Optimisation of the ABC Analysis Method Application in Material Inventory Control at PT. Supra Teknologi Plastik

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Abstract. PT Supra Teknologi Plastik is an industrial manufacturing company engaged in the oil and gas sector that produces pipe protectors as its main product. The supporting materials used to make pipe protectors have various types and characteristics. Therefore, controlling material inventory is essential to avoid stock-outs of materials. This study aims to determine the material calcification based on each material component's annual fund absorption value, safety stock, and reorder time. This type of research is quantitative, with data analysis techniques using the ABC Analysis method, safety stock calculation, and reorder point (ROP) calculation. The results showed that the classification using the ABC Analysis method obtained those included in category A (2 types) of materials with a total investment absorption of 85.26%, category B (4 types) of materials with a total investment absorption of 12.79%, category C (7 types) of materials with a total investment absorption of 1.96%.
Keywords: ABC Analysis, Safety Stock, Reorder Point.

1 Introduction

Raw material inventory control management is one of the essential factors in keeping the production process running effectively and efficiently. This is because inventory control directly impacts the production chain due to the need for raw materials to keep the production process running. Excellent and efficient inventory management can improve the production process and encourage operational efficiency so that there is no waste resulting in stock-outs. Following the description above, inventory control is crucial in optimizing raw material inventory planning. Given the importance of optimizing control over raw materials, a method is needed to analyze further raw material inventory planning through inventory control. Always better control (ABC) analysis is a method used to determine the level of control and frequency of inventory review. Goods are divided into three classes, namely class A, which represents 60-80% of the cost of goods inventory; class B, which represents 25-35% of the cost of goods inventory; and class C, which represents 5-15% of the cost of goods inventory (Reid & Sanders, 2012).

ABC analysis helps establish the most effective inventory control solution for various items. One of the problems that often occurs in inventory control is stock-out. Stock-out occurs when inventory control can no longer meet ongoing production needs. However, it can also disrupt existing inventory planning and decrease production efficiency, according to research conducted by Touseef et al. (2023). The ABC Analysis method is used in the shoe industry in Pakistan, where the industry uses the make-to-stock work method, which means that products are made and stored based on estimated orders even before there are incoming orders from customers. However, this way of working has led to excess stock and higher inventory costs. The results of the research using the ABC Analysis method show that in the initial data before the calculation, the inventory holding cost was $34,832, but this changed after categorizing the stock using the ABC

F. Arif Rahman et al. (eds.), *Proceedings of the Sixth International Conference on Applied Economics and Social Science (ICAESS 2024)*, Advances in Economics, Business and Management Research 312,
https://doi.org/10.2991/978-94-6463-640-6_33

Analysis method, and the inventory holding cost incurred is $24,489 (Touseef et al., 2023). Based on the results of interviews with Mr. Gala, a store employee at the company PT Supra Teknologi Plastik, there have been several stock-outs so far due to inefficient inventory control. PT Supra Teknologi Plastik is a manufacturing company engaged in oil and gas where Pipe Protector is the main product that has been made. A Pipe Protector is a component used to protect pipes when delivered offshore. This product diversification causes the number and type of raw materials to vary, so it is necessary to classify and assess each material based on its investment value and frequency of use. This study aims to analyze the implementation of the ABC method in material inventory control and calculate the safety stock and optimal reorder time.

2 Literature Review

2.1 Logistic Management

To meet consumer needs, logistics management is organizing, implementing, and monitoring protocols for the movement and storage of commodities, along with associated services and data, from the origin to the place of consumption. It requires careful coordination of complex tasks involving multiple individuals, locations, or resources (Mangan & Lalwani, 2016). Logistics management is the part of supply chain management that plans, executes, and controls the flow of goods, services, and related information from the point of origin to the point of consumption to meet customer needs efficiently and effectively (Lysons & Farrington, 2020).

2.2 Inventory Management

Inventory management is the process of planning, organizing, and monitoring the movement of goods and materials into and out of a company's inventory. This includes making decisions about how much inventory to buy, when to replenish, and how much safety stock to hold (Wiley and Sons, 2002). Inventory management is essential in many businesses. Its main function is to ensure that the right amount of inventory is accessible at the right time to meet customer demand while keeping expenses to a minimum (Vrat, 2014).

2.3 Inventory Control

Inventory control is a series of activities carried out by the company to analyze the effectiveness of inventory as a consideration for making policies related to the use of resources to meet the demand capacity of customers (Sampeallo, 2012). Inventory control aims to minimize the costs associated with holding inventory while ensuring that the company has the appropriate amount of inventory to meet consumer demand. Monitoring inventory levels, forecasting demand, and choosing when to place new inventory orders are all part of inventory control (Waters, 2003).

2.4 ABC Analysis

ABC analysis divides inventory into three classifications based on annual investment value. ABC Analysis, also known as the Pareto Principle (named after Vilfredo Pareto, a 19th century Italian economist) The Pareto Principle states that about 80% of the results are based on 20% of the causes. The idea is to establish an inventory policy that focuses on a few critical resources. Category A materials are those that comprise 15-20% of the total material types but absorb up to 70-80% of the total inventory investment value, Category B materials are those that comprise 30-35% of the total material types and absorb about 15-25% of the total inventory investment value, Category C materials are those that comprise 55% of the total material types but only absorb about 5-10% of the total inventory investment value (Heizer and Render, 2011).

2.5 Safety Stock

Safety stock is an inventory level that has been strategically set to address potential stockouts, which can occur due to fluctuating customer demand. By acting as a buffer, safety stock protects against supply chain disruptions and ensures customer service level targets are met (Heizer and Render, 2011).

2.6 Reorder Point

Reorder Point is a term used to describe an important inventory level in an inventory management system that takes lead times into account. Unlike the basic model that assumes instantaneous receipt of orders, ROP recognizes the time lag between placing an order and obtaining the associated inventory. Replenishment actions, such as placing a new order, are triggered when an item's inventory level falls to a predetermined ROP. By taking a proactive stance, stock-outs are avoided and there is always sufficient inventory to meet demand during lead times (Heizer and Render, 2011).

3 Research Methodology

The method used in this research is a quantitative approach. The quantitative approach is used to classify materials based on their frequency of demand to then determine the safety stock and material buyback time needed. The data collection technique used in this research is an Interview which is used to dig deeper into information related to stock-out problems in the company, In addition, data collection is also used through desk research to collect existing raw material purchase data. The analysis method used is ABC Analysis. The ABC analysis method is used to classify the materials used to manufacture Pipe Protector products and to determine priorities in purchasing materials. The formula used is as follows:

$$Percentage\ Value\ of\ Goods = \left(\frac{Total\ Stock\ Value}{Annual\ Investment\ Value}\right) X\ 100\% \quad (1)$$

After obtaining the investment value and annual percentage of each material, the safety stock calculation can be done as for the formula as follows:

$$SAFETY\ STOCK = Sd\ X\ Z\ X\ \sqrt{Lead\ Time} \quad (2)$$

Description:
Sd = Standard Deviation
Z = Service Level
Lead Time = Waiting time from the order process until the goods arrive.

After getting the results of the safety stock calculation, then it can be continued with the calculation of the reorder point to find out the right time to place a reorder, the formula used is as follows:

$$ROP = d \times L + SS \quad (3)$$

Description:
d = Average demand in one day
L = Order lead time
SS = Safety Stock

4 Results

Based on the data in Table 1, the annual demand data for each material in 2023 is as follows:

Table 1. Annual Material Demand

Material	Annual Demand		Unit Price
Marlex HDPE - HHM 5502 (Done)	67.500	Kg	19.400
Masterbatch Green Pantone With UV (Done)	100	Kg	90.000
Kansai Paint Black (Done)	585	Kg	101.600
Cold Rolled Steel (Done)	115.124	Kg	20.500
Ceisen HDPE Black (Done)	37.000	Kg	10.800
Ceisen LDPE Transparan (Done)	500	Kg	12.000
Kansai Paint Red (Done)	25	Kg	137.400
Paint Green (Done)	300	Kg	150.500
Masterbatch Biru Ungu (Done)	50	Kg	70.000
Masterbatch Black (Done)	750	Kg	40.000
Masterbatch Green Pantone (Done)	325	Kg	70.000
Masterbatch Remafin Green (Done)	250	Kg	184.400
Kansai Paint Orange (Done)	75	Kg	127.000

Source: Processed from primary data, (2024)

4.1 ABC Analysis

Table 2. ABC Analysis Calculations

Description of Material	Volume	Unit cost	Investment Value	Percentage	Cumulative Percentage	Classification
Cold Rolled Steel	115.124	Rp20.500	Rp2.360.042.000	54,83%	54,83%	A
Marlex HDPE - HHM 5502	67.500	Rp19.400	Rp1.309.500.000	30,42%	85,26%	A
Ceisen HDPE Black	37.000	Rp10.800	Rp399.600.000	9,28%	94,54%	B
Kansai Paint Black	585	Rp101.600	Rp59.436.000	1,38%	95,92%	B
Masterbatch Remafin Green	250	Rp184.400	Rp46.100.000	1,07%	96,99%	B
Paint Green	300	Rp150.500	Rp45.150.000	1,05%	98,04%	B
Masterbatch Black	750	Rp40.000	Rp30.000.000	0,70%	98,74%	C
Masterbatch Green Pantone	325	Rp70.000	Rp22.750.000	0,53%	99,27%	C
Kansai Paint Orange	75	Rp127.000	Rp9.525.000	0,22%	99,49%	C
Masterbatch Green Panton With UV	100	Rp90.000	Rp9.000.000	0,21%	99,70%	C
Ceisen LDPE Transparan	500	Rp12.000	Rp6.000.000	0,14%	99,84%	C
Masterbatch Biru Ungu	50	Rp70.000	Rp3.500.000	0,08%	99,92%	C
Kansai Paint Red	25	Rp137.400	Rp3.435.000	0,08%	100,00%	C
TOTAL:			**Rp4.304.038.000**			

Source: Processed from primary data, (2024)

Table 2 explains the results of the ABC Analysis calculation, where in category A, there are 2 types of materials, 4 types of materials are in category B, and 7 types of materials are in category C.

4.2 ABC Analysis Based on Investment Value

Table 3. ABC Analysis Based on Investment Value

Material Category	Material Type	Material Type (%)	Investment Value	Investment Value (%)
A	2	15%	Rp3.667.000.000	85,25%
B	4	31%	Rp550.286.000	12,79%
C	7	54%	Rp84.210.000	1,96%
Total	**13**	**100%**	**Rp4.301.496.000**	**100%**

Source: Processed from primary data, (2024)

Table 3 shows the group of materials based on investment value, materials that belong to category A are 2 types or represent 15% of the total types of materials available with an investment value of Rp 3,667,000,000 or 85.26% of the total investment value of inventory at PT Supra Teknologi Plastik. Materials classified into category B are 4 types or represent 31% of the total types of materials available with an investment value of Rp 550,286,000 or 12.79% of the total value of inventory investment at PT Supra Teknologi Plastik. Materials belonging to category C are 7 types or represent 54% of the total types of materials available with an investment value of Rp 84,210,000 or 1.96% of the total value of inventory investment at PT Supra Teknologi Plastik.

4.3 Safety Stock

Safety stock is the amount of additional inventory needed to prevent stock-outs of materials. After classifying each material used at PT Supra Teknologi Plastik, the next step is to calculate the amount of safety stock for each material in categories A, B and C to avoid the possibility of stock-outs at PT Supra Teknologi Plastik. The calculation is obtained by the following formula:

$$SAFETY\ STOCK = Sd\ X\ Z\ X\ \sqrt{Lead\ Time} \quad (4)$$

Description:

Sd = Standard deviation

Z = Service level

Lead Time = Waiting time from the order process until the goods arrive.

The service level set by the company is 95%, so the work achievement target is 95% = 1.65. With an average lead time of 14 days.

Table 4. Safety Stock Calculation

No	Goods Description	Service Level	Standard Deviation	Lead Time (Month)	Safety Stock (Kg)	Classification
1	Cold Rolled Steel	1,65	6.203	0,47	4.810	A
2	Marlex HDPE-HHM 5502	1,65	2.053	0,47	1.592	A
3	Ceisen HDPE Black	1,65	1.605	0,47	1.245	B
4	Kansai Paint Black	1,65	48	0,47	37	B
5	Masterbatch Remafin Green	1,65	4	0,47	3	B
6	Paint Green	1,65	5	0,47	4	B
7	Masterbatch Black	1,65	19	0,47	15	C
8	Masterbatch Green Pantone	1,65	11	0,47	9	C
9	Kansai Paint Orange	1,65	1	0,47	1	C
10	Masterbatch Green Pantone with UV	1,65	2	0,47	2	C
11	Ceisen LDPE Transparan	1,65	7	0,47	5	C
12	Masterbatch Biru Ungu	1,65	2	0,47	2	C
13	Kansai Paint Red	1,65	1	0,47	1	C

Source: Processed from primary data, (2024)

4.4 Reorder Point

Reorder Point is a method used to calculate when is the right time for a company to reorder materials used to suppliers/vendors. The following is the reorder point calculation formula:

$$ROP = d \times L + SS \quad (5)$$

Description:

d = Average demand in one day
L = Order lead time
SS = Safety stock / Safety availability

To determine d or average demand, it can be done using the following formula:

$$d = \frac{D}{\text{number of working days in a year}} \quad (6)$$

Description:

D = total demand in one year

Table 5. Average Material Demand

Material	Annual Demand	Number of Working Days	Average Demand (Kg)
Cold Rolled Steel	115.124	264	436
Marlex HDPE - HHM 5502	67.500	264	256
Ceisen HDPE Black	37.000	264	140
Kansai Paint Black	585	264	2,216
Masterbatch Remafin Green	250	264	0,947
Paint Green	300	264	1,136
Masterbatch Black	750	264	2,841
Masterbatch Green Pantone	325	264	1,231
Kansai Paint Orange	75	264	0,284
Masterbatch Green Panton With UV	100	264	0,379
Ceisen LDPE Transparan	500	264	1,894
Masterbatch Biru Ungu	50	264	0,189
Kansai Paint Red	25	264	0,095

Source: Processed from primary data, (2024)

Table 5 describes the average demand in one day for each material at PT Supra Teknologi Plastik, the results are obtained from collecting annual demand data which is then divided by the number of working days in one year.

Table 6. Reorder Point Calculation

Material	Average Demand (Kg)	Lead Time	Safety Stock	ROP	Classification
Cold Rolled Steel	436	0,47	4.810	5.015	A
Marlex HDPE - HHM 5502	256	0,47	1.592	1.712	A
Ceisen HDPE Black	140	0,47	1.245	1.311	B
Kansai Paint Black	2,216	0,47	37	38	B
Masterbatch Remafin Green	0,947	0,47	3	3	B
Paint Green	1,136	0,47	4	5	B
Masterbatch Black	2,841	0,47	15	16	C
Masterbatch Green Pantone	1,231	0,47	9	10	C
Kansai Paint Orange	0,284	0,47	1	1	C
Masterbatch Green Panton With UV	0,379	0,47	2	2	C
Ceisen LDPE Transparan	1,894	0,47	5	6	C
Masterbatch Biru Ungu	0,189	0,47	2	2	C
Kansai Paint Red	0,095	0,47	1	1	C

Source: Processed from primary data, (2024)

Based on the information in the Table 6, it can be concluded that the ROP for Cold Rolled Steel material is 5,015 Kg, Marlex HDPE-HHM 5502 material is 1,712 Kg, Ceisen HDPE Black material is 1. 3111 Kg, Kansai Paint Black material of 38 Kg, Remafin Green Masterbatch material of 3 Kg, Paint Green material of 5 Kg, Black Masterbatch material of 16 Kg, Green Pantone Masterbatch material of 10 Kg, Kansai

Paint Orange material of 1 Kg, Green Pantone Masterbatch material with UV of 2 Kg, Ceisen LDPE Transparent material of 6 Kg, Purple Blue Masterbatch material of 2 Kg, and Kansai Paint Red material of 1 Kg. In category A materials, namely Cold Rolled Steel and Marlex HDPE - HHM 5502, it is known that the optimal material ordering time is when the amount of material storage reaches 5,015 and 1,712.

5 Conclusion

Based on the results of the data analysis that has been carried out, to optimize the application of ABC Analysis in Material Inventory Control, researchers suggest a specific supervision policy for each existing material category, namely as Category A Supervising category A materials is carried out periodically every week to prevent miscalculations in inventory. Category B Supervision of category B materials can be carried out moderately because category B materials are one of the types used quite often by companies. Hence, they need to be monitored periodically. Category C Supervision of material C can be carried out every month even though it is not the primary material or component; this still needs to be considered, considering that category C materials are supporting components that also play a role in the company's production process.

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