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# Analysis of Dump Truck Spare Parts Inventory Control Using the EOQ Lot Sizing Method at PT XYZ

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**ABSTRACT**

PT XYZ operates in hauling, mining, and road maintenance. At one of its operational sites, the company only orders spare parts when stock runs out, leading to frequent orders, increased operational costs, and disruptions due to stock shortages. Effective inventory management is essential to ensuring sufficient stock availability while minimizing costs. This study focuses on optimizing spare parts inventory for Dongfeng dump trucks using the Economic Order Quantity (EOQ) method. EOQ determines the optimal order quantity by balancing ordering and holding costs, aiming to reduce total inventory expenses. Demand forecasting is conducted to support inventory optimization. The findings indicate that implementing EOQ significantly lowers total inventory costs compared to the company's current approach. The EOQ model results in a total inventory cost reduction of 39.15%, saving IDR 10,514,286. The analysis highlights that ordering and holding costs play a crucial role in inventory expenses. These insights can serve as a reference for PT XYZ in developing more efficient inventory management policies to improve operational continuity and reduce the risk of downtime due to spare parts shortages.

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## 1. Introduction

The heavy equipment industry plays a crucial role in various sectors such as mining, construction, and plantations. Heavy equipment includes large machinery designed to facilitate tasks that are difficult or time-consuming if performed manually. In the mining sector, for example, heavy equipment is used for excavation and material transportation. In construction, equipment like cranes and excavators assist in infrastructure development, while in plantations, they accelerate land processing. The presence of heavy equipment enhances efficiency and effectiveness across these industries.

To maintain optimal performance, heavy equipment must always be in good condition. However, due to the demanding work environment, components known as spare parts are prone to damage. When damage occurs, operations halt until the necessary spare parts are replaced. Therefore, maintaining spare parts inventory is essential to minimizing downtime and ensuring smooth operations (Ramadhani & Nugroho, 2022).

Effective inventory management is critical in the heavy equipment industry, as companies must ensure the availability of spare parts for diverse machinery such as excavators, bulldozers, and motor graders. Poor inventory planning and control can lead to stock shortages, causing prolonged downtime, or excessive inventory, increasing storage costs and reducing operational efficiency (Fattah & Handayani, 2023).

One commonly used inventory management method is the Economic Order Quantity (EOQ) model, which determines the optimal order quantity to minimize total inventory costs, including ordering and holding costs (Heizer & Render, 2017 in Adelia & Mandala, 2021). Another method is lot sizing, which optimizes order quantity by considering ordering and storage costs. Lot sizing is classified into two types: static lot sizing, which applies when demand is stable, and dynamic lot sizing, which is used for fluctuating demand. Proper lot sizing can help companies maintain an optimal spare parts inventory while minimizing costs.

PT XYZ operates as a mining contractor and hauling company. Currently, the company orders spare parts only when stock is depleted. This policy often leads to stock shortages, disrupting operations. Additionally, high demand from its business partners increases order frequency, leading to higher ordering costs, including supplier communication and administrative expenses. Poor inventory management contributes to operational inefficiencies.

This study aims to analyze spare parts inventory management using the lot sizing method, particularly EOQ, to determine optimal order frequency, minimize stockout risks, and improve operational efficiency. The findings are expected to provide recommendations for PT XYZ and similar companies on optimizing inventory costs and enhancing overall productivity and business sustainability.

## 2. Literature Review

Inventory refers to a company's assets in the form of goods or equipment stored for future use or sale to support operational activities. There are three types of inventories used in production activities: raw materials, supplementary and auxiliary materials, work-in-progress (WIP), and finished goods. Failure to determine the appropriate inventory levels can cause various issues, such as disruptions in production activities and the inability to meet customer demand. On the other hand, excessive inventory can result in prolonged storage, increasing holding costs or leading to product expiration (Rizkya & Fernando, 2021).

Lot sizing is a method used to determine the quantity of goods ordered and delivered. Lot sizing helps establish the order quantity, which depends directly on the supplier. Sipper and Bulfin (1998), as cited in Slamet and Dianti (2022), categorize lot sizing into two types based on demand patterns: static and dynamic. Static demand allows for order quantity determination using methods such as Fixed Order Quantity (FOQ), *Economic Order Quantity* (EOQ), *Economic Production Quantity* (EPQ), dan *Resource Constraints*. Meanwhile, dynamic demand is further divided into three groups based on solution approaches: *simple rules*, *heuristics*, and *optimization*. (Isnantoro & Hariastuti, 2018).

According to Indrajit and Djokopranoto (2003), the Economic Order Quantity (EOQ) method is used to determine the most economical order quantity and minimize inventory costs incurred by a company. This method ensures that customer demand is consistently met while helping companies avoid excessive costs. The EOQ method aligns with the fundamental reasons for maintaining inventory, which can be explained by reducing uncertainty in customer demand, such as fluctuations that may lead to unmet demand and avoiding procurement issues such as delayed deliveries, stock unavailability, damaged goods, and other disruptions. Preventing price increases, allowing the company to maintain operations and profitability.

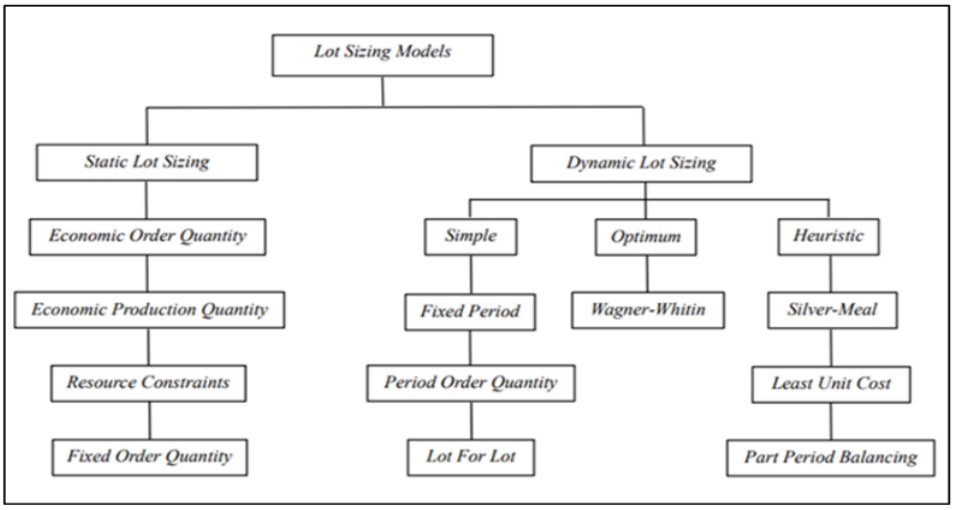


Figure 1. Lot Sizing Models Classification

Inventory calculations using the EOQ model can be performed using the following equation.

$$EOQ = \sqrt{\frac{2DS}{H}}$$

Reorder point is the inventory level that triggers a replenishment order from suppliers, ensuring that new stock arrives precisely when existing inventory is depleted or aligns with the safety stock level. The accuracy of reorder timing must be calculated. If there is no lead time, the reorder point becomes zero, causing stock to be replenished immediately. However, lead time is never zero, meaning there is always a time gap between the order placement date and the date the raw materials arrive at the company's warehouse (Hudori, 2018). According to Hazimah et al. (2020), the reorder point (ROP) refers to the inventory level at which a reorder is triggered. The ROP value can be determined using the following equation.

$$ROP = (D \times L) + SS$$

## 3. Methodology

The research was conducted at PT XYZ, focusing on inventory management for heavy equipment spare parts. This study employs a quantitative research approach, utilizing historical data on demand and ordering, interviews with company representatives, and direct observations. Data collection in this study includes gathering past records of spare parts demand and procurement, conducting structured interviews with relevant company personnel, and observing inventory management processes within the organization.

The data processing method involves calculating Economic Order Quantity (EOQ) and analyzing order frequency to determine cost efficiency in inventory management. After obtaining the necessary calculations, the results are compared with the company's existing ordering policy to evaluate the effectiveness of the EOQ method. This analysis provides insights into how optimizing order quantities can reduce total inventory costs while ensuring sufficient stock availability.

## 4. Results and Discussion

The calculation results using the Economic Order Quantity (EOQ) method determine the optimal order quantity for each spare part item as follows: 88 units per order for rubber bushing, 53 units per order for locking gasket, 177 units per order for lining brake, 12 units per order for shock absorber, and

35 units per order for center bearing. The order frequency for each spare part item over one year was calculated, resulting in a total of 70 orders annually. The breakdown is as follows: 9 orders per year for rubber bushing, 5 orders per year for locking gasket, 24 orders per year for lining brake, 12 orders per year for shock absorber, and 20 orders per year for center bearing. In total, the annual order quantity amounts to 346 units, with a total of 70 ordering cycles.

Table 1. EOQ Results

| Item Name | Order Quantity | | Order Frequency | |
|---|---|---|---|---|
| | Qty | Unit | F | Interval |
| Rubber Bushing | 88 | Pcs | 9 | times/year |
| Locking Gasket | 35 | Pcs | 5 | times/year |
| Lining Brake | 177 | Pcs | 24 | times/year |
| Shock Absorber | 12 | Pcs | 12 | times/year |
| Center Bearing | 35 | Pcs | 20 | times/year |

Table 2. ROP Results

| Item | ROP |
|---|---|
| Rubber Bushing | 16 Pcs |
| Locking Gasket | 4 Pcs |
| Lining Brake | 88 Pcs |
| Shock Absorber | 3 Pcs |
| Center Bearing | 15 Pcs |

Based on the inventory calculation using the EOQ method, the total inventory cost showed a reduction of IDR 10,514,286, achieving an efficiency of 39.15%. This efficiency is attributed to the lower order frequency under the EOQ method compared to the company's existing ordering policy.

Table 3. TIC Results

| Methods | Ordering Cost | | Holding Cost | | TIC | |
|---|---|---|---|---|---|---|
| EOQ | Rp | 8.401.390 | Rp | 7.941.810 | Rp | 16.343.200/year |
| Company’s Approach | Rp | 11.401.886 | Rp | 15.455.600 | Rp | 26.857.486/year |

## 5. Conclusion

Based upon the results, this research concludes that implementing the Economic Order Quantity (EOQ) method for spare parts inventory management at PT XYZ leads to more efficient ordering and cost savings. The optimal order quantities are 88 units for rubber bushing, 53 units for locking gasket, 177 units for lining brake, 12 units for shock absorber, and 35 units for center bearing, with minimal safety stock required. The company experiences no lead time deviations as spare parts always arrive on time. The ordering frequency is significantly reduced compared to the company's previous policy of ordering only when stock runs out. By applying EOQ, the total inventory cost is reduced to Rp 16,343,200, achieving a 39.15% cost reduction compared to the company's current approach, resulting in annual savings of Rp 10,514,286.

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