**Analysis of Safety Inventory Control on Wiring Harness Components with ABC Analysis, Economic Order Quantity, and Reorder Point Methods at PT XYZ**

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Abstract

PT XYZ is manufacturing industry that produces wiring harnesses for Suzuki, Daihatsu, and Toyota products. Supporting materials in wiring harness assembly consist of various types. Therefore, material inventory control is important to do so that there is no overstock. This type of research is descriptive quantitative with the aim of determining the value of material use and investment absorption, the optimal number of orders, and the time of reordering. The results of classification using the ABC analysis method obtained materials belonging to group A (3 types) of materials with the use of 76.94% and investment absorption of 47.0%. Group B (4 types) of materials with a use of 21.12% and investment absorption of 39.2%. Group C (7 types) of materials with a use of 1.94% and investment absorption of 13.8%. Based on EOQ calculations, the value for group A materials is 2,909-4,399, and the ROP value is 1,234-2,371. This research aims to reduce excess inventory or overstock that occurs in the company.

***Keywords: Safety Inventory, ABC Analysis, Economic Order Quantity, Reorder Point***

Abstrak

PT XYZ merupakan industri manufaktur yang memproduksi *wiring harness* untuk produk Suzuki, Daihatsu, dan Toyota. Material pendukung dalam perakitan *wiring harness* terdiri dari beragam jenis. Oleh karena itu, pengendalian persediaan material penting untuk dilakukan agar tidak terjadi kelebihan persediaan atau *overstock*. Jenis penelitian ini adalah deskriptif kuantitatif dengan tujuan untuk mengetahui nilai penggunaan material dan penyerapan investasi, jumlah pemesanan optimum, dan waktu pemesanan kembali. Hasil klasifikasi dengan metode ABC *analysis* diperoleh material yang termasuk kelompok A (3 jenis) material dengan penggunaan 76,94% dan penyerapan investasi sebesar 47,0%. Kelompok B (4 jenis) material dengan penggunaan 21,12% dan penyerapan investasi sebesar 39,2%. Kelompok C (7 jenis) material dengan penggunaan 1,94% dan penyerapan investasi sebesar 13,8%. Berdasarkan perhitungan EOQ didapatkan nilai untuk material kelompok A yaitu 2.909-4.399, dan nilai ROP sebesar 1.234-2.371. Penelitian ini bertujuan untuk mengurangi kelebihan persediaan atau *overstock* yang terjadi diperusahaan.

Kata kunci: *Safety Inventory, ABC Analysis, Economic Order Quantity, Reorder Point*

1. **Introduction**

Material inventory control plays an important role for the effectiveness and efficiency of the production process in a company. This is because inventory or inventory can affect the smooth operation of the company so that the company can still meet the needs of the production process. In line with research conducted by (Fauzi Afianti & Hamdi Azwir, 2017) which explains that, if the inventory is insufficient to meet consumer needs, the company will miss the opportunity to get maximum profit, because often consumer demand fluctuates both in quantity and frequency of orders.

A detailed analysis of material inventory planning and control must also be carried out to ensure that overstock does not occur. Because if the material has exceeded what is calculated, it is likely that material defects will occur due to being stored for too long. Not only that, the impact of overstock will also affect labor costs, raw material costs, storage costs and material repairs.

This is in line with the problems faced by PT XYZ, where during the observation it was found that there was a lack of efficiency in controlling material inventory, especially for the daihatsu speed sensor production process, where excess material inventory occurred in raw materials or materials whose use was quite significant and included in the fast moving material category, so that there is a need for specific calculations and more in-depth analysis of the level of demand, quantity of inventory, and lead time for material delivery. The goal is that the balance between material usage and existing inventory is maintained and does not experience excess inventory or overstock.

In (Mahardhika, Rahman, & Yanuar Efranto, 2018), to enhance effectiveness and efficiency in inventory management, it is necessary to establish a well-organized inventory planning and control system, thereby facilitating the production process. The objective of inventory control is to minimize operational costs as much as possible, thus optimizing the company's performance. Furthermore, the findings of this research also lead to the conclusion that proficient inventory control can enable the company to reduce unnecessary expenses, such as the costs associated with returning materials to the supplier.

Improving inventory effectiveness and efficiency can be achieved by utilizing various analysis methods, including the ABC analysis method which is used to classify materials. Furthermore, materials that are included in group A, will be analyzed by the Economic Order Quantity (EOQ) method to calculate the optimum amount in one order, then to find out when the reorder time is used the Reorder Point (ROP) method, so that the problem of excess inventory or overstock can be resolved.

1. **Literature Review**
	1. **Inventory Control**

Inventory control is an activity to control or regulate the quantity of raw material inventory and finished product inventory, so that companies can avoid disruption of the production process and know the optimal value of sales and purchases (Nur Oktavianty & Sukmono, 2020). Meanwhile, according to (Prastyorini, 2020) inventory control is the provision of raw materials according to the predetermined quantity and quality and is used efficiently.

1. **Safety Inventory**

Safety stock is the amount of goods stored to guard against unexpected fluctuations in demand and storage. Safety stock can also be interpreted as additional inventory to protect or guard against the possibility of a shortage of raw material support (stock out). (Darmadi, 2020)

In (Andika Lubis, 2019) the purpose of safety inventory is to minimize stock out and reduce additional storage costs. Storage costs will increase in line with the additions that come from reorder points or repurchases.

1. **Wiring Harness Component**

Wire harness is a collection of cable circuits that function as a conduit for electric current and signals in automotive vehicles. (Kamal, 2018)

A wiring harness is a group of wires, each isolated, connected to components, circuits, and so on. The whole is put together in one unit for easy connection between the electrical components of a vehicle.

1. **Research Methods**

The method in this research is descriptive with a quantitative approach. The descriptive approach in this research is used to describe inventory inefficiencies at PT XYZ. While the quantitative approach is done to classify or group materials based on the intensity of their use to then determine the purchase quantity and repurchase time of the material. This research also involved respondents consisting of section assembly, material control, and purchasing.

The data in this study comes from primary data and secondary data. Where primary data comes from the results of observations and interviews. While the author's secondary data sources use material data used for the daihatsu speed sensor production process and material price data, the purpose of which is to classify materials based on their frequency of use and to determine priorities in purchasing materials. The research methods used are ABC Analysis, Economic Order Quantity, and Reorder Point methods.

1. **Results and Discussion**

Material group based on ABC Analysis

Table 1. Material grouping results with ABC Analysis method

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Group** | **Number of Items** | **Total Usage** | **% Total Items** | **% Total Usage** |
| **A** | 3 | 1.878.000 | 21% | 76,94% |
| **B** | 4 | 515.400 | 29% | 21,12% |
| **C** | 7 | 47.400 | 50% | 1,94% |
| **TOTAL** | 14 | 2.440.800 | 100% | 100% |

Based on the results of the analysis with the ABC method, the results obtained, group A with the highest total material usage of 76.94% which represents 3 types of materials (21%). Group B with moderate usage intensity is 21.12% of the total usage of 4 types of materials (29%) and group C with the smallest usage of 1.94% with the total usage of 7 types of materials (50%). With this, it can be concluded that the calculation with the ABC Analysis method can be used

to determine which materials are included in the priority or fast moving category and the non-priority or slow moving category. So that for materials included in class A groups, more detailed attention can be paid to material purchases, safety inventory, and material usage every period of time.

**Investment Based on ABC Analysis Method**

Table 2. Investment Grouping Results with ABC Analysis Method

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Category** | **Number of Items** | **Total Investment** | **% Total Items** | **% Total Investment** |
| A | 3 | Rp 459.815.822 | 21,4% | 47,0% |
| B | 4 | Rp 383.000.866 | 28,6% | 39,2% |
| C | 7 | Rp 135.315.031 | 50,0% | 13,8% |
| **TOTAL** | **14** | **Rp 978.131.718** | **100,0%** | **100,0%** |

Based on the results of calculations using the ABC Analysis method, it shows that group A consisting of 3 types of material items has a significant influence on total investment, which is 47%. Group B with 4 types of material items has an investment proportion of 39.2%, which means that the influence on total investment is not greater than group A, but still must be considered to optimize company spending. Group C with 7 types of material items, has the highest percentage of material types, which is 50%, but has the lowest investment value of 13.8%, in this case the company can pay more attention to spending on purchasing group C materials, because the materials included in group C are materials that are classified as slow moving or materials with a small quantity of use. This is done to reduce storage costs.

**Storage Cost**

Table 2. Material Storage Cost for Class Group A

|  |  |  |  |
| --- | --- | --- | --- |
| **No.** | **Material No.** | **Price/Unit (Rp)** | **Storage Cost (Year)** |
| 1 | 65227708 | Rp 143 | Rp 36.756.000 |
| 2 | 61102557 | Rp 284 | Rp 36.756.000 |
| 3 | 61103292 | Rp 427 | Rp 36.756.000 |

The table above is the storage cost for class A group materials based on the results of the analysis using the ABC Analysis method, where the storage cost is calculated based on per-unit material storage.

**Ordering Cost**

Ordering costs refer to the costs incurred during the procurement process of raw materials or materials in a company. Ordering costs include administrative costs such as order processing costs, purchase processing costs, and order documentati

Table 3. Group A material ordering cost

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **No.** | **Material No.** | **Price/Unit (Rp)** | **Total Usage** | **Ordering Cost** | **Ordering Cost** |
| 1 | 65227708 | Rp 143 | 940.000 | Rp 134.420.000 | Rp 3.570.000 |
| 2 | 61102557 | Rp 284 | 527.000 | Rp 149.668.000 | Rp 3.570.000 |
| 3 | 61103292 | Rp 427 | 411.000 | Rp 175.497.000 | Rp 3.570.000 |

**Economic Order Quantity (EOQ) Calculation**

The calculation formula in the optimum order, namely:

**Q =** $\sqrt{\frac{2 D S}{H}}$$\sqrt{\\frac{2 D S}{H}}$

Where:

Q: Optimal number of units per order

D: Annual demand in units

S: Ordering cost for each order

H: Storage cost per unit

Table 5 will show the results of the analysis using the Economic Order Quantity (EOQ) method on each material included in group A.

**Table 5.** Optimum order quantity of group A materials

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **No.** | **Material No.** | **Price/Unit (Rp)** | **Ordering Cost** | **Cost Requirement/Year** | **EOQ (pcs)** |
| 1 | 65227708 | Rp 143 | Rp 3.570.000 | Rp 134.420.000 | 4.399 |
| 2 | 61102557 | Rp 284 | Rp 3.570.000 | Rp 149.668.000 | 3.294 |
| 3 | 61103292 | Rp 427 | Rp 3.570.000 | Rp 175.497.000 | 2.909 |

Based on the results of calculations using the Economic Order Quantity (EOQ) method, the optimal quantity in each order for material 65227708 is 4.399 pcs, material 61102557 with an optimal number of orders of 3.294 pcs, and material 61103292 of 2.909 pcs. If each material has a quantity / box of 100 pcs, then the optimal purchases for these materials are 44 boxes, 33 boxes, and 29 boxes, respectively.

**Safety Stock Calculation**

Safety stock is additional material that is used as a deterrent against the possibility of running out of material (stock out). The advantage of safety stock is that if there are fluctuations, then safety stock can be used to prevent the possibility of running out of material. However, inventory control also needs to be considered, in (Hudori, 2018) The existing safety stock should not be too high or too low, because if the safety stock exceeds that set as a result the company will bear too high storage costs. The formula for calculating safety stock is as follows:

$$SS=Z×σd×LT $$

Where:

SS = Safety Stock

Z = Desired level of confidence / *forecasting*

$σd$ = Standard Deviation

LT = Lead time

Based on the results of interviews with the head of the warehouse section of PT XYZ, it was found that the average lead time for purchasing materials was 14 days. Referring to previous research, with the company's estimate choosing a standard deviation of 5% so that Z was obtained with a standard deviation table of 1,65. So that the performance achievement value (service level) is 95% = the Z value is 1,65.

**Table 6.** Safety stock of group A materials

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **No** | **Material No** | **Standard Deviation** | **Service Level** | **Lead Time (month)** | **Safety Stock (pcs)** |
| 1 | 65227708 | 1.476 | 1,65 | 0,47 | 1.144 |
| 2 | 61102557 | 1.174 | 1,65 | 0,47 | 910 |
| 3 | 61103292 | 900 | 1,65 | 0,47 | 698 |

From the data obtained through table 6, it can be concluded that the safety stock for material 65227708 is 1.144 pcs, while for material 61102557 the safety stock is 910 pcs, and the safety stock for material 61103292 is 698 pcs.

**Reorder Point Calculation**

Reorder point is a method to find out the optimum time for companies to reorder materials to suppliers. The reorder point calculation formula is as follows:

**ROP= (D x LT) + SS**

Where:

ROP = Reorder Point

D = Rata-Rata Demand

LT = Lead Time

SS= Safety Stock

The table below is the result of calculations with the reorder point method for group A materials

Table 7. ROP calculation results of group A materials

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Material No.** | **Average****Usage** | **Lead Time** | **Safety Stock** | **ROP** |
| 65227708 | 2.611 | 0,47  | 1.144 | 2.371 |
| 61102557 | 1.463 | 0,47  | 910 | 1.597 |
| 61103292 | 1.141 | 0,47  | 698 | 1.234 |

Based on the data obtained through table 7, it can be concluded that the reorder point for material 65227708 is 2.371 pcs, while for material 61102557 the order point is 1.597 pcs, and the reorder point for material 61103292 is 1.234 pcs.

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Graphic 1. Relation Graphic EOQ, SS, and ROP

Discussion

Material inventory control needs to be organized systematically and purposefully. A detailed analysis of material inventory planning and control must be carried out to ensure that overstock does not occur. In line with the opinion of (Indrajit & Djokopranoto, 2003) which is cited through research conducted by (Fauzi Afianti & Hamdi Azwir, 2017) explained that storage costs can generally reach 20-40% of the price of goods each year. Therefore, companies need to effectively calculate the quantity and time of ordering materials.

According to (Johns & Harding, 2011), in (Fitrotun Nisa, 2021) to ensure that inventory control is effective, the three basic questions to be answered are what to control, how much to order, and when to reorder. Alternatives to the problems that occur can use the ABC analysis method to classify materials, then materials that fall into category A or fast moving materials will be calculated using the economic order quantity (EOQ) method to determine the optimum amount in one order, and to find out when to reorder, can use the reorder point (ROP) method.

Based on the results of research and observations made, storage costs for ABC analysis group A materials caused by excess material can reach Rp17.241.400. In fact, based on the results of interviews the author conducted with the purchasing department, the company had to return the material to the supplier due to the material exceeding the predetermined safety stock, which if the company returns the material to the supplier, the cost of returning the material is charged to the company. This means that financial losses are one of the impacts caused by excess inventory.

Attempt that can be made by the company in overcoming the problem of overstocked materials are to control materials that are high in intensity of use, but without ignoring materials that are moderate or moderate use and slowmoving materials, but by considering the needs and supplies needed. In the end, if inventory control can be done properly, effectiveness and efficiency in material management can be achieved. In addition, the company can also reduce unnecessary expenses and optimize the production process.

1. **Conclusion**

Based on the results of the analysis, it can be concluded that the material in the form of components used for the daihatsu speed sensor production process consists of 14 types of materials, and after analyzing using the ABC analysis method, a class classification is obtained based on the intensity of its use, with details of group A with the highest amount of material usage consisting of 3 types of materials with a usage percentage of 76,94% and investment absorption of 47,0%. Group B with moderate material usage consists of 4 types of materials with a usage percentage of 21,12% and investment absorption of 39,2%. Group C with the lowest amount of material usage consists of 7 types of materials with a percentage of usage of 1,94% and investment absorption of 13,8%.

Investment absorption for material procurement in group A ABC analysis reaches 47% of the total purchase of materials for the daihatsu speed sensor production process, for this reason it is necessary to better control inventory using the EOQ and ROP methods.

The optimum ordering / EOQ values for materials 65227708, 61102557, and 61103292 are 4.399, 3.294, and 2.909, respectively, and the reorder point / ROP values for materials 65227708, 61102557, and 61103292 are 2.371, 1.597, and 1.234 respectively.

1. **Advice**

After analyzing inventory control, the author suggests that companies apply the Economic Order Quantity (EOQ) and Reorder Point (ROP) methods in considering material procurement and controlling security inventory. Applying this method, companies can increase efficiency in inventory control and avoid unnecessary expenses. Company can avoid the impact of losses caused by excess inventory or overstock of materials.

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