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Analysis of raw material inventory control for hinge upper assembly products using the economic order quantity method

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ABSTRACT

Every business, but particularly those in the industrial sector, have what is known as inventory. In order for the business to survive and carry on with production, inventory is crucial. Inventory control makes sure that products and resources don't run out of stock or become overstocked, which could lead to higher inventory costs and a halt in production. A business engaged in manufacturing is called PT. X. Hinge Upper Assy is one of the products that PT. X manufactures. Overproduction of raw materials caused issues for the hinge upper assembly material during the process, raising the overall cost of inventory. The EOQ (Economic Order Quantity) approach is one inventory control technique that determines overall inventory costs. The EOQ approach takes into account the frequency of orders, the amount of orders per order, safety stock, and reorder points in addition to inventory costs. The purpose of this study was to determine the overall cost of inventory at PT. X using the EOQ approach, as well as the frequency and quantity of orders, safety stock value, and reorder points. The study's findings indicate that the overall cost of inventory with EOQ is IDR 2,500,752.00, with a frequency of orders placed twice and a quantity per order of 20167 pieces, safety stock of 3242.28, and a reorder point of 3257 pieces. When comparing the EOQ approach to the company's traditional method, there was a 63% savings in total inventory expenses.

Keyword: Inventory control; economic order quantity; safety stock; reorder point

1. INTRODUCTION

In a firm, production control and planning are essential. Inventory is one item that is crucial to the efficient operation of production processes. Inventory avoidance a there is a risk of excess or shortage of stock [1]. Running out of stock can cause the production process to be hindered, while having too much stock can result in excessive inventory costs [2]. Controlling inventory is therefore essential to prevent supply shortages or excesses.

Economic order quantity [3], ABC, VEN (Vital, Essential, Non-Essential) approaches [4][5], and Just in Time [6]. are some of the techniques used to control raw material inventories. The Economic Order Quantity (EOQ) approach is the one employed in this study. One benefit of the EOQ approach is that it can be used to calculate inventory costs by figuring out how many orders, safety stock, and frequency of orders there are in a given period [7]. When compared to the company's traditional strategy, the EOQ method can save money on inventory expenses [8], and delivery frequency [9].

Manufacturing goods with hinge upper assemblies are made by PT. X. PT. X is situated in Bekasi, West Java, in the Jababeka IX Industrial Area. The benefits and drawbacks of the materials utilized to make Hinge upper assy goods were encountered by PT. X in 2022. According to corporate data for 2022, there will be 36,552 pieces, or around 15%, more raw materials in excess of what is used (51,141 pieces) than there are in inventory (87,653 pieces). The order frequency is four times per month or forty-

eight times annually, and the company's total inventory cost is IDR 6,797,000.00. A graph comparing ordering data with raw material utilization data is shown in Figure 1.

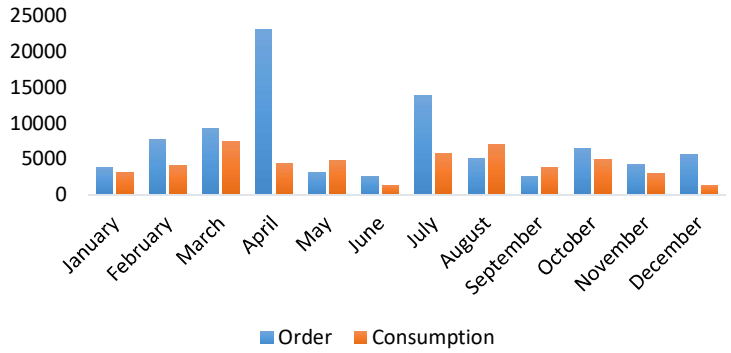

Figure 1. Raw material ordering and consumption graph

It is evident from the graph in Figure 1 that orders and raw material usage differ from one another. For instance, there was excess stock in April and July due to more orders than raw material use. This was due to the fact that in those months, material was ordered and used as stock material to ensure that it was not out of stock, and orders were still determined using traditional procedures. High inventory costs may arise from having too much stock [6]. Thus, to get the best overall inventory expenses, inventory control is required. With the purpose of comparing the overall inventory costs between the EOQ method and the Company's conventional method, as well as the number of orders and order frequency, this study was carried out.

2. METHOD

In this study, descriptive research was carried out using a quantitative methodology. In order to do inventory control analysis, this study employs Economic Order Quantity and forecasting techniques, namely the time series method (moving average, single exponential smoothing, and ARIMA). The demand data plot in Figure 2 serves as the basis for choosing the time series forecasting technique.

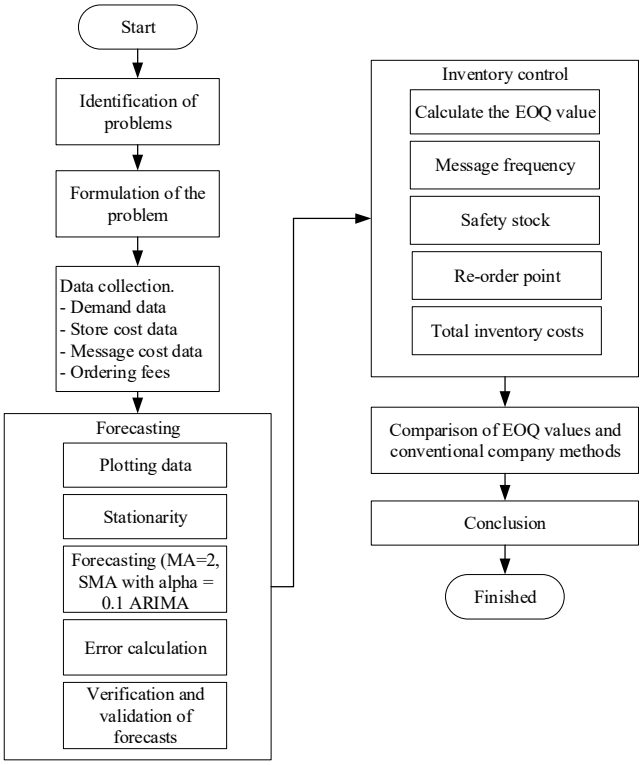

Figure 2. Research flow

Purchases, manufacturing, consumer demand, inventory costs, usage, and inventory of raw materials, as well as transportation and storage expenses, are the data required to support this research. Plotting consumer demand data, assessing data stationarity, choosing forecasting techniques, computing error values, and confirming forecasted outcomes are the first steps in the forecasting portion of this study [10]. After that, calculate the Economic Order Quantity, safety stock, reorder points, frequency of ordering raw materials, and inventory costs [11]. In Figure 2, the research flow is detailed.

3. RESULTS AND DISCUSSION

3.1 Demand forecasting

The first step in the production planning process for the company is to forecast client demand for Hingge Upper Assy items. The time series approach, specifically the Moving Average with n = 2, Exponential Smoothing with α = 0.1, and the ARIMA method, is employed in this study. The output of the computations for stationary data (figure 4) and demand data charting (Figure 3) are used to determine the forecasting approach.

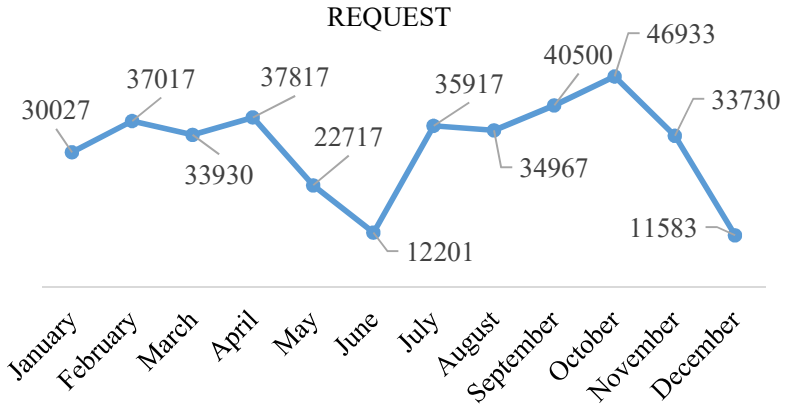

Figure 3. Plotting customer demand data

The image demonstrates how client demand data is organized into a horizontal pattern, indicating that a time series approach was employed [12].

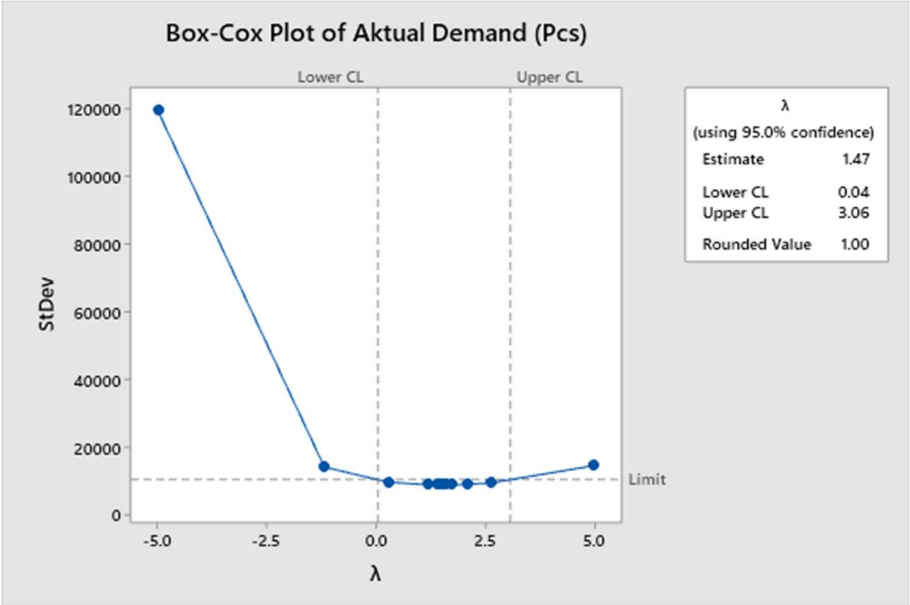

Figure 4. Box cox plot stationarity graph using Minitab

The outcome of a stationarity graph created with Minitab software is the graph shown in Figure 4. The output of the box-cox demand for the lambda rounded value of 1.00 (λ = 1) is shown in Figure 4. It indicates that the data is stationary and forecasting can be used to continue it. If the lambda value is 1, the data is considered stationary.

The moving average with n = 2, exponential smoothing with α = 0.1, and the ARIMA method are the forecasting techniques employed. The approach of looking at the least MSE, MAD, and MAPE values was selected as the forecasting method. Table 1 presents a summary of the MSE, MAD, and MAPE values.

Table 1. Summary of error values

No	Forecasting Methods		MAD	MSD	MAPE
1	*Moving Average*	n = 2	11633	200.123.513,00	50%
2	*Single Exponential Smoothing*	α = 0.1	8209	118.777.026,00	44%
3	ARIMA	(1,1,1)	8044	776.420.993,50	48%

Table 1 shows that the forecasting with α = 0.1 Single Exponential Smoothing approach has the lowest error value (both MAPE and MSD). When predicting customer demand, the organization employs traditional demand forecasting techniques (methods-free). Table 2 displays the predicting results obtained with the single exponential smoothing forecasting approach.

Table 2. Forecasting results

Month	Forecast
January	33522,0
February	33172,5
March	33556,9
April	33594,3
May	34016,5
June	32886,6
July	30818,0
August	31327,9
September	31691,8
October	32572,6
November	34008,7
December	33980,8
Total	395148,6

3.2 Inventory control

It is necessary to maintain inventory control to prevent overstock and out-of-stock situations, which can raise expenses. Transportation, administration, and phone/internet fees are examples of message fees [13]. The total booking fee at PT. X is Rp. 502,125, damaged, which includes Rp. 7,000 for telephone fees and Rp. 495,125.00 for shipment. Transportation, upkeep, and warehouse operating costs are all included in storage costs [3] [7]. There is no need to incur additional transportation expenses because PT. X owns a warehouse close to the production area. For instance, the cost of electricity utilized is the only expense included in storage expenses. IDR 6,300,000 is spent on warehouse electricity for a month, and another IDR 6,300,000.00 is spent on storage. Four orders are placed in a month on average.

The first steps in inventory control calculations are to determine the Q value in the EOQ, order frequency, safety stock, reorder points, and inventory costs [14].

3.2.1 Calculating the EOQ value

EOQ used to determine the optimal quantity of ordered products

$$EOQ = \sqrt{\frac{2SD}{H}} \quad (1)$$

$$EOQ = \sqrt{\frac{2\ x\ 497000\ x\ 50738}{124}} = 20167{,}459$$

The hinge upper assembly product material's order quantity, rounded up to 20168 pieces, is 20167, based on the EOQ value calculations.

3.2.2 Message Frequency

Order frequency is required to determine the ideal number of orders in a given time frame.

$$F = \frac{D}{EOQ} \quad (2)$$

$$F = \frac{50738}{20168} = 2$$

The product material for hinge upper assembly is ordered twice a month or in one period

3.2.3 Safety Stock

Safety stock is the reserve inventory required to prepare for product shortages brought on by delays in the delivery of raw materials. Safety stock keeps things from running out of supply. Aside from that, safety stock serves to keep things stable in the event that demand changes or the ordered material is delayed [15].

$$safety\ stock = S_d x Z \quad (3)$$

The safety factor is Z. The Z value using the usual table is 1.65 if the business can meet 95% of demand and reserve 5% of inventory [13][9]. Consequently, safety stock's value is.

SS = 1,65 x 1977 = 3.242,28

3.2.4 *Reorder Point*

Reorder Point is a Reorder point. The formula for ROP (Reorder Point):

$$ROP = SS + (LT \times \left(\frac{D}{Working\ days}\right) \quad (4)$$

ROP = 3242,28 + (1 x 15) = 3257 pcs

3.2.5 Calculation of total inventory cost

When comparing the EOQ approach with the company's traditional method, total inventory cost is computed as the total inventory of raw materials [16].

$$TIC = \left[\frac{D}{Q}S\right] + \left[\frac{Q}{2}H\right] \quad (5)$$

$$TIC = \left(\frac{50.738}{20.168}x497.000\right) + \left(\frac{20.168}{2}x124\right) = 2500752{,}474$$

Table 3 presents a comparison of the two approaches based on inventory cost calculations utilizing the EOQ method and the Company's conventional method.

Table 3. Cost comparison of inventory using the EOQ approach and the company's traditional method

	Message Frequency	Number of Messages	TIC	ROP	SS
Company	4	17896	Rp6.796.000,00	-	-
EOQ	2	20167	Rp2.500.752,00	3257	3242,28

Table 3 illustrates how the corporation can use the EOQ method to prevent stock outages by maintaining safety stock. It also shows how using ROP will increase frequency, which will raise ordering costs. Furthermore, IDR 6,796,000.00 is the overall inventory cost for the company using the traditional technique, and IDR 2,500,752.00 is the total inventory cost utilizing the EOQ method. Between these two approaches, there is a 63% savings.

4. SIMPULAN

The study's findings support the notion that businesses can save money by implementing the EOQ method. With a total inventory cost of IDR 2,500,752.00 utilizing the EOQ method, twice-daily order frequency, safety stock of 3242.28, reorder point of 3257, and quantity per order of 20167, the savings are around 63%. The company has applied a total inventory cost of IDR 6,796,000.00. When compared to the total inventory expenses of IDR 2,500,752.00 using the EOQ approach, this yields a 63% savings.

Businesses can reduce the danger of having too many or running out of items by implementing the EOQ approach. In addition, the EOQ approach offers PT. X the best overall inventory costs.

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