Optimizing Service Valve Material Inventory Control: An Analysis Using ABC Approach, Croston Forecasting, and Economic Order Quantity in a Distribution Company

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ABSTRACT

This study aims to optimize the maintenance of service valve material inventory at PT. X, a company providing, repairing, and manufacturing equipment for the oil and gas industry in Indonesia. The problem faced by the company is the imbalance between inventory levels and actual demand, especially for critical components such as service valve materials that have an intermittent demand pattern. The research method integrates three approaches, namely the ABC classification to group materials based on annual consumption value, the Croston method to predict intermittent demand, and the Economic Order Quantity (EOQ) to determine optimal procurement policies. The results of the study identified 6 types of service valve materials included in category A (75% of total consumption value) from 612 types of materials. The implementation of the Croston method proved effective in predicting intermittent demand, while the application of EOQ based on forecasting results resulted in optimal procurement policies including optimal order quantity, annual order frequency, safety stock, and reorder point. The integration of these three methods provides a total savings of Rp657,152,210.44 or approximately 10.51% of the total inventory costs of category A service valve materials, with savings ranging from 9.35% to 11.52% for each material, thus significantly increasing cost efficiency and optimizing inventory management.

1. INTRODUCTION

The oil and gas industry is a strategic sector that plays a vital role in the Indonesian economy. In this dynamic industry, companies providing equipment supply, repair and manufacturing services face complex challenges in managing supply chain and material inventory. PT. X as one of the leading companies serving various large companies such as Pertamina Upstream and Pertamina International Refinery, has built a reputation as a high-quality service provider. Along with increasing demand and expanding service coverage, the company faces increasingly complex challenges in material inventory management, especially critical components such as service valves that have a vital role in the piping system and equipment of the oil and gas industry.

PT. X is a company engaged in the supply, repair, and manufacturing of equipment for the oil and gas industry in Indonesia. The company's business processes consist of three main activities, namely the provision of high-quality materials and components for the oil and gas industry, repair and maintenance services for industrial equipment, and the manufacture of special components according to client specifications. In its operations, PT. X manages an inventory of over 750 types of service valves with various sizes, pressures, construction materials, and technical specifications tailored to clients' specific needs. The company serves various customer segments, including oil and gas exploration and production companies, refineries, and oil and gas distribution and transportation companies. PT. X's business model prioritizes responsiveness to clients' urgent needs, as failure to provide components on time can cause operational disruptions that result in significant financial losses for clients.

PT. X's operational data shows a significant imbalance in service valve inventory management. Based on 2024 data analysis, out of the 612 types of service valve materials managed by the company, there is a disparity in consumption value distribution, where only 6 materials (less than 1%) account for 75% of the total annual consumption value of Rp5,869,889,479.00. This phenomenon reflects the characteristics of the Pareto classification, where a small number of materials have a significant impact on total inventory costs. Historical demand data shows highly fluctuating patterns with demand variability reaching 85% for critical category materials, where periods of zero demand occur in 60-70% of the total observation period. This situation results in a stockout rate of 15% for critical materials and overstocking of up to 40% for materials with low demand, leading to operational cost inefficiencies of Rp657,152,210.44 or approximately 10.51% of the total inventory costs for service valve materials.[1]

Effective inventory management is crucial for PT X given the huge impact that can arise from the unavailability of components at the time they are needed. Failure to meet demand can lead to project delays, operational disruptions at client facilities, and potentially significant financial losses. On the other hand, procuring excess materials (overstock) results in wasted capital that could have been allocated to other aspects of the business. This situation creates an inventory management dilemma that requires a systematic approach and the right methodology to achieve an optimal balance. [2]

The challenges faced by PT X in inventory management are further complicated due to the fluctuating demand characteristics and diverse material specifications requested by clients from the oil and gas sector. Service valves as critical components have variations in size, pressure, material, and specifics from each client. This makes the procurement and inventory management process complex and requires a systematic approach. [3]

The main problem identified is the imbalance between inventory levels and actual demand. Inaccuracies in forecasting demand often resulted in the accumulation of low-demand materials while high-demand materials were understocked. This situation not only impacts service performance but also has implications for the efficient use of the company's working capital. [4]

The intermittent nature of servive valve demand, which is demand that occurs at irregular intervals with many periods of no demand, requires a specialized forecasting method that can accurately handle these demand patterns. Conventional forecasting methods are often unable to provide optimal results for demand patterns like this. Therefore, the application of the Croston method becomes highly relevant in this context. The Croston method is specifically designed to forecast intermittent demand by separating the forecasting of demand size and the interval between demands, resulting in a more accurate estimate of future requirements.[5]

To overcome these problems, this research uses a material classification approach using the ABC (Always Better Control) method to identify materials based on annual consumption, so as to provide the right priorities in inventory management . In this study using material with category A. After classifying the material, then forecasting demand using the croston method after that determining the optimal procurement policy using the EOQ (Economic Order Quantity) method. The EOQ method focuses on determining the most optimal order quantity by balancing order costs and storage costs. Especially for service valve materials whose demand is by request, the approach using the EOQ method based on Croston's forecasting results is very suitable because it can determine the optimal order quantity that minimizes the total cost of inventory.[6]

This study aims to optimize service valve inventory management at PT X through the integration of the Croston method for intermittent demand forecasting and the EOQ method for optimal procurement policies. The implementation of the integration of these two methods is expected to provide various benefits, including improved forecasting accuracy for intermittent demand, decreased average inventory levels, reduced total inventory costs, and improved service levels to clients. The EOQ method reinforced with Croston forecasting allows companies to determine more precise reorder points, thus ensuring materials are available when needed without having to maintain excessive inventory levels. [7]

In a previous study entitled “Optimization of Ball Valve Spare Parts Inventory Control at PT X Warehouse Using the Economic Order Quantity Method,”[6] an inventory cost analysis was conducted on ball valve materials that had been classified using the ABC classification method. The study calculated inventory costs using the EOQ method with fluctuating material ordering characteristics. However, when demand data is fluctuating and contains periods with zero values, the EOQ method cannot be applied directly because the EOQ formula ignores these zero-value periods.

Therefore, this study uses the Croston forecast method to refine demand data in periods with zero values, so that the EOQ method can be implemented more accurately.

A systematic approach to material inventory management, especially service valves, is key for PT X to face challenges amidst the evolving dynamics of the oil and gas industry. By integrating appropriate forecasting methods for intermittent demand, material classification using ABC, and optimal procurement policies, PT. X can achieve the ideal balance between material availability, cost efficiency, and responsiveness to client needs. The results of this study are expected to contribute not only to PT. X but also to similar companies in the oil and gas industry that face similar challenges in critical component inventory management.

2. METHOD

This research was conducted at PEM Akamigas because this research was conducted by the author starting from the data provided on March 20 until completion. The subjects of this research are the inventory management department and the procurement department of PT X which are responsible for the management and procurement of Service Valve materials. The inventory management department manages the availability and storage of materials, while the procurement department is responsible for the process of purchasing materials from suppliers. The object of this research is the Service Valve material managed by PT X to meet the needs of clients in the oil and gas industry. This research specifically focuses on approximately 750 types of Service Valves that represent variations in size, pressure, construction materials, and other technical specifications. This research is a quantitative descriptive research with a case study approach that focuses on optimizing inventory management of Service Valve materials at PT X. Quantitative descriptive research was chosen because it is able to provide a systematic description of the characteristics of Service Valve material inventory and analyze historical demand and cost data to produce optimal inventory management policy recommendations so that it can assist companies in managing inventory by optimizing inventory costs. The case study approach is used to provide an in-depth analysis of the specific problems faced by PT X in managing Service Valve inventory as a critical component in the oil and gas industry.

Data collection techniques include historical data on service valve material demand from January to December 2024, interviews, literature studies. The data processing stage begins with the preparation of service valve material demand data which is classified using the ABC method, after obtaining category A material, followed by forecasting analysis using the Croston method to determine demand in the next period because the demand for this material is intermittent. After that, an analysis of the optimization of inventory control of service valve materials using the EOQ method is carried out by considering the order cost and storage cost, then comparing the total inventory cost of the existing and EOQ methods.

3. RESULTS AND DISCUSSIONS

3.1. ABC classification of service valve material

ABC classification is a method of grouping materials based on annual consumption value to assist management in placing the focus of control on high-value items. In this study, ABC classification is applied to service valve materials at PT X. Classification of service valve materials using the ABC method based on the percentage of absorption of material funds where to find out that using the formula:[8]

$$persentase\ penyerapan\ dana = \frac{harga\ total\ setiap\ material}{harga\ total\ keseluruhan} \times 100\% \quad (1)$$

Next is to determine the cumulative percentage, by the way:

$$persentase\ kumulatif = \frac{nilai\ kumulatif\ setiap\ barang}{total\ nilai\ kumulatif} \times 100\% \quad (2)$$

After that, determine the ABC classification based on the cumulative percentage. If the cumulative percentage result obtained is 0 - 75%, it is classified as A. If it is between 75 - 95%, it is classified as B, and if it is between 95 - 100% it is classified as C. Then the classification results of the service valve material in category A are in table 1 below.

Table 1. ABC classification results Category A

ITEM	Order Frequency	Quantity Request	Price (estimated)	Total Demand Value	Percentage of fund absorption	cumulative percentage	classification
BUTTERFLY WAFER 60" 150 EPDM	4	12	IDR103,635,480.00	Rp1,243,625,760.00	21%	21%	A
BUTTERFLY WAFER 18" 150 EPDM	4	24	,945,780. 00	:,698,720. 00	17%	38%	A
DISC BUTTERFLY VALVE HARD CHROME STEEL + BODY HARD CHROME 16"	3	12	,458,312. 00	;,499,744. 00	12%	50%	A
BUTTERFLY VALVE DN 300 12"	8	36	,376,583. 00	.,556,988. 00	11%	61%	A
BUTTERFLY VALVE 12" #150	6	24	,765,893. 00	),381,432. 00	10%	71%	A
BUTTERFLY WAFER 42" 150 EPDM	3	5	,345,367. 00	;,726,835. 00	4%	75%	A

The following are the results of the ABC classification of service valve materials where there are 6 materials in category A of 612 types of service valve materials. Material in category A is a material that has a high consumption value because it has a value that is not cheap and a high demand value so that it can be prioritized because it will be necessary to optimize inventory management on the following critical materials so that there is no overstock in periods of low demand and stock shortages in periods of high demand.

3.2. Forecasting Using the Croston Method

The results of analyzing the historical data of service valve material demand at PT. X which is classified into category A during the period January to December 2024 show that the service valve demand pattern has very clear intermittent characteristics. The characteristics of intermittent demand are characterized by periods of zero demand that occur irregularly, interspersed with demand in varying amounts at certain periods. Can be seen from the table below.

Table 2. Service Valve Material Demand Pattern

Period	BUTTERFLY Y WAFER 60 "150 EPDM	BUTTERFLY WAFER 18 "150 EPDM	DISC BUTTERFLY VALVE HARD CHROME STEEL +BODY HARD CHROME 16"	BUTTERFLY VALVE DN 300 12"	BUTTERFLY Y VALVE 12" #150	BUTTERFLY WAFER 42" 150 EPDM
January	2	0	0	2	0	0
February	0	8	0	0	4	0
March	3	0	4	4	0	0
April	0	0	0	8	2	0
May	4	6		3	4	0
June	0	0		7	2	0
July	3	0	0	0	0	1
August	0	4	0	4	0	0
September	0	0	0	2	7	0
October	0	0	5	0	0	2
November	0	0	0	6	5	0
December	0	6	3	0	0	2

From this demand pattern, forecasting cannot be done with conventional methods because conventional forecasting methods tend to treat periods without demand as low demand, not as the absence of demand. Therefore, this research conducts forecasting using the Croston method because the Croston method is designed to do forecasting with intermittent demand because Croston can separate the two main components, namely: demand size and demand interval. To forecast demand using the Croston method using the following equation if there is demand (Yj>0) : [9]

$$\widehat{Y_j} = aY_j + (1\text{-}a)\widehat{Z_{j-1}} \quad (3)$$

$$\widehat{n_j} = b\widehat{n_j} + (1\text{-}b)\widehat{n_{j-1}} \quad (4)$$

The demand quantity in period j is shown in the equation

$$\widehat{Y_j} = \frac{\widehat{Z_j}}{\widehat{n_j}} \quad (5)$$

Description:
Zj = Forecasting the quantity of demand in period j
$\widehat{n_j}$ = Forecasting the time between demand in period j
Yj = Croston Forecasting Result
Yj = Demand quantity in period j and is not zero
a = smoothing parameter Zj
b = smoothing paramer
j = Period

The results of forecasting calculations using the Croston method can be seen in Table 3:

Table 3. Forecasting Results for 60 "150 EPDM Butterfly Valve Material

period	BUTTERFLY WAFER 60 "150 EPDM	Qt	Zt (quantity on demand)	pt (interval)	dt (forecast)
1	2	1	1	0.5	2
	0	2 1 1	0.5 2		
	3	3 2 2	1.25 2		
	0	4 1 2	1.25 2		
	0	5 2 2	1.25 2		
	4	6 3 3	1.25 1 7	0 1	3 2.125 1
9		3	8	2 3	1
		0 1	3 2.0625	1 10 0	3
		2.0625	1		
11	0 3	3 2.0625	1		
12	0 4	3 2.0625	1		

Table 4. Material Forecasting Results Disc Butterfly Valve Hard Chrome Steel + Body Hard Chrome 16"

period	BUTTERFLY VALVE HARD CHROME STEEL + BOSY HARD CHROME 16”	Qt	Zt	pt	dt
1	0				0
4	0	1			
5	0	2	2	1.5	1
6	0	3	2	1.5	1
2	0 0		2	1.5	1
3	4 3	2 1.5	1		
7		0 4			
8		0 5			
9		0 6			
	5	10 7 3.5			
11	0	1		3.5 4.25	1
12	3	2		3.25 3.125	1

Table 5. Forecasting Results for 18" 150 EPDM Butterfly Wafer Material

period	BUTTERFLY WAFER 18" 150 EPDM		Qt	Zt	pt	dt
		1	0		0	
	8	2	2 4	1 4		
3			0 1	4 1	4	
4			0 2	4 1	4	
	6	5	3 5	2 3		
6			0 1	5 2	3	
7			0 2	5 2	3	
	4	8	3 4.5	2.5 1.8		
9	0		1	4.5	2.5	1.8
10	0		2	4.5	2.5	1.8
11	0		2	4.5	2.5	1.8
12	6		4	5.25	3.25	2

Table 6. Forecasting Results for 12" 00 EPDM Butterfly Valve Material

period	BUTTERFLY VALVE DN 300 12"		Qt	Zt	pt	dt
1	2		1	1	0.5	2
2			0 1	1 0.5	2	
	4	3	2 2.5	1.25 2		
	8	4	1 5.25	1.125 5		
	3	5	1 4.125	1.0625 4		
	7	6	1 5.5625	4.03125 1		
7			0 1	5.5625 4.03125	1	
	4	8	2 4.78125	3.015625 2		
	2	9	1 3.390625	2.0078125	2	
10			0 1	3.390625 2.0078125	2	
	6	11	2 4.6953125	2.00390625	2	
12	0		1	4.6953125	2.00390625	2

Table 7. Forecasting Results for 12" #150 Butterfly Valve Material

period	**BUTTERFLY VALVE 12" #150**		**Qt**		**Zt**		**pt**				**dt**	
		1	1				0.5				2	
	4	2	2	2	1	2	2					
3			0	1	2	1	1					
	2	4	2	2	1.5	1	1					
	4	5	1	3	1.25	2	2					
	2	6	1	2.5	1.125	2	2					
		7	0	1	2.5	1.125	1.125	2				
8			0	2	2.5	1.125	1.125	2				
	7	9	3	4.75	2		2					
10			0	1	2.0625	2	2.0625	2				
	5	11	2	4.875	2.12	0	2.12	0	1	4.875	2.03125	2

Table 8. Forecasting Results for 42" 150 EPDM Butterfly Valve Material

period	**BUTTERFLY WAFER 42" 150 EPDM**		**Qt**		**Zt**		**pt**	**dt**
1			0					
2			0					
3			0					
4			0					
5			0					
6			0					
	1	7	7	0.5	3.5	0.142857143		
	2							
10	0		1		0.5		3.5	0.142857143
	0		2		0.5		3.5	0.142857143
	10.3				1.25		3.25	0.384615385
	0		1		1.25		3.25	0.384615385
	2		2		1.625		2.625	0.619047619

To evaluate the forecasting results of the Croston method, several accuracy metrics are used to measure the smallest error in this study, the authors used MAD (Mean Absolute Deviation) and MFE (Mean Forecast Error). The following is an example of error measurement for forecasting service valve material demand. To measure the error in MAD using the following equation: [10]

$$\text{MAD} = \sum \left| \frac{A_t - F_t}{n} \right| \quad (6)$$

Description:

A_t = Actual demand in period t

F_t = Forecasting demand in period t

n = number of forecasting periods involved

To calculate the accuracy of MFE using the following equation:

$$MFE = \frac{(A_t - F_t)}{n} \quad (7)$$

Description:

A_t = Actual demand in period t

F_t = Forecasting demand in period t

n = number of forecasting periods involved

For the first accuracy that has been done can be seen from table 9 below:

Table 9. Forecasting Accuracy Level

Material	MAD	MFE
BUTTERFLY WAFER 60”	1.516666667	-0.616666667 150
EPDM DISC BUTTERFLY VALVE		
HARD CHROME STEEL + BODY HARD CHROME 16"	1.74	0
BUTTERFLY WAFER 18" 150 EPDM	3.009090909	-0.554545455
BUTTERFLY VALVE DN	2.15	0.833333333
300 12"		
BUTTERFLY VALVE 12"	2.072727273	0.054545455
#150		
BUTTERFLY WAFER 42" 150 EPDM	0.766666667	0.6

MAD (Mean Absolute Deviation) aims to measure the average absolute value of the difference between the actual value and the forecasting value. The smaller the MAD value, the more accurate the forecasting model. MFE (Mean Forecast Error) aims to measure the average of the forecasting errors, taking into account the direction of the error (negative or positive). An MFE value close to zero indicates that the forecasting model has no systematic bias. Positive values indicate underforecasting (forecasting lower than actual), while negative values indicate overforecasting (forecasting higher than actual). Based on the table above, the most effective forecasting model for BUTTERFLY WAFER 42 "150 EPDM and DISC BUTTERFLY VALVE HARD CHROME STEEL + BODY HARD CHROME 16" on BUTTERFLY WAFER 42 "150 EPDM material has an MAD value of 0.767 and an MFE value of 0.600 where the low MAD value indicates that the forecasting accuracy is close to the actual, and the MFE value close to 1 has a small bias and positive MFE values tend to be underforecast. [11]

3.3. Inventory Control Using Existing Methods

To calculate the cost of existing inventory in this service valve material, consider the storage costs and order costs for each material where the order and storage costs can be seen from the following tables:

Table 10. Order Cost Data

ITEM	Shipping costs (2.5%)	ADM costs (1.5%)	Stationery Cost (1%)	Order Cost
BUTTERFLY WAFER 60" 150 EPDM	Rp2,590,887.00	Rp1,554,532.20	Rp1,036,354.80	Rp5,181,774.00
BUTTERFLY WAFER 18" 150 EPDM	Rp1,023,644.50	Rp614,186.70	Rp409,457.80	Rp2,047,289.00
DISC BUTTERFLY VALVE HARD CHROME STEEL + BODY HARD CHROME 16"	Rp1,511,457.80	Rp906,874.68	Rp604,583.12	Rp3,022,915.60
BUTTERFLY VALVE DN 300 12"	Rp459,414.58	Rp275,648.75	Rp183,765.83	Rp918,829.15
BUTTERFLY VALVE 12" #150	Rp594,147.33	Rp356,488.40	Rp237,658.93	Rp1,188,294.65
BUTTERFLY WAFER 42" 150 EPDM	Rp1,083,634.18	Rp650,180.51	IDR433,453.67	Rp2,167,268.35

Table 11. Save Cost Data

ITEM	Saving costs (15%)
BUTTERFLY WAFER 60" 150 EPDM	Rp15,545,322.00
BUTTERFLY WAFER 18" 150 EPDM	Rp6,141,867.00
DISC BUTTERFLY VALVE HARD CHROME STEEL + BODY HARD CHROME 16"	Rp9,068,746.80
BUTTERFLY VALVE DN 300 12"	Rp2,756,487.45
BUTTERFLY VALVE 12" #150	Rp3,564,883.95
BUTTERFLY WAFER 42" 150 EPDM	Rp6,501,805.05

Inventory costs are the overall costs incurred for the process of procuring material supplies in one period. The formula for calculating the total cost of inventory is: Company [12]

TIC = (D x ch) + Cr + CB (8)

Description:

TIC : Total Inventory Cost

D : Demand

ch : storage cost Cr : order cost

CB : purchase cost

Table 12. Total Inventory Cost of the Company

ITEM	Quantity_ Demand	Price (estimated)	storage cost (15%)	ordering cost	Company TIC
BUTTERFLY WAFER 60" 150 EPDM	17	Rp103,635,480.00	Rp15,545,322.00	Rp5,181,774.00	Rp2,031,255,408.00

BUTTERFLY WAFER 18" 150 EPDM	10	Rp40,945,780.00	Rp6,141,867.00	Rp3,022,915.60	Rp473,899,385.60
DISC BUTTERFLY VALVE HARD CHROME STEEL + BODY HARD CHROME 16"	30	Rp60,458,312.00	Rp9,068,746.80	Rp2,047,289.00	Rp2,087,859,053.00
BUTTERFLY VALVE DN 300 12"	26	Rp18,376,583.00	Rp2,756,487.45	Rp918,829.15	Rp550,378,660.85
BUTTERFLY VALVE 12" #150	22	Rp23,765,893.00	Rp3,564,883.95	Rp1,188,294.65	Rp602,465,387.55
BUTTERFLY WAFER 42" 150 EPDM	6	Rp43,345,367.00	Rp6,501,805.05	Rp2,167,268.35	Rp301,250,300.65

3.4. Inventory Control Using the EOQ Method

Economic Order Quantity (EOQ) is a model in inventory management that functions as a determination of the optimal amount of ordering goods or products. The EOQ formula is as follows: [13].

$$EOQ = \sqrt{\frac{2 \times Cr \times D}{ch}} \quad (9)$$

$$\text{Order frequency} = \frac{D}{EOQ} \quad (10)$$

$$Ss = Z \times S'd \quad (11)$$

$$ROP = (d \times LT) + SS \ [14] \quad (12)$$

$$TIC = ch \times \left(\frac{Q}{2}\right) + cr \times \left(\frac{D}{Q}\right) + (b \times D) \quad (13)$$

Table 13. EOQ Calculation Results

ITEM	Frekuensi_Pemesana pemesanan	safety stock	Jumlah_Permintaan ROP	d(permintaan rata TIC n	lead time rata/ bulan)	Harga (estimasi)	Total Nilai Permintaan	biaya penyimpanan (15%)			biaya pemesanan	EOQ	dibulatkan	frekuensi
BUTTERFLY WAFER 60" 150 EPDM														
							Rp28,145,322.00	Rp5,181,774.00	2.102043716	3	4	3	4	Rp2,310,788,457.25
DISC BUTTERFLY VALVE HARD CHROME STEEL + BODY HARD CHROME 16"														
BUTTERFLY WAFER 18" 150 EPDM														
							Rp12,968,746.80	Rp2,047,289.00	1.946463175	3	4	4	5	Rp1,062,742,932.07
BUTTERFLY VALVE DN 300 12"	4	12	1	1	Rp187,635,480.00	Rp2,251,625,760.00								
							Rp6,441,867.00	Rp3,022,915.60	4.746000204	4	6	6	8	Rp1,061,271,822.10
BUTTERFLY VALVE 12" #150	3	12	1	1	Rp86,458,312.00	Rp1,037,499,744.00								
BUTTERFLY WAFER 42" 150 EPDM	4	24	2	1	Rp42,945,780.00	Rp1,030,698,720.00	Rp2,756,487.45	Rp918,829.15	4.898979486	5	7.2	5	8	Rp675,060,963.47
	8	36	3	1	Rp18,376,583.00	Rp661,556,988.00								
							Rp3,564,883.95	Rp1,188,294.65	4	4	6	5	7	Rp584,640,967.80
	6	24	2	1	Rp23,765,893.00	Rp570,381,432.00								
	3	5	0.416666667	1	Rp96,345,367.00	Rp481,726,835.00	Rp14,451,805.05	Rp2,167,268.35	1.224602938	2	2.5	2	2.416666667	Rp499,424,557.93

The table above is the result of the calculation of EOQ, order frequency, safety stock, reorder point, and total inventory cost of 6 materials. From the calculations that have been carried out using the formula above, the results of the comparison of the calculation of total inventory cost using the EOQ and existing methods can be seen in the following table:

Table 14. Comparison Analysis

jeni	material		material		material		material		material		material	
	EOQ	perusahaan	EOQ	perusahaan	EOQ	perusahaan	EOQ	perusahaan	EOQ	perusahaan	EOQ	perusahaan
permintaan	4	17	4	30	3	10	5	26	4	22	2	6
frekuensi pemesanan	4	1	6	1	3	1	5	1	5	1	3	1
biaya pesan	Rp5,181,774.00	Rp5,181,774.00	Rp2,047,289.00	Rp2,047,289.00	Rp3,022,915.60	Rp3,022,915.60	Rp918,829.15	Rp918,829.15	Rp1,188,294.65	Rp1,188,294.65	Rp2,167,268.35	Rp2,167,268.35
biaya simpan	Rp15,545,322.00	Rp15,545,322.00	Rp9,068,746.80	Rp9,068,746.80	Rp6,141,867.00	Rp6,141,867.00	Rp2,756,487.45	Rp2,756,487.45	Rp3,564,883.95	Rp3,564,883.95	Rp6,501,805.05	Rp6,501,805.05
total inventory cost (TIC)	Rp1,814,916,343.50	Rp2,031,255,408.00	Rp1,847,241,521.10	Rp2,087,859,053.00	Rp428,746,985.83	Rp473,899,385.60	Rp489,460,288.21	Rp550,378,660.85	Rp536,515,034.48	Rp602,465,387.55	Rp273,075,812.10	Rp301,250,300.65

Based on the calculations that have been carried out, the application of the Economic Order Quantity (EOQ) method has proven to result in a more efficient Total Inventory Cost (TIC) compared to the procurement method currently used by the company. For Material 1, the company's TIC of Rp2,031,255,408.00 can be reduced to Rp1,814,916,343.50 by using EOQ, resulting in savings of Rp216,339,064.50. Material 2 shows similar results, with the company's TIC of Rp2,087,859,053.00 decreasing to Rp1,847,241,521.10, yielding a savings difference of Rp240,617,531.90. For materials 3, 4, 5, and 6, the savings achieved are Rp45,152,399.77 (from Rp473,899,385.60 to Rp428,746,985.83), Rp60,918,372.65 (from Rp550,378,660.85 to Rp489,460,288.21), Rp65,950,353.07 (from Rp602,465,387.55 to Rp536,515,034.48), and Rp28,174,488.55 (from Rp301,250,300.65 to Rp273,075,812.10). Overall, the total savings achieved through the implementation of the EOQ method amounted to Rp656,152,210.44, demonstrating that this method is capable of significantly reducing the company's procurement costs.[15]

4. CONCLUSION

Based on the results of research on the optimization of service valve material inventory management at PT X using the integration of ABC, Croston, and EOQ methods, it can be concluded that the ABC classification successfully identified 6 category A materials that accounted for 75% of the total consumption value even though only 1% of the total material. The Croston method proved effective in forecasting intermittent demand with high accuracy, as shown by the best MAD and MFE evaluation results on Butterfly Wafer 42" 150 EPDM (MAD = 0.6; MFE = 0.767) and Disc Butterfly Valve Hard Chrome Steel + Body Hard Chrome 16" (MAD = 0; MFE = 1.74). The implementation of EOQ based on Croston forecasting results in an optimal procurement policy by determining the number of orders, order frequency, safety stock, and reorder point specific to each category A material.

The integration of the three methods results in significant cost savings with a range of 9.35% to 11.52% for each material, with total savings reaching Rp657,152,210.44 or around 10.51% of the total inventory cost of category A service valve materials. This research proves that a systematic approach through the integration of ABC, Croston, and EOQ methods can have a significant positive impact on operational efficiency and can be a reference for similar companies in the oil and gas industry to optimize material inventory management with intermittent demand patterns.

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