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Article

AISI 4130 Material Inventory Control Using Safety Stock and Economic Order Quantity Methods at XYZCompany

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Abstract

Inventory management is important for minimizing unnecessary costs associated with excess or insufficient inventory. XYZ Company experienced a shortage of AISI 4130 material when a new order required additional material beyond the available stock, resulting in production delays. This study aims to analyze the inventory control of AISI 4130 material using the Safety Stock and Economic Order Quantity (EOQ) methods by comparing the company's existing inventory policy with the EOQ approach. The results showed an optimal order quantity of 1,573 pieces, a total inventory cost of IDR 3,724,257, a safety stock of 267 pieces, a reorder point of 399 pieces, and a purchase frequency of three times. The application of the EOQ method is recommended as an inventory control strategy for AISI 4130 material to improve cost efficiency and ensure production continuity. Based on the analysis, the company is also recommended to review its existing inventory policy to optimize material availability and inventory costs.

Keywords: Inventory Control, Safety Stock, Economic Order Quantity, Saving Budget.

1. Introduction

Inventory management is crucial for companies to minimize unnecessary costs associated with excess or shortages of inventory [1]. The company plans raw material inventory control to minimize costs and maximize profits by its own goals so that companies can purchase and produce products in economical quantities. Poor raw material inventory management will potentially result in errors in calculating raw material requirements [2]. The importance of raw material inventory management in supporting the smooth production process is a crucial aspect in the company [3]. Some conditions such as imperfect quality and product growth are variants of the EOQ. In addition, some requirements, such as reducing CO2 emissions, can change the formula. Furthermore, disruptions in the supply chain, such as COVID-19, can affect the formula [4].

The success of a company is measured by its ability to provide goods and services at the right time and place [5]. In addition, one of the factors of company progress is also supported by inventory management which functions to control the company's inventory so that it does not hoard a lot of products or run out of products [6]. Technological developments require fast, precise, and accurate company inventory management to support its performance. In fact, some companies experience difficulties in determining their production stock of goods, thus hampering the fulfillment of consumer needs in situations of high

market demand [7]. Inventory control and management are important tasks for every organization, where they need to determine order quantities and ordering periods to maintain sufficient inventory to meet demand [8].

Dariusz Milewski et al [9], with the title "Regression analysis as an alternative method of determining the Economic Order Quantity and Reorder Point" The purpose of this paper is to show how the problem of determining the Economic Order Quantity (EOQ) and the Reorder Point can be solved using a regression model. The method proposed by the authors of this paper is an alternative to the method using the mathematical EOQ formula and also the simulation method. The authors' goal is to find a solution that allows, on the one hand, to obtain results as close as possible to the real parameters and on the other hand, can be useful for decision makers in the company. Using a specially designed model, simulations have been carried out for various parameters (value, weight, commodity demand, logistics costs) which firstly prove the importance of optimizing deliveries to the warehouse. Secondly, based on the results of these simulations, regression models have been developed and used to find the delivery quantity and the reorder point. Both regression models are statistically significant, slightly better values are obtained by the model created for the reorder point.

Uma Raju [8], Titled "A review of Economic Order Quantity modeling, their extensions and applicability" The original Economic Order Quantity (EOQ) model was developed by Ford W. Harris to address this issue and determine the optimal order quantity that helps optimize the costs incurred by the organization. Although this model provides excellent estimates on these parameters, there are many inherent limitations to the model that are based on unrealistic expectations. Over the more than a century since its original publication, many researchers have extended this model to overcome the limitations and align it with real-world scenarios. In this review paper, we intend to provide a representation of the original EOQ model, its limitations, and the various extensions made to the model to address these limitations.

R. Susanto [10], with the title "Raw Material Inventory Control Analysis with Economic Order Quantity Method," aimed to minimize the total cost of raw material inventory according to production needs. The Economic Order Quantity (EOQ) method was used to determine the optimal inventory level and ordering quantity based on ordering and storage costs. The results showed that the EOQ method could provide a more economical inventory level and total inventory cost, thereby reducing unnecessary storage costs.

In production activities at XYZ Company, material inventory management is an important factor in maintaining the stability and efficiency of the production process [11]. One of the materials frequently used for production needs is AISI 4130, a low alloy steel containing molybdenum and chromium as reinforcing materials. Its carbon content is 0.30% and with this relatively low carbon content, this alloy is very good from the perspective of fusion welding capabilities. This alloy can be hardened by heat treatment [12], used for the construction of machine components. The availability of materials on time and in the right amount affects cost efficiency and production continuity. If the inventory is excessive, the company has the risk of bearing high storage costs, while if it is too little, it can cause production delays and losses [13]. In order to anticipate uncertainty in demand and delivery times, I is used as a safety stock [14].

This case study obtained information that there was a new order that required AISI 4130 material, However, the availability of the material in the logistics department was insufficient to meet production needs, so that the XYZ company had to reorder. This condition caused the production process of related goods to be temporarily delayed, until the ordered material arrived at the XYZ Company. Based on this condition, through field work practice activities, students contributed to one of the three pillars of higher education, namely Community Service in Industry by conducting a case study analyzing the impact of material shortages to provide technical recommendations as a basis for improvement in maintaining the stability of the production process. In overcoming this problem, the Safety Stock and Economic Order Quantity (EOQ) method approaches were used as the basis for the projection design in determining the optimal order quantity and the required safety stock [15]. Through this study, which is a derivative of manufacturing process science more specifically related to the Production Management

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Framework in the aspect of inventory management, it is hoped that the company can realize more efficient material inventory management and prevent material shortages in the next production period.

The purpose of this case study is to analyze AISI 4130 material inventory control using the Safety Stock and Economic Order Quantity (EOQ) approaches for XYZ Company. The results of the case study activities can be a technical recommendation for the Company to compare the currently implemented policies with the Projection Design for controlling the optimal number of material orders using the Safety Stock and Economic Order Quantity (EOQ) approaches.

2. Material and Method

2.1. Compiling a Literature Study

Gathering references from books, standards, and previous research journals related to the activity topic. This activity aims to strengthen the basis of the activity by referring to available theories, understanding and establishing the methods used for this activity's implementation. This method has been used for a long time, but not all companies have established optimization policies using this approach. The journal articles used as references refer to journal articles published in international journals or proceedings with a 10-year publication observation period.

2.2. Making the Identification of Procurement and Use of Existing Inventory

Identification was carried out through direct observation of the logistics department, whose primary task and function is managing production material inventory at XYZ Company. The identification data investigated consisted of existing monthly routine records, with data collected over three years (one current year and two previous years). The following records are shown in Figure 1.

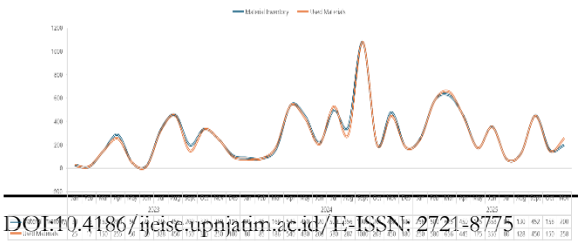

Fig. 1. 3-years Stock Taking of Material Inventory and Material Usage AISI 4130

Based on the three-year baseline stocktaking, the data was then narrowed down to the current year, or the period from January to November 2025, as per the case study. The data was supplemented with monthly storage costs. The details of the AISI 4130 material inventory data for the current year are shown in Table 1:

Table 1. AISI 4130 Material Purchase Data

Month	Material Inventory	Used Materials	Material Remaining After Use	Shipping costs
January	256	250	6	800,000
February	580	580	6	1,300,000
March	625	656	0	1,500,000
April	450	445	0	1,100,000
May	175	175	0	500,000
June	358	355	0	950,000
July	80	80	0	250,000
August	130	128	0	500,000
September	452	450	0	1,100,000
October	158	150	0	500,000
November	200	258	0	800,000
Total 11 Months	**3464**	**3527**	**-**	**9,300,000.**
Average	**314.9**	**320.6**	**-**	**845,454.**

Source: Company Data

Inventory shortages are interpreted as stock depletion, not negative physical inventory values. Therefore, the remaining inventory values are adjusted to reflect actual warehouse management conditions. The data presentation is intended to reflect realistic industrial inventory management practices where stock shortages lead to stock depletion or delayed procurement.

For your information, the inventory held is in the form of physical bars with a diameter between Ø 20mm - 50mm and a length between 1-6 meters. XYZ Company has a subscription to the supplier of the goods in question who regularly provides AISI 4130 material. Electricity consumption for 1 month for the logistics department is IDR 746,000. In addition to electricity expenses, the holding cost estimation also considers warehouse operational activities and material handling requirements associated with heavy steel bar inventory so the total cost for 11 months is IDR 8,206,000.

Due to the physical dimensions and weight characteristics of AISI 4130 steel bars, inventory storage capacity and material handling capability are important considerations in determining the

practical implementation of EOQ recommendations.

2.3. Making Inventory Projections Using the EOQ Method

The process of obtaining the required data depends on the type of research. Data is obtained through observation, interviews, company documents, or other instruments. This stage ensures that the collected data is valid, accurate, and meets the requirements for analysis. The following formula calculates the average purchase amount.

$$Average\ purchase\ amount = \frac{total\ purchase}{purchase\ frequency} \quad (1)$$

Equation (1) describes the relationship between the total number of purchases and the frequency of purchases.

2.3.1. Procurement and Storage Costs

In order to meet the need for AISI 4130 material, XYZ Company needs to incur material inventory procurement costs, including procurement costs and inventory storage costs. These costs need to be carefully controlled so that the company can determine the amount of material procured more efficiently and economically. The total cost of procuring AISI 4130 material inventory is greatly influenced by the frequency of procurement and the amount of material procured per transaction. The more frequently a company procures, the higher the procurement costs, while the greater the amount of material stored in the warehouse, the higher the storage costs that the company must bear. The following is the ratio approach that needs to be applied:

$$Procurement\ Costs = \frac{Total\ Procurement\ Cost}{Procurement\ Frequency} \quad (2)$$

Storage costs are costs incurred related to inventory storage management over a certain period of time. Storage costs are costs incurred related to inventory storage management over a certain period of time. In this study, holding costs include electricity consumption, warehouse maintenance, material handling activities, inventory supervision, and material preservation costs. These costs are considered to better represent actual industrial storage conditions for AISI 4130 steel materials, for which the cost of electricity consumption arises to finance the electricity used for storing AISI 4130 material in the storage space available in the logistics section. These costs have been determined based on company policy, the electricity consumption for the logistics room for one month as stated in the identification stage is IDR 746,000. Thus, the cost of electricity consumption for 11 months is IDR 8,206,000. Meanwhile, storage costs are determined by the following calculation:

$$Storage\ Costs = \frac{Total\ storage\ costs}{Amount\ needed} \quad (3)$$

Based on Table 1, it is known that the number of AISI 4130 material purchases in 2025 in units (D) is 3464 pieces. The number of items per order (Q) is 314.90 pieces. The ordering cost per transaction (S) is determined based on the allocation of procurement administration costs incurred for each order, including communication costs, document processing, supplier coordination, and material handling preparation. Based on the company's goods/services procurement activities, the ordering cost management used in this activity is IDR 500,000 per order transaction, while the storage cost per unit per year (H) is IDR 2,368. The storage cost parameter (H) is estimated by considering the overall operational costs of warehouse management, including the allocation of electricity consumption needs, inventory maintenance, and material handling activities. Therefore, the total inventory cost (TC) can be calculated using the following formula approach:

$$TC = \frac{D}{Q}S + \frac{Q}{2}H \quad (4)$$

The ordering cost variable is recalculated based on actual procurement transaction activity to conform to standard EOQ methodology.

2.3.2. Lead Time, Safety Stock and Reorder Point

XYZ Company obtains AISI 4130 material with a 7-day supply and delivery time after procurement, meaning a 7-. Meanwhile, the safety stock inventory used by XYZ Company is 30

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pieces. Therefore, the company must pay for any excess or shortage of AISI 4130 material at the reorder point held when the company's inventory is the same as the safety stock with a total of 30 pieces. The policy in effect in the company is to implement Lead Time = 7 days, Safety Stock = 30 pieces.

2.3.3. Maximum AISI 4130 Material Inventory Procurement

The maximum quantity of material inventory is related to the average procurement transaction value, with the salvage value set by Company policy. This is implemented to limit the number of procurement transactions carried out. The following calculation approach is applied:

Maximum Inventory = Average Purchase + Company Rescue (5)

2.4. Making an Inventory Projection Analysis Using the EOQ Method

The data analysis stage, based on the method used, is followed by applying several calculations. These results then form the basis for XYZ Company's considerations. The consideration process naturally involves interpreting the calculation results, using existing theoretical studies to explain the findings. Considerations are conducted critically and carefully to identify the root cause of the problem and assess the effectiveness of the process or condition being analyzed.

2.4.1. Quantity Ordering

Based on the data in Table 1 related to the procurement of AISI 4130 material at XYZ Company in 2025, information was obtained on the amount of material requirements and procurement activities during the period from January to November 2025. In the inventory control review, there are several main parameters applied to determine the optimal procurement policy. These parameters include the material storage cost per unit per year of IDR 2,368, the total material requirement of 3,464 units, and the ordering cost for each procurement transaction of IDR 500,000. These three variables are complete variables to be followed up in calculating the most economical procurement amount or Economic Order Quantity (EOQ), so as to minimize the total cost of inventory management by determining the optimal procurement amount in each procurement period. With this EOQ calculation, the company is expected to be able to reduce storage and procurement costs, while ensuring that material availability remains met according to production needs.

Although the EOQ calculation resulted in an optimal order quantity of 1573 pieces, this value represents a theoretical economic quantity. In actual industrial implementation, warehouse floor capacity, structural load limits, and heavy material handling equipment availability must also be considered before determining the final procurement quantity.

$$Q = \sqrt{\frac{2DS}{H}} \quad (6)$$

2.4.2. Determining Total Inventory Cost

The storage cost of AISI 4130 material per unit (H) is IDR 2,368 while the total requirement for AISI 4130 material (D) reaches 3,464 units per year. The ordering cost for each procurement transaction (S) is determined at IDR 500,000 based on administrative and procurement preparation activities. Based on calculations using the Economic Order Quantity (EOQ) method, the optimal order quantity (Q) units is obtained. Thus, the next step is to calculate the total inventory cost (Total Cost/TC) to determine the efficiency of the ordering policy.

$$\text{total inventory cost} = \frac{Total\ Cost}{TC} \quad (7)$$

2.4.3. Determination of Rescue Supplies

The implementation of safety stock aims to maintain smooth operations at XYZ Company so that the production process is not hampered due to shortages or empty supplies of AISI 4130 materials. Determination of the safety stock value is carried out using a statistical approach method, namely by comparing the average material requirements to actual usage and then calculating the level of deviation. The formula and standard deviation calculation form as the basis for determining safety stock are as follows:

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Table 2. Standard Deviation Calculation

No.	Month	x	$\bar{x}$	$(x-\bar{x})$	$(x-\bar{x})^2$
1	January	256	314.90	−58,909	3,471.98
2	February	580	314.90	265,091	70,273.17
3	March	625	314.90	310,031	96,147.62
4	April	450	314.90	135,091	18,253.60
5	May	175	314.90	-139,909	19,576.42
6	June	358	314.90	43,091	1,856.84
7	July	80	314.90	-234,909	55,179.40
8	August	130	314.90	-184,909	34,184.25
9	September	452	314.90	137,091	18,787.95
10	October	158	314.90	-156,909	24,645.03
11	November	200	314.90	-114,9096	13,205.77
	Quantity	**3464**			**355,581.03**

$$SD = \sqrt{\frac{\sum(x-\bar{x})^2}{n}} \quad (8)$$

$$\text{Safety stock} = 1.65 \times SD \quad (9)$$

2.4.4. Reorder Point (ROP)

The reorder point is determined based on the calculation of average material usage. The number of working days at XYZ Company over 11 months is 238, with a total usage of 3,464 units of AISI 4130 material. Therefore, the average daily material usage can be calculated as follows:

$$\text{Average usage per day} = \frac{One\ period\ usage}{Number\ of\ working\ days} \quad (10)$$

The reorder point calculation is based on the average daily usage of AISI 4130 material, the company's 7-day lead time, and the safety stock value used as the basis for determining the reorder point.

$$ROP = (Average\ usage \times 7) + safety\ stock \quad (11)$$

2.4.5. Purchase Frequency

Procurement frequency is the number of procurements made in one period based on the results of the Economic Order Quantity (EOQ) calculation. In this case study, it is known that the need for AISI 4130 material in one period (D) is 3,464 units, while the optimal order quantity uses the EOQ (Q) unit method. Thus, the purchasing frequency can be determined as follows:

$$F = (D)/Q \quad (12)$$

The next step is to compare Inventory Management according to XYZ Company's policy with the results of the Economic Order Quantity (EOQ) analysis. The following is a comparison form prepared to record the calculation results.

Table 3. Comparison of Company Policies with the Implementation of EOQ

No	Description	Company Policy	EOQ	Difference
1	Optimal Purchase Quantity	315	1573	1258
2	Total Inventory Cost	9,672,848	3,724,257	5,948,591
3	Safety Stock	30	297	267
4	Reorder Point	-	399	-
5	Purchase Frequency	11	3	8

3. Results and Discussion

3.1. Literature Study Results

Literature studies were conducted using reference books, relevant standards, and journal articles discussing Economic Order Quantity (EOQ) and inventory control. The references were selected from publications in international journals and proceedings, with a publication period of up to 10 years. These references were used as theoretical foundations to support the selection and implementation of the methods used in this study.

3.2. Results of the Preparation of Identification of Procurement and Use of Existing Inventory

January–November 2025 Total 11 Months Material Inventory with a total of 3464 pieces with an average of 314.9 pieces, Used Materials with a total of 3527 pieces and an average of 320.6 pieces Material Remaining After Use 0 Shipping costs total IDR 9,300,000. with an average per month of IDR 845,454. the physical form of AISI 4130 material is a bar with Ø 20-50mm and a length of between 1-6 meters. XYZ company has a subscription to a supplier of AISI 4130 material goods. Electricity consumption for 1 month is IDR 746,000 and the total cost for 11 months is IDR 8,206,000.

3.3. Results of Inventory Projection Preparation Using the Economic Order Quantity (EOQ) Method

The results of the average purchase calculation made by XYZ Company are as follows:

The EOQ result represents a theoretical calculation under standard EOQ assumptions. In requirements.
the revised manuscript, the Safety Stock value has been recalculated based on the standard deviation result of 179.793 Piece. The corrected calculation produces a Safety Stock value of approximately 297 units, and the Reorder Point calculation has been adjusted accordingly.

Considering the physical characteristics of AISI 4130 steel bars, inventory holding costs are influenced not only by electricity consumption but also by warehouse operational activities, storage space utilization, and heavy material handling

Table 4. EOQ Implementation Scenario

Number Formula	Description	Units	Value
(1)	Average purchase amount	piece	314.90
(2)	Procurement costs	IDR	500,000
(3)	Storage costs	Piece	2.368
(4)	Total inventory cost (TC)	IDR	9,672,848
(5)	Lead Time	Day/piece	7/30
(6)	Maximum inventory procurement	Piece	345
(7)	Procurement Amount (Q)	Piece	1573
(8)	otal overall inventory cost	IDR	3,724,257
(9)	Safety Stock (SD)	Piece	179,793
(10)	Safety Stock	Piece	297
(11)	Average usage per day	Piece	15
(12)	Reorder Point (ROP)	Piece	399
(13)	Purchase Frequency (F)	amount	3

4. Conclusions

The total inventory cost based on the EOQ method is IDR 3,724,257 which shows significant cost savings compared to the company's current policy, the EOQ calculation results also produce a safety stock value of 297 units, which is more representative of fluctuations in demand and lead time. The optimal reorder point based on the EOQ method is when inventory reaches 399 units, The comparison shows that the EOQ method is more efficient than the company's current policy, because it is able to: 1) Reduce total inventory costs; 2) Reduce the frequency of orders; 3) Determine more accurate safety stock and reorder points and 4) Minimize the risk of stock outs and overstocks. Thus, the application of The EOQ method is recommended as an inventory management strategy. However, the implementation of the EOQ approach must be tailored to the company's actual warehouse capacity and operational constraints for controlling AISI 4130 material inventory in the company to improve cost efficiency and operational continuity. Suggestions from the results of the analysis and evaluation of AISI 4130 material inventory control that have been carried out, XYZ Company is advised to review the inventory policy currently implemented.

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