Optimizing Inventory Management with Inventory Control and Ordering Methods in the Automotive Industry

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Abstract:- **Tight competition encourages every company to increase its competitiveness by making efficiency in all fields, one of which is by controlling inventory in the company by optimizing warehousing costs, availability of raw materials and products. At the same time by avoiding interruptions in the production flow. As one of the companies that produces car engines, the company optimizes inventory to meet consumer demand and avoid production stops. The problem that occurs in this company is that only 20% of the components have the amount of stock that is in accordance with the company's planning. Based on these problems, there is a need for proper classification of component and inventory policy to minimize the occurrence of excess stock experienced by the company. In this study, component classification is using ABC and XYZ analysis. In addition, the company needs to determine its stock level, reorder components using the Reorder Point (ROP) method, and optimize the number of orders ordered for each part with Economic Order Quantity (EOQ). The results of this study obtained a grouping of components for classes A = 15 components, B = 18 components and C = 78 components and X = 86 components, Y = 8 components and Z = 17 components. By improving the ROP and EOQ values, the company can optimize inventory by reducing the amount of inventory by 9.1 billion.**

Keywords:- *Inventory, ABC analysis, XYZ analysis, Reorder point (ROP), Economic Order (EOQ).*

I. INTRODUCTION

The automotive industry is currently growing according to data from the Indonesian Automotive Industry Association (GAIKINDO) car sales in 2022 were 1,048,000 units, this figure increased compared to the total in 2021 by 14.8% so that the automotive industry is facing several challenges(Gaikindo, 2022). The impact of competition on the automotive market makes assembly plants more demanding in terms of cost and functionality. They must also be able to guarantee a wide selection of functionality at a competitive price (Priniotakis & Argyropoulos, 2018; Zowid et al., 2019). One of the functionalities that play an important role is inventory management. Deciding the right degree of stock is basic since stock ties up cash and influences execution. Having an excessive amount of stock decreases working capital and influences the liquidity of the organization. On the other hand, too little stock prompts stock-outs and lost deals prompting diminished benefits. Obviously the board's consideration ought to be centered around keeping stock levels some in the middle between, endeavoring to increment consumer loyalty and limit stock-outs while keeping stock expenses as low as could really be expected (Saliji, 2021).

This research was conducted at an automotive company that produces car engines where most of the basic ingredients of engine parts are imported goods. In its arrangement, the company divides it into 2 categories, namely local goods and imported goods. In this factory, the standard stock for imported parts is 2 months yet as displayed in Figure 1 the bar diagram shows the quantity of part numbers in the distribution center for how long of stock while the line shows the level of the piece. The data used in this study are components used in the engine production process in the automotive industry. We can see in the picture below that the number of components that meet these criteria is only 19 (nineteen) part numbers out of a total of 111 part numbers or 20% of the total components in the warehouse. While other components exceed the target set by the company, there are even 13 part numbers that have a storage period of more than 12 months.
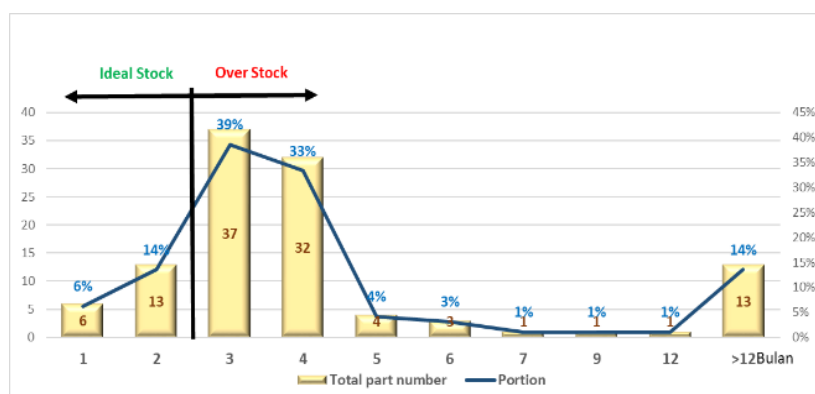

Fig. 1: Inventory at the end of February 2023

The condition of the number of parts that experience overstock will greatly affect the total inventory in the company. This causes the total inventory costs that must be spent by the companyto be high and exceed the allocation of inventory costs. As found in Figure 2 where the total inventory in the warehouse is currently 38% (154,522 MIDR) of the total inventory including raw materials that are experiencing overstock. Of course, this condition can indirectly disrupt the company's cash flow.
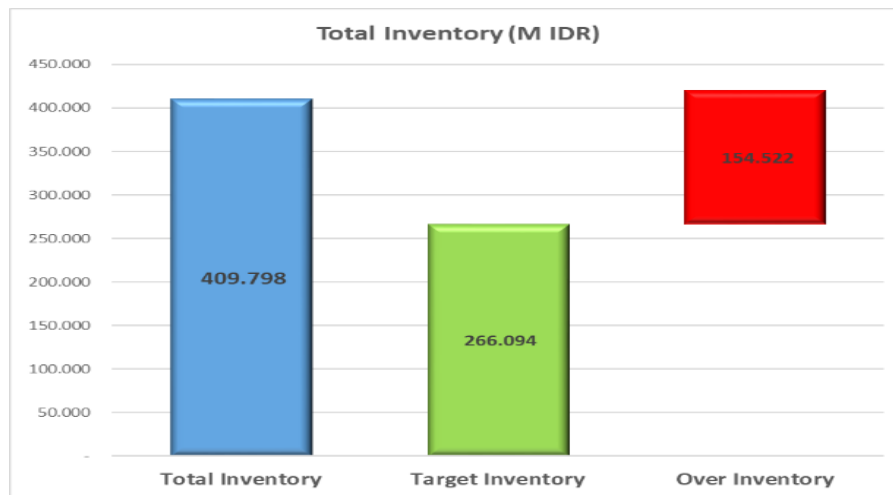

Fig. 2: Total Inventory at Engine warehouse

In inventory management is commonly used ABC analysis method to separate items based on pareto diagrams (Umry & Singgih, 2019). ABC analysis is not difficult to utilize and figured out by many individuals. Other stock grouping involving XYZ examination to characterize parts in light of its interest fluctuation(Swastomo et al., 2020).

In connection with this condition, it is important for companies to look at their inventory policies. Companies need to classify raw materials to determine the level of stock and reorder, one of which is by using the Reorder Point (ROP) method, this strategy is generally used to decide when the stock will be repurchased so that the amount of basic materials available can meet production needs (Daman & Nusraningrum, 2020). In addition, companies need to optimize the number of orders ordered for each part with Economic Order Quantity (EOQ). This strategy is a technique used to decide how much of goods that can be ordered in a period for the purpose of minimizing the cost of inventorying these goods with this method the company can maximize profits in terms of shipping and storage costs(Nobil et al., 2020).

II. LITERATUR RIVIEW

Inventory is an inactive asset whose presence is hanging tight for the following system. The following system can be through assembling activities that occur in factories or consumption activities that occur in households, offices and others (Maulaya et al., 2019; Swastomo et al., 2020). Inventory not only provides added value, but also incurs costs. These costs can be categorized into different sections depending on the approach chosen such as ordering costs, storage costs, and shortage costs (Taufik Djatna, 2020)Hence inventory is the most important part of assets and working capital in a business. For smooth operations, every organization needs some sort of inventory to maintain(Malviya et al., 2020).

A. ABC Analysis

The priorities for inventory management are established using ABC analysis. There are three classes of inventories: A, B, and C. Class A inventories receive the greatest attention and management efforts, whilst class C receives the least attention and class B is in between A and B.(Jadhav & Jaybhaye, 2020).

Each item is categorized by ABC analysis based on the annual investment made in inventory acquisition. Commodities can be classified into three categories using the Pareto principle.(Kučera & Suk, 2019; Prachuabsupakij, 2019)

- Category A (70-20) comprises product categories that account for 70% of the total capital, and the quantity of items handled represents 20% of all product categories.
- Category B (15–30), which includes products that make up around 20% of the total capital allocated for inventory (following category A), with roughly 30% of all commodities handled falling into this group.
- Things in Category C (10–50) represent both the quantity of things that account for roughly 50% of all handled items and those that only take up around 5% of the entire capital.

B. XYZ Analysis

An XYZ analysis classifies an object based on its range of possible uses. Three categories are created by this study for the products.(Suryaputri et al., 2022):

- X-classes are things with steady interest that have little change and can be estimated with high exactness.
- Y-class things with variable interest with moderate changes and moderate expectation exactness.
- Z-class, how much interest for different wares shifts significantly after some time and is difficult to gauge.

In view of the Variety Coefficient (CV), the predefined boundaries are XYZ examination grouping positioning(Saputra et al., 2018):

- Class X with a Coefficient of Variety under 0.5.
- Class Y with a Coefficient of Variety somewhere in the range of 0.5 and 1.
- Class Z with a Coefficient of Variety more noteworthy than 1.

C. Combination ABC and XYZ Analysis
ABC examination has constraints that can be covered by XYZ examination, which adds a variable normal of interest

vacillations (Trubchenko et al., 2020). The blend of these two examinations assists in deciding the buying technique for each stock grouping and figuring out what items ought to continuously be in with loading, when items ought to be requested, and when items are requested by the estimate results (Christopher Amadeus Herlambanga, 2021).

The ABC - XYZ examination network should be visible in Table 1, where X is classified as an item with steady interest, Y is an item with fluctuating business sector interest and Z is an item with little or exceptionally dubious interest (Suryaputri et al., 2022).

Table 1: Combination ABC and XYZ

D. ROP Analysis
To oversee stock, it is important to decide when the stock should be added to keep up with stock at the ideal point. This point is regularly known as Reorder point (ROP) (Umry & Singgih, 2019).

According to (Darmawan et al., 2021)material control with Reorder Point (ROP), the decision regarding when to submit a reorder lies in two factors, namely; the first is consideration of the level of reordering directly based on normal usage and the second is consideration of safety preparations based on the degree of uncertainty and the level of service requested.To compute the reorder point stock the equation utilized is:

$$ROP = (d \times L) + SS\ldots\ldots\ldots..(1)$$

With:
ROP = Reorder Point
d = Demand
L = Lead-time
SS = Safety Stock

E. EOQ Analysis
EOQ an accounting formulation that determines the point at which the combination of order cost and inventory delivery cost is the least, then the result will be the most cost-effective quantity to order(Daman & Nusraningrum, 2020). As the quantity ordered increases, the number of orders per year will decrease, but as the quantity ordered

increases, storage costs will increase because the average amount of inventory that must be maintained is more (Nisa, 2019).

The purpose of the EOQ method is to calculate the total order with the most economical level that must be ordered by a company that still pays attention to the financing of total ordering and storage costs (Romadhon & Wardoyo, 2021)if this method can be applied properly, of course, the amount of inventory available will be better and reduce the risk of the item becoming damaged.To calculate the Economic Order Quantity the formula used is:

$$EOQ = \sqrt{\frac{2 \times D \times S}{H}}$$

With:
D = annual demand for raw material inventory
S = cost required per order
H = the fee required for storage per unit annually

III. RESERCH RESULT

A. ABC Analysis
The item to be dissected purposes ABC for 111 items, the division in ABC examination for each class depends on Pareto and item center. In the wake of dissecting utilizing ABC from the current item, the outcomes are as per the following:
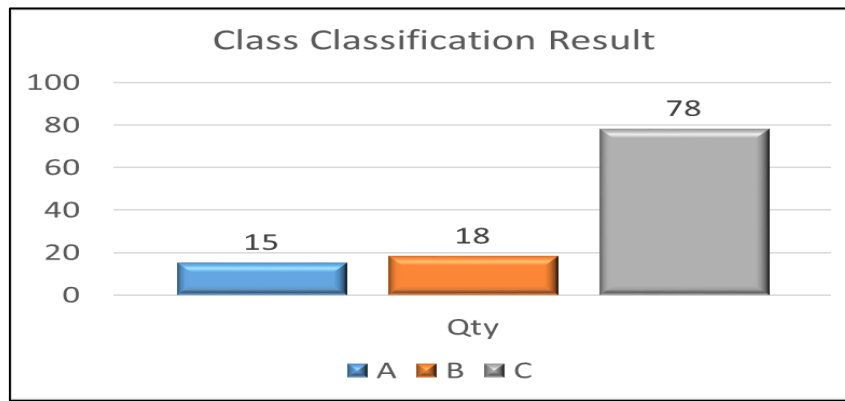
Fig. 3: ABC Classification Result

Based on the calculation results in Figure 3, it can be concluded that of the 111 components in the warehouse, group A amounts to 15 types or 13.5%, group B amounts to 18 types or 16.2% and group C amounts to 78 items or 70.3%. The results of this grouping have an impact on the handling of raw materials in the warehouse. According to (Suryaputri et al., 2022) for components that are class A are strict inventory control, the recording system must be monitored so that it is precise and carried out every day. Furthermore, the handling of class B raw materials with moderate or periodic inventory control, and the handling of night raw materials is in class C with infrequent inventory control.

B. XYZ Analysis

XYZ analysisis utilized when the interest for a part can differ fundamentally starting with one part then onto the next for a specific item. XYZ investigation sorts items into three gatherings. There is bunch X for items with persistent interest, portrayed by tiny vacillations and request can be assessed with great precision. Then bunch Y for parts whose utilization is discontinuous, the interest changes and has a medium degree of interest estimate exactness. The latter is bunch Z for items whose utilization after some time has a huge distinction popular volume and is truly challenging to gauge. The consequences of part gathering in the distribution center in light of XYZ examination should be visible in Figure 4.
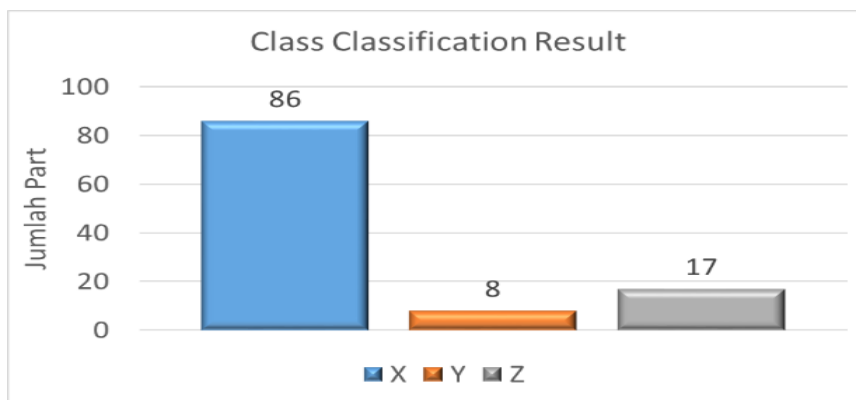

Fig. 4: XYZ Classification Result

This can be concluded that from 111 components in the X group warehouse, there are 86 types or 77%, Y group is 8 types or 7% and C group is 17 items or 15%.

C. ABC and XYZ Analysis

Based on the examination results of XYZ characterizing products by considering changes in interest, this can overcome the constraints of ABC investigation. The relationship between the characterization and stock control approaches applied to each subsequent attribute is clear because the execution of the general framework relies on the fusion of the two (Suryaputri et al., 2022). Subsequent to leading ABC and XYZ investigation, a grid was made to bunch natural substances and parts in light of the consequences of the two examinations. This framework has nine groupings in light of the combination of ABC and XYZ examination as displayed in Table 2.

Table 2: ABC and XYZ Combination Result

Prediction/ Value	A	B	C
X	14 Items	16 Items	56 Items
Y	-	-	8 Items
Z	1 Item	2 Items	14 Items

D. ROP

In the ROP, ordering components based on average daily usage, safety stock and lead-time required for the component can be received by the company. Because this engine component is sent from abroad which has a lead-time of 20 working days and in this company determines that the safety stock for each component is 2 months, the results of the ROP calculation of the components in the warehouse based on this calculation are compare with the company's determination are as in table3 below:

Table 3: ROP Comparison

No	Part No	ROP Tesis ini	ROP system	Diff
1	21111-2M030	17.000	17.159	159
2	28300-2M200	17.200	18.159	959
3	35300-2M370	17.200	18.159	959
4	21130-2M001	17.000	18.159	1.159
5	25600-2M030	16.750	18.159	1.409
6	25600-2M060	500	602	102
7	22140-2M050	17.150	16.959	-191
8	23111-2M100	17.200	18.159	959
9	24300-2M011	17.200	18.159	959
10	22410-2M010	17.200	18.159	959
11	23510-2M500	68.950	68.636	-314
12	24100-2M020	17.200	18.159	959
13	24500-2M800	275.050	274.544	-506
14	24200-2M020	17.200	18.159	959
15	24400-2M011	17.200	18.159	959
16	23200-2M100	500	602	102
17	23410-2M510	60.100	59.465	-635
18	39210-2M360	17.200	18.159	959
19	25280-2M000	17.200	18.159	959
20	21310-2M030	17.200	18.159	959
-	-	-	-	-
-	-	-	-	-
106	23611-2M500	-	-	-
107	21211-2M550	-	-	-
108	21211-2M500	-	-	-
109	21111-2M001	-	-	-
110	21191-2M100	-	-	-
111	22410-2M030	-	-	-

From the above comparison, it is found that there are parts that have ROP numbers that are higher and lower than the calculation. With the high level of ROPit will have an potential impact on the high value of inventory in the company, as well as the low level of existing inventory that can create a risk of not fulfilling demand.In Figure 5 we can see the impact of inventory on the company, the impact of the high ROP value the company has an additional inventory of around 9.11 billion.
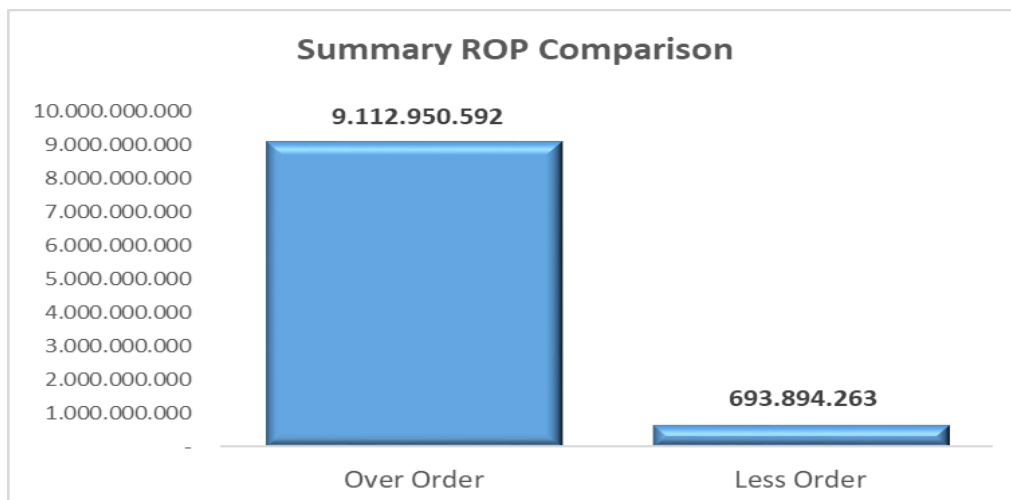

Fig. 5: Summary ROP Comparison

E. EOQ

With the correct application of the EOQ method, it can have a positive impact on the company, such as minimizing ordering costs and reducing storage costs.Lower component procurement to EOQ can lead to an increasing higher ordering cost for each order. Meanwhile, if the order exceeds EOQ, it will have an impact on increasing storage costs and the high amount of inventory in the warehouse. This impact can be seen from the graph generated by the EOQ calculation using POM QM for Windows in Figure6.
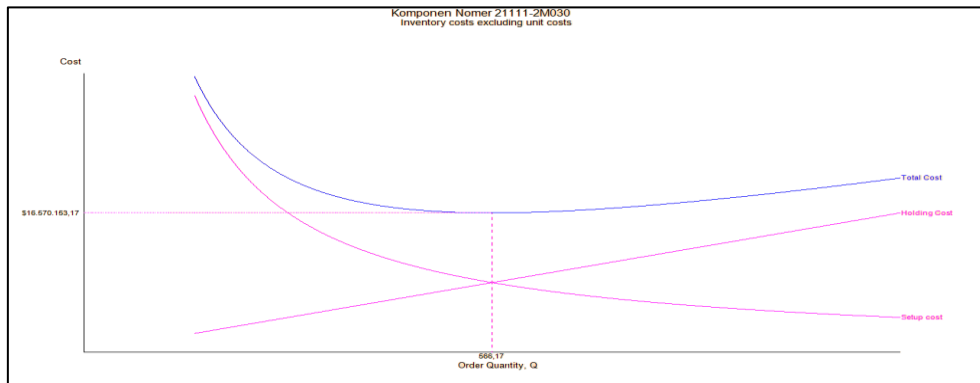

Fig. 6: EOQ Calculation result by POM QM

From Figure 6 we can see that the equilibrium point for component 21111-2M030 is at 566.17 or 566 if rounded up, which is the meeting point between holdingcost and setup cost where the point shows the lowest cost that must be incurred by the company for ordering raw materials for component 21111-2M030.

IV. CONCLUSION

Management of inventory is a crucial capability for each business that keeps up with stock. It is vital for organizations to keep up with stock, however dependent upon a specific level to forestall both running unavailable and having a lot stock. More than 77% (86 parts) of the inventory is Class X where this part group is a group that has stable demand variability so that it will be easier to control. Besides that, only 13.5% (15 parts) are ClassA which absorbs almost 70% of the company's total inventory. By controlling the appropriate level of ROP and EOQ the company can have the opportunity to reduce the amount of inventory by 9,1 Billion IDR.

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