = (33.560) (0,0027) + (3,54) (1.488) ($\sqrt{0{,}0027}$) = 367,31 m^3

Compare the values of r_1 and r_2

From the first iteration, the value obtained was r_1 = 367.02 m^3, which was not the same as the result r_2 = 367.31 m^3, so the iteration was continued.

Iteration 2

Determining the order lot size using the value r_2 = 367.31 m^3 then the value can be found

f (Zα) f (Zα) = 0.009 and Ψ(Zα) = 0.00006

N = SL (f ((Zα)) - Zα (Ψ(Zα)) = ((1.488) (0.0027) (0.009)) – (3.545) (0.00006) = 0.0358

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So the reorder lot size value is obtained as follows:

$$q_{03} = \sqrt{\frac{2D(A+CuN)}{h}} = \sqrt{\frac{2(33.560)((370.000 + (5.000.000 \times 0,0358))}{35.000}} = 1,026 \text{ m}^3$$

Determine the magnitude of the inventory shortage (α)

$$\alpha_3 = \frac{(35.000)(1.026)}{(5.000.000\ )(33.560)} = 0,00021$$

With an α value of 0.00021, it can be seen from the normal distribution table that the Zα value is 3.525

Determines the reorder point value

$r_3 = DL + Z_\alpha S\sqrt{L}$ =(33.560) (0,0027) + (3,525) (1.488) (*0,0027*) = 363.15 m^3

Compare the values of r_2 and r_3

The resulting value of r_2 = 367.31 m^3 is not the same as r_3 = 365.15 m^3. So the iteration continues.

Iteration 3

Determine the order lot size using the value r_3 = 365.15 m^3 then the value can be found

f (Zα) f (Zα) = 0.009 and Ψ(Zα) = 0.00006

N = SL (f ((Zα)) - Zα (Ψ(Zα)) = ((1.488) (0.0027) (0.009)) – (3.545) (0.00006) = 0.0358

So the reorder lot size value is obtained as follows:

$$q_{04} = \sqrt{\frac{2D(A+CuN)}{h}} = \sqrt{\frac{2(33.560)((370.000 + (5.000.000 \times 0,0358))}{35.000}} = 1,026 \text{ m}^3$$

Determine the magnitude of the inventory shortage (α)

$$\alpha_4 = \frac{(35.000)(1.026)}{(5.000.000\ )(33.560)} = 0.00021$$

With an α value of 0.00021, it can be seen from the normal distribution table that the Zα value is 3.525

Determines the reorder point value

$r_4 = DL + Z_\alpha S\sqrt{L}$ =(33.560) (0,0027) + (3,525) (1.488) (*0,0027*) = 363.15 m^3

Compare the values of r_2 and r_3

The resulting value is r_3 = 365.15 m^3, which is the same as r_4 = 365.15 m^3. Then the iteration is complete.

The optimal inventory policy is obtained as follows:

$q_{03} = q_{04}$ = 1,026 m^3

$r_3 = r_4$ = 363.15 m^3

Expectations of total inventory costs using the continuous review (Q) back order method are: (a) Purchase Cost (Ob) = 33,560 m3 × 857,690 = IDR 28,784,076,400; (b) Order Cost (Op) = 33,560/1,026 × 370,000 = IDR 12,102,534; (c) Holding Costs (Os) = 35,000 (1,026/2 + 363.15 – (33,560) (0.0027)) = IDR 27,493,900; (d) Shortfall Cost (Ok) = (5,000,000 × 33,560)/1,026 × 0.0358 = IDR 5,855,010

Total inventory costs = IDR 28,784,076,400 + IDR 12,102,534 + IDR 27,493,900 + IDR 5,855,010= IDR 28,829,527,844

ISSN: 2716-3865 (Print), 2721-1290 (Online)

Periodic Review (Q) Back Order Method

Determine the order time interval (T_0)

T_0 = √((2 (370,000))/((33,560)(35,000))) = 0.025 Years

Determine the amount of inventory shortage (α)

α = ((0.025)(35,000))/5,000,000= 0.000175

Calculating maximum inventory (R)

R = 33,560 × (0.025 + 0.0027) + (3.575)(1.488)√(0.025+0.0027) = 1.813 m^3

After obtaining the R value, first look for the values of f (Zα) = 0.009 and Ψ(Zα) = 0.00006 so that the N value can be calculated as follows:

N = S√(T+L) [f (Zα) - ZαΨ(Zα)] = (1.488)√(0.025+0.0027)[(0.009) – (3.575) (0.00006)] = 2.17

Calculate the expected total cost of inventory

$O_T = Dp + \frac{A}{T} + (R - DL + \frac{TD}{2})\, h + \left(\frac{Cu}{T}\right)\int_R^\infty (z - R)\, f(z)\, dz = (33{,}560)(857{,}690) + \frac{370{,}000}{0{,}025} + (1{,}813 - (33{,}560)(0.0027) + (\frac{(0.025)(33{,}560)}{2}))(35{,}000) + \left(\frac{5{,}000{,}000}{0.025}\right)(2.17)$ = Rp 29,307,842,550

Iteration 2

With a T_0 value of 0.025, we will try adding T_0¬ by 1/2 T_0 period, namely 0.0125, so that the T_0 value = 0.0375.

Determine the amount of inventory shortage (α)

α = ((0.0375) (35,000))/5,000,000= 0.00026

Calculating maximum inventory (R)

R = 33,560 × (0.0375 + 0.0027) + (3.47) (1.488) √ (0.0375+0.0027) = 2.384 m^3

After obtaining the R value, first look for the values of f (Zα) = 0.0012 and Ψ(Zα) = 0.00009 so that the N value can be calculated as follows:

N = S√(T+L) [f (Zα) - ZαΨ(Zα)] = (1.488) √ (0.0375+0.0027) [(0.0012) – (3.47) (0.00009)] = 0.264

Calculate the expected total cost of inventory

$O_T = Dp + \frac{A}{T} + (R - DL + \frac{TD}{2})\, h + \left(\frac{Cu}{T}\right)\int_R^\infty (z - R)\, f(z)\, dz = = (33{,}560)(857{,}690) + \frac{370{,}000}{0.0375} + (2{,}384 - (33{,}560)(0.0027) + (\frac{(0.0375)(33{,}560)}{2}))(35{,}000) + \left(\frac{5{,}000{,}000}{0.0375}\right)(0.264)$ = Rp 28.851.169.110

The iteration is continued because the total inventory costs produced in the second iteration are smaller than the total inventory costs in the first iteration.

Iteration 3

With a T_0 value of 0.0375, we will try adding a T0 value of 1/2 T_0 period, namely 0.01875, so that the T_0 value = 0.05625. The calculation result was IDR 28,876,492,904. The iteration was not continued because the third iteration was greater than the second iteration. So, the optimum iteration was the second iteration with a total inventory cost of IDR 28,851,169,110. Expectations of total inventory costs using the continuous review (Q) back order method are:

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(a) Purchase Cost (Ob) = 33,560 m3 × 857,690 = IDR 28,784,076,400; (b) Order Cost (Op) = 370,000/0.0375 × 370,000 = IDR 9,866,667; (c) Holding Cost (Os) = (2,384 - (33,560)(0.0027) + (((0.0375)(33,560))/2)) (35,000) = IDR 102,292,400; (d) Shortage Cost (Ok) = (5,000,000/0.0375)(0.264) = IDR 35,200,000; (e) Total inventory costs = IDR 28,784,076,400 + IDR 9,866,667 + IDR 102,292,400 + IDR 35,200,000 = IDR 28,931,435,467

Table 1. Results of Comparison of Total Sengon Wood Inventory Costs with Continuous Review (Q) and Periodic Review (P) Methods

	Continuous Review (Q) Back Order Method	**Periodic Review (P) Back Order Method**
Sengon Wood	IDR 28,829,527,844	IDR 28,931,435,467

From Table 1, it can be seen that the calculation of total inventory costs using the continuous review (Q) back order method is IDR 28,829,527,844 and the periodic review (P) back order method is IDR 28,931,435,467. This is because the continuous review method allows companies to be more responsive to changes in customer demand. By continuously monitoring inventory, companies can more quickly adjust orders to unexpected fluctuations in demand. So it can be concluded that the continuous review (Q) back order method provides a minimum total inventory cost of sengon wood. So, the continuous review (Q) back order method was chosen to compare total inventory costs with the company method.

Table 2. Results of Comparison of Total Sengon Wood Inventory Costs with Continuous Review (Q) and Company Methods

	Continuous Review (Q) Back Order Method	**Company Method**
Sengon Wood	IDR 28,829,527,844	IDR 32,502,564,700

Based on Table 2, it can be seen that the total inventory cost calculation using the company is IDR 32,502,564,700 and the continuous review (Q) back order method is IDR 28,829,527,844. So it can be concluded that the total inventory costs using the continuous review (Q) back order method are smaller than the company's current condition with cost savings of 11.3%. However, the continuous method has challenges, namely that inventory that is continuously monitored can result in an increase in inventory in the company's storage facilities. Limited storage capacity can be a challenge in managing necessary inventory and preventing overstocking. In addition, continuous monitoring of inventory can result in higher costs in terms of human resources and information technology. Companies need to consider the costs involved in continuously monitoring and analyzing inventory in recalculating the benefits of better inventory control.

Forecasting the need for raw materials for sengon wood

In figure 1 , it shows the flow of use of Sengon wood in the one fiscal year from May 2023 to April 2024. A general trend can be observed wherein usage rises and falls across different months and this is fairly common for sectors where production quantities and supply chain activities are not constant. Probing further, a lot of variation observed; nevertheless, presence of considerable fluctuation in the course of the time series could owe its existence to seasonal production reduction during the last weeks of August 2023 or supply chain problem or management decisions like handling of inventory rather than stocking more inventory than is required in the follow months.

ISSN: 2716-3865 (Print), 2721-1290 (Online)

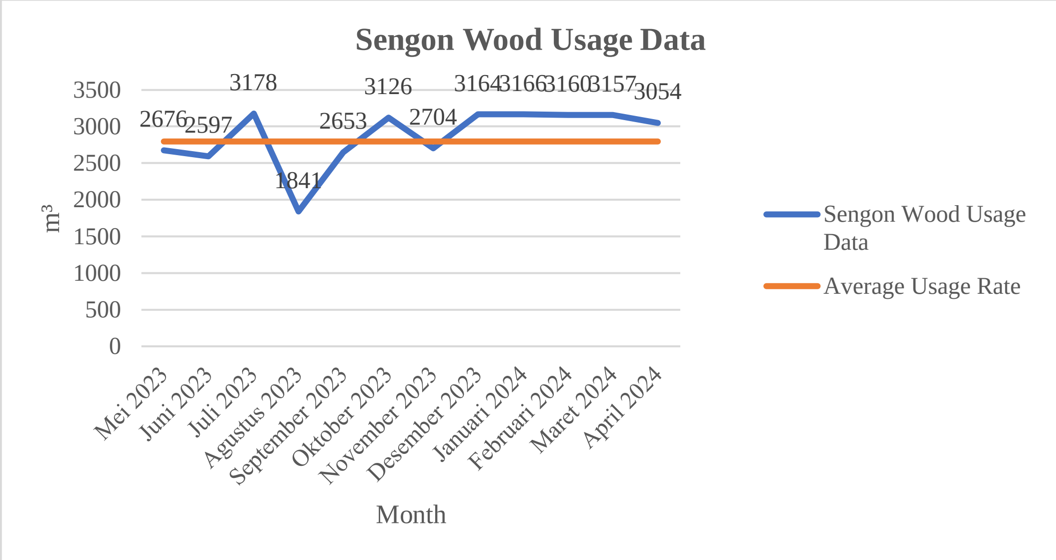

Figure 1. Sengon Wood Usage Data Pattern for May 2023 - April 2024

From the figure above is evident how the high variability hinders PT XYZ in striking a balance between raw material stock and production demand. Such a pattern underlines the need to have a sound inventory management system that will be capable of managing such changes in a way that will ensure the company does not order excess stocks or order for stocks when they are scarce in the market. The average usage rate which is close to 2797 m³ over the period suggests a core require which inventory management policies must always revolve around.

Calculate the mean square error (MSE)

Table 3. Comparison of Mean Square Error (MSE)

Forecasting Method	**Mean Square Error (MSE)**
Single Exponential Smoothing (α= 0,21)	177,305.4
ARIMA	**95,424**
Naïve	313,780.5
Moving Average	204,279.8

Source : Processed Data

From Table 3, it is found that the forecasting method has the smallest Mean Square Error (MSE) value, namely the ARIMA method, which is 95.424, so the next step is to verify the data using the ARIMA method forecasting data.

Final Estimates of Parameters

Type	Coef	SE Coef	T-Value	P-Value
MA 1	1,401	0,518	2,70	0,024
Constant	46,97	3,98	11,79	0,000

Differencing: 1 regular difference

Number of observations: Original series 12, after differencing 11

Residual Sums of Squares

DF	SS	MS
9	858816	95424,0

Figure 2. Mean Square Error (MSE) of ARIMA

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Mean Square Error (MSE) depicted in Figure 2 relates to the ARIMA model applied to forecast demand of Sengon wood. It is ascertained that MSE of the proposed ARIMA model is comparatively lesser than the other models like Single Exponential Smoothing, Naïve, and Moving Average models pointing out the fact that the proposed model fits the actual data better. This low MSE value, that is 95,424 indicates that the ARIMA model used in this study is very accurate in forecasting future demand and aid in improving inventory management plans. The tighter range of forecast error is essential to PT XYZ since it enhances the ability to make some decision in a company such as procurement of raw materials; this means that the company cannot afford to have frequent overstock of which may be very costly or frequent stock out which may disrupt operations. That's why the choice of ARIMA for forecasting can be considered a strategic decision that will help to improve the management of inventories and better coordinate the supply of raw materials and their consumption.

Table 4. Forecasting for the period May 2024-April 2025

95% Limits				
Period	**Forecast**	**Lower**	**Upper**	**Actual**
13	3250,80	2645,22	3856,38	
14	3297,76	2645,33	3950,20	
15	3344,73	2648,59	4040,87	
16	3391,70	2654,44	4128,96	
17	3438,66	2662,46	4214,87	
18	3485,63	2672,34	4298,92	
19	3532,60	2683,85	4381,35	
20	3579,56	2696,77	4462,36	
21	3626,53	2710,97	4542,10	
22	3673,50	2726,29	4620,71	
23	3720,46	2742,64	4698,29	
24	3767.43	2759,92	4774,95	

Forecasting using back adjustment method is shown in detail in tables, together with 95% confidence interval from May 2024 to April 2025 as follows: The consumption trend reveals that the projected monthly water consumption will rise form 325,080 m^3 in May 2024 to 376,743 m^3 in April 2025. The interval estimations show where it is likely the real demand is, and this is capturing the fuzziness that is associated with the forecasting task. The decrease in the confidence intervals in the latter months shows the refinement of the model's forecast ability when more data is incorporated in the model. This forecast data is useful in inventory management since it helps in order quantities and time when order should be placed to avoid stock out situations hence preventing excess capital being invested in raw materials.

Table 5. Sengon Wood Needs Forecasting Results

No	**Month**	**Forecasting**
1	Mei 2024	3.251
2	Juni 2024	3.298
3	Juli 2024	3.345
4	Agustus 2024	3.392
5	September 2024	3.439
6	Oktober 2024	3.486
7	November 2024	3.533
8	Desemer 2024	3.580

ISSN: 2716-3865 (Print), 2721-1290 (Online)

9	Januari 2025	3.627
10	Februari 2025	3.674
11	Maret 2025	3.720
12	April 2025	3.767
Total		**42.109**

The results of the forecasting on the wood of Sengon for May 2024 to April 2025 are shown in Table 5. The table shows that there was a gradual rise in the forecasted demand which starts from 3,251 m^3 in May 2024 and ends at 3,767 m^3 in April 2025. The total requirement for the whole period amounts to 42,109 m^3. Such consistent increase in the frequency portrays a gradual shift in the production necessity of manufacture at PT XYZ, perhaps fuelled by a growing market need or enhanced production capabilities. The timeliness of such forecasts is essential for the company's inventory management plan. Forecasts enable the company to order the right amount of raw material that meets production requirements, while at the same time avoiding costs associated with high inventory levels. Furthermore, this forecasting enables determination of reorder points and safety stock, which is important for managing demand fluctuations and ensure business operations are not interrupted.

After knowing the forecasting results, the next step is to carry out calculations using the proposed method as follows:

Average Calculation ($\bar{X}$)

$$\bar{X} = \frac{42{,}109}{12} = 3{,}509 \text{ m}^3$$

Calculating Standard Deviation

$$S\ (\sigma) = \sqrt{\frac{\sum(3{,}251-3{,}509)^{2}+(3{,}298-3{,}509)^{2}+(3{,}345-3{,}509)^{2}+\ldots+(3{,}767-3{,}509)^{2}}{12-1}} = 169 \text{ m}^3$$

Iteration 1

Determine the order lot size (q_{01})

$$q_{01} = \sqrt{\frac{2(370{,}000)(42{,}109)}{35{,}000}} = 944 \text{ m}^3$$

Determine the amount of inventory shortage (α)

$\alpha = ((35{,}000)(944))/((5{,}000{,}000)(42{,}109)) = 0.000156$

It can be seen from the normal distribution table that the $Z\alpha$ value is 3.605. So you can find the value of r_1

$r_1 = (42.109)\ (0{,}0027) + (3{,}605)\ (169)\ (\sqrt{0{,}0027}) = 146 \text{ m}^3$

In the table, it is obtained that $f(Z\alpha) = 0.006$ and $\Psi(Z\alpha) = 0.00004$ so that the values of N and q_{02} can be calculated as follows:

$N = ((169)\ (0{,}0027)\ (0{,}006)) - (3{,}605)\ (0{,}00004) = 0{,}00272$

$$q_{02} = \sqrt{\frac{2(42.109)((370.000 + (5.000.000 \times 0{,}00272))}{35.000}} = 944 \text{ m}^3$$

Recalculate the values of α_2 and r_2

$$\alpha_2 = \frac{(35{,}000)(944)}{(5{,}000{,}000)(42{,}109)} = 0.000156$$

Next, look for the $Z\alpha$ value using the normal distribution table and obtain the $Z\alpha$ value for $\alpha = 0.000156$ of 3.605. So we can find the r2 value of:

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r_2 = (42,109) (0.0027) + (3.605) (169) (√0.0027) =146 m^3

Compare the values of r_1 and r_2

From the second iteration, the value obtained is r_1 = 146 m^3, which is the same as the result r_2 = 146 m^3. Then the iteration is complete.

Expectations of total inventory costs using the continuous review (Q) back order method are: (a) Purchase Cost (Ob) = 42,109 m^3 × 857,690 = IDR 36,116,468,210; (b) Order Cost (Op) = 42,109/944 × 370,000 = IDR 16,504,587; (c) Holding Costs (Os) = 35,000 (944/2 + 146 – (42,109) (0.0027)) = IDR 17,650,850; (d) Shortage Cost (Ok) = (5,000,000 × 42,109)/944 × 0.00272 = IDR 606,655. Total inventory costs = IDR 36,116,468,210 + IDR 16,504,587 + IDR 17,650,850 + IDR 606,655 = IDR 36,151,230,302

Table 6. Total Inventory Costs and Number of Sengon Wood Orders using the Continuous Review (Q) Back Order Method

	Order Quantity	**Reorder Point**	**Total Inventory Cost**
Sengon Wood	944 m^3	146 m^3	IDR 36,151,230,302

Source: Processed Data

Based on the calculation of the total cost of sengon wood inventory for May 2024 to April 2025 using the continuous review (Q) back order method of IDR 36,151,230,302 with a total order of 944 m^3 and a reorder point of 146 m^3.

These findings show that the continuous review method costs a total of IDR 28,829,527,844 which is significantly less than that of the periodic review method with its total of IDR 28,931,435,467. This finding aligns with the extant literature on the viability of continuous monitoring mechanisms in settings with uncertain and volatile demand (Bechtsis et al. , 2022). This is because the continuous review method enjoys a head start in terms of its real time monitoring of the actual demand fluctuations. Since inventory levels are continually checked, changes in order quantities can be more promptly made to avoid excessive inventory or the lack of it. This is especially important given that demand exists outside the control of business, for instance due to market forces, the economic situation and disrupted supply chains. The below-mentioned recent studies by Sahin et al. (2013) and Mahajan et al. (2024) further substantiate these findings by emphasizing that continuous review systems facilitate more robust and flexible approaches towards inventory management, especially in scenarios that undergo a high level of fluctuation.

The use of the ARIMA model in demand forecasting demonstrates how this study adopts a more sophisticated methodological strategy compared to conventional studies. Based on the ARIMA model results, the MSE of was relatively low at 95,424 suggesting that the model can predict the future demand accurately and that is crucial towards making right decisions on inventory management. This is in line with the new trend in the use of intelligent systems in forecasting, where the integration of statistical models like ARIMA has been useful in improving the precision in the model (Nguyen, 2020). Furthermore, more precise planning could also be achieved through ARIMA model to improve resource allocation and achieve the adequate level of supply and demand that PT XYZ needs to meet without costing too much.

However, like we have earlier seen when discussing the continuous review method, the study also recognizes some of the difficulties that accompany this method. Continuous monitoring means investing heavily in information technology and human resources, as pointed by Hutahayan (2020) in their recent study. Also, the likelihood of overstocking as a result of placing multiple orders is likely to be realized in firms with small storage capacity. This is in line with the argument made by Hossain et al. (2020) that while the 'Continuous review

ISSN: 2716-3865 (Print), 2721-1290 (Online)

system offers greater cost savings they must be properly organised in order to avoid problems of storage and operational overhead costs.

The generalization of the finding of this research lies in supply chain management practices which are nowadays focusing on the responsiveness and agility. The capability of changing supply stocks according to the actual information is not only an edge but also a vital factor in current furious industrial scope. The result of this study thus adds to this discourse by presenting evidence to show that continuous review systems, if supported by accurate demand forecasting, holds the potential of boosting supply chain functioning and robustness. In practice-oriented terms, it can be said that this research yields rather tangible and specific findings for managers of industrial organisations. The 11. It is shown that cost savings in the range of 3% can be obtained using the continuous review method and it implies that similar manufacturing firms would also stand to gain if they apply the same. However, the study also notes that the ultimate effectiveness of the advanced forecasting models is critical to organizational success and can only be achieved if the organisation is also willing and able to deal with technological implications of such implementation such as IT structure and storage limitations. Hence, to optimize this strategy of inventory management, certain measures which are the technological advancement in the method, skilled workforce and optimum planning must be incorporated.

Conclusion

Based on the results of the analysis and discussion above, the following conclusions can be drawn: (1) It is known that the comparison of total inventory costs incurred using the continuous review (Q) back order method and the periodic review (P) back order method from May 2023 to April 2024. Total inventory costs using the continuous review (Q) back method the order is IDR 28,829,527,844, while using the periodic review (P) method the back order is IDR 28,931,435,467. From the cost description, it can be concluded that the continuous review (Q) back order method was chosen with the minimum total inventory costs which will then be compared between the continuous review (Q) back order method and the company method; (2) It is known that by comparing the total inventory costs of the continuous review (Q) back order method with the company method, it is found that the total inventory costs using the company method are IDR 32,502,564,700 and the total inventory costs using the continuous review (Q) back order method are IDR 28,829 ,527,844, thus the minimum cost was chosen, namely the continuous review (Q) back order method with cost savings of IDR 3,673,036,856 and a cost savings percentage of 11.3% of the company's total inventory cost method; (3) Forecasting was carried out using the ARIMA method for forecasting sengon wood from May 2024 to April 2025 and calculations were made to control the supply of sengon wood using the continuous review (Q) back order method. Thus, the total cost of sengon wood inventory obtained from May 2024 to April 2025 using the continuous review (Q) back order method is IDR 36,151,230,302 with a total order of 944 m^3 and a reorder point of 146 m^3.

From the results of the discussion and conclusions explained above, several suggestions can be given as follows: (1) PT. XYZ is expected to be able to implement raw material inventory control using the continuous review (Q) back order method because it can provide minimum total inventory costs; (2) PT. XYZ is expected to carry out careful planning regarding the amount of raw materials needed and the total inventory costs incurred in the coming period to avoid excesses and shortages of raw materials; (3) It is hoped that PT. XYZ can control the supply of sengon wood by paying attention to the pattern of demand for sengon wood.

ISSN: 2716-3865 (Print), 2721-1290 (Online)

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