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Evaluation of Brushed Stainless Steel 430 Inventory Control Using The EOQ Model at PT. X

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Abstract: *Raw material inventory control is essential for maintaining production continuity and improving cost efficiency in manufacturing companies. This study analyzes the optimization of stainless steel 430 brushed inventory at PT X using the Economic Order Quantity (EOQ) method. A descriptive quantitative approach with a case study design was employed. The analysis used annual demand, ordering cost, holding cost, lead time, and the company's current ordering policy. The annual demand was 12,000 units, with an ordering cost of IDR 350,000 per order and a holding cost of IDR 25,000 per unit per year. Under the company's existing policy of ordering 1,000 units per order, the total inventory cost reached IDR 16,700,000 annually. The EOQ analysis determined an optimal order quantity of 580 units, reducing the total inventory cost to IDR 14,491,379 and generating annual cost savings of IDR 2,208,621 (13.23%). The reorder point was calculated at 280 units based on an average daily demand of 40 units and a lead time of seven days. These findings indicate that the EOQ model provides a more efficient basis for inventory ordering decisions at PT X under deterministic assumptions, including constant demand, fixed lead time, and stable ordering and holding costs. However, the results are limited to deterministic inventory conditions and may not be directly applicable to environments with demand or lead-time uncertainty.*

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INTRODUCTION

Raw material inventory control is a fundamental component of manufacturing operations because it directly influences production continuity, cost efficiency, and a company's ability to meet customer demand in a timely manner. Inventory serves not only as a physical stock of materials but also as a strategic asset affecting cash flow, profitability, and operational competitiveness. Poor inventory management often results in excessive holding costs, stock shortages, production interruptions, delayed deliveries, and inefficient utilization of working capital. Conversely, effective inventory control enables firms to balance material availability with inventory-related costs, thereby supporting sustainable operational performance. Consequently, manufacturing companies require inventory policies based on quantitative analysis rather than relying solely on historical purchasing practices or managerial intuition (Adam & Imaroh, 2019).

Among industrial raw materials, Stainless Steel 430 Brushed plays a strategic role because its physical properties directly influence product appearance, corrosion resistance, dimensional consistency, and manufacturing quality. Unlike many conventional raw materials, Stainless Steel 430 Brushed is characterized by relatively high procurement value, strict quality specifications, and limited supplier flexibility, making procurement decisions more sensitive to inventory inaccuracies. Material shortages may interrupt continuous production and reduce delivery reliability, whereas excessive inventory increases holding costs and ties up significant working capital. Therefore, inventory

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decisions for this material require systematic evaluation to ensure production continuity while maintaining cost efficiency. These characteristics justify the need for empirical assessment of inventory policies rather than assuming that general inventory management practices are universally applicable.

The Economic Order Quantity (EOQ) model has long been recognized as one of the most widely used quantitative approaches for inventory optimization because it identifies the order quantity that minimizes the combined costs of ordering and inventory holding. The model balances two opposing cost components: larger order quantities reduce ordering frequency but increase carrying costs, whereas smaller order quantities decrease holding costs but increase ordering frequency. By identifying the equilibrium between these costs, EOQ provides an objective basis for determining economically optimal order quantities while maintaining adequate inventory availability. Owing to its simplicity and practicality, EOQ has been extensively implemented in manufacturing, retail, and service industries as a decision-support tool for inventory planning (Riza, Purba, & Mukhlisin, 2018; Ruslan, 2018).

Previous studies consistently demonstrate that EOQ contributes to inventory cost reduction and procurement efficiency across various industrial sectors (Amrillah, Zahroh, & Endang NP, 2016; Andiana & Pawitan, 2018; Darmadi, 2020; Alicia et al., 2024). More recent studies have extended EOQ applications by integrating forecasting techniques, ABC analysis, simulation models, information systems, and comparisons with alternative inventory approaches such as Period Order Quantity (POQ), Min–Max, and Just-in-Time (JIT) to improve inventory performance under different operational settings (Britania et al., 2024; Irfani et al., 2024; Maulana et al., 2024; Octavieka & Pratama, 2024; Harashta & Tranggono, 2025; Suryaningrum & Windah, 2025). These studies generally conclude that EOQ effectively reduces total inventory costs; however, they primarily emphasize computational optimization and broad industrial applications rather than evaluating whether the deterministic assumptions underlying EOQ remain appropriate for specific high-value industrial materials with unique operational characteristics.

Despite the extensive application of EOQ, several research gaps remain. Most previous studies report inventory cost reductions after implementing EOQ but provide limited discussion regarding the contextual applicability and limitations of the deterministic EOQ model for materials possessing distinct procurement characteristics, quality requirements, and production criticality. Inventory policies cannot be assumed to be universally transferable because differences in material value, consumption patterns, procurement lead times, storage requirements, and operational dependence may substantially influence inventory decisions. Consequently, empirical evidence validating the applicability of deterministic EOQ assumptions for high-value stainless steel materials remains limited, particularly within manufacturing environments where uninterrupted production is essential.

Previous EOQ studies have mainly focused on demonstrating inventory cost optimization across various industries and material categories. In contrast, the present study emphasizes empirical validation rather than methodological innovation by evaluating whether the deterministic EOQ model is appropriate for managing Stainless Steel 430 Brushed inventory under actual manufacturing conditions at PT X. Instead of proposing a new mathematical model, this study examines the practical relevance, operational feasibility, and cost-saving potential of EOQ using actual demand, ordering cost, holding cost, and lead-time data. Accordingly, this research extends previous EOQ studies by providing

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contextual evidence regarding the applicability and limitations of deterministic EOQ for a strategically important industrial raw material.

Based on the identified research gap, this study addresses three research questions: (1) What is the optimal order quantity for Stainless Steel 430 Brushed at PT X according to the EOQ model? (2) How does the total inventory cost under the company's existing ordering policy compare with the EOQ-based policy? and (3) What reorder point should be established to maintain uninterrupted production? Accordingly, this study aims to determine the optimal order quantity, evaluate the efficiency of the existing procurement policy, and develop inventory recommendations based on quantitative cost analysis.

The contribution of this study is both practical and conceptual. Practically, the findings provide PT X with evidence-based recommendations for establishing more economical procurement policies while maintaining material availability for continuous production. Conceptually, this study contributes to inventory management literature by expanding empirical evidence regarding the applicability of deterministic EOQ models for high-value industrial raw materials. Furthermore, the study demonstrates that although EOQ remains an effective decision-support tool under deterministic conditions, its implementation should be interpreted within the operational characteristics and assumptions of the specific inventory environment rather than generalized across all manufacturing contexts.

RESEARCH METHOD

Type and Research Design

This study employed a descriptive quantitative approach with a case study design. A quantitative approach was selected because the study analyzed numerical data related to inventory management, including annual demand, ordering costs, holding costs, raw material requirements, lead time, and ordering frequency. The descriptive design was used to describe the existing inventory control practices for Stainless Steel 430 Brushed at PT X and to compare the company's current inventory policy with the results obtained using the Economic Order Quantity (EOQ) model. A case study design was adopted because the research focused on a specific raw material within a single manufacturing company, allowing an in-depth evaluation of inventory management practices under actual operational conditions.

This study did not investigate causal relationships among variables but focused on evaluating the efficiency of the company's inventory policy through quantitative inventory analysis. The primary objective was to determine the economic order quantity, optimal ordering frequency, total inventory cost, safety stock, and reorder point. These analytical results were then compared with the company's existing inventory policy to assess whether EOQ could provide a more efficient inventory control strategy.

Research Location, Time, and Object

The study was conducted at PT X, a manufacturing company that utilizes Stainless Steel 430 Brushed as one of its principal raw materials. This material was selected because of its strategic importance in maintaining production continuity and its significant contribution to procurement and inventory costs. The research covered one annual operating period based on the availability of

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company inventory records. Annual data were used to ensure comprehensive calculation of annual demand, ordering frequency, inventory costs, and optimal ordering quantities.

The study population consisted of all raw material inventory records maintained by PT X. Purposive sampling was employed to select Stainless Steel 430 Brushed as the research object because it is repeatedly consumed during production, represents a relatively high inventory value, and requires an efficient ordering policy to minimize inventory-related costs.

Data Collection Techniques

Research data were collected through documentation, document observation, and structured interviews. Documentation involved reviewing purchase records, warehouse inventory reports, raw material consumption records, ordering costs, holding costs, procurement lead time, and the inventory policies implemented by the company. Document observation was conducted to verify the consistency between inventory records and procurement documents. Structured interviews were carried out with personnel from the purchasing and warehouse departments to obtain detailed information regarding procurement procedures, supplier lead times, ordering practices, and inventory management policies.

The research instrument consisted of a structured data recording sheet containing annual demand, order quantity, ordering frequency, ordering cost per order, holding cost per unit per year, average daily demand, procurement lead time, and existing inventory policies. Secondary data obtained from company documents were supported by information collected through interviews. All data were verified to ensure consistency in measurement units, recording periods, and completeness prior to analysis.

Data Analysis Techniques

The analysis was conducted in several stages. The first stage identified the inventory policy currently implemented by PT X, including order quantity, ordering frequency, and total inventory cost under the existing procurement system. The EOQ method was selected because it provides a well-established and objective analytical framework for determining the order quantity that minimizes total inventory cost under deterministic operating conditions using readily available company data.
The second stage calculated the Economic Order Quantity (EOQ) using the following equation:

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

where D represents annual demand, S denotes the ordering cost per order, and H indicates the holding cost per unit per year. The optimal ordering frequency was subsequently determined by dividing annual demand by the EOQ value.
The third stage calculated the Total Inventory Cost (TIC) using the following equation:

$$TIC = (\frac{D}{Q} \times S) + (\frac{Q}{2} \times H)$$

where TIC is the total inventory cost and Q is the order quantity. The calculation was performed for both the company's current ordering policy and the EOQ-based policy. The resulting costs were then compared to determine potential cost savings and inventory efficiency.

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The fourth stage determined safety stock and the reorder point (ROP). Safety stock was maintained as buffer inventory to reduce the risk of production interruption, while the reorder point identified the inventory level at which a new purchase order should be placed. The reorder point was calculated using average daily demand during lead time together with safety stock. Finally, the analytical results were presented in comparative tables to facilitate systematic evaluation of the company's existing inventory policy relative to the EOQ model. The interpretation of the findings considered the deterministic assumptions underlying EOQ and evaluated their compatibility with PT X's operational characteristics.

EOQ Assumptions and Research Limitations

The Economic Order Quantity (EOQ) model was selected because it is a widely accepted deterministic inventory model capable of identifying the optimal order quantity that minimizes the combined ordering and holding costs. The model is appropriate for this study because the objective is to evaluate the efficiency of PT X's existing inventory policy using actual operational data. Moreover, all required variables—including annual demand, ordering cost, holding cost, and procurement lead time—were available from the company's inventory records.

Alternative inventory models, such as Period Order Quantity (POQ), Material Requirements Planning (MRP), Just-in-Time (JIT), and stochastic inventory models, were not adopted because they require different operational conditions or additional data beyond the scope of this study. POQ is generally suitable for time-phased replenishment systems, MRP requires integrated production scheduling data, JIT depends on highly synchronized supplier and production systems, whereas stochastic inventory models require probabilistic demand distributions and lead-time variability data that were unavailable in the company's historical records. Therefore, the deterministic EOQ model was considered the most appropriate analytical approach for evaluating PT X's inventory policy.

The implementation of EOQ in this study is based on several deterministic assumptions. First, annual demand for Stainless Steel 430 Brushed is assumed to remain relatively stable throughout the observation period based on historical inventory records. Second, procurement lead time is assumed to be constant at seven days according to the company's historical purchasing performance. Third, inventory shortages are assumed not to occur because replenishment is scheduled before inventory reaches the reorder point, thereby maintaining uninterrupted production. Fourth, warehouse capacity is assumed to be sufficient to accommodate the optimal order quantity without introducing additional storage constraints.

Although these assumptions were considered consistent with PT X's operational conditions during the study period, they also define the limitations of this research. Accordingly, the findings should be interpreted only within deterministic inventory environments and may not be directly applicable to situations characterized by fluctuating demand, variable lead times, supply disruptions, warehouse capacity constraints, or other forms of operational uncertainty. Future research is recommended to compare the deterministic EOQ model with stochastic inventory models or other advanced inventory management approaches under uncertain operating conditions.

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RESULTS AND DISCUSSION

Existing Inventory Policy at PT X

Inventory management is a critical component of manufacturing operations because it directly affects production continuity and inventory costs. Before evaluating the effectiveness of the Economic Order Quantity (EOQ) method, it is necessary to examine the inventory policy currently implemented by PT X as the baseline for comparison. The existing policy reflects the company's routine purchasing practices for Stainless Steel 430 Brushed, including demand characteristics, ordering quantity, procurement frequency, ordering costs, holding costs, and procurement lead time.

The historical inventory data indicate that PT X requires 12,000 units of Stainless Steel 430 Brushed annually to support its production activities. The company currently places orders of 1,000 units per transaction, resulting in 12 procurement orders per year. Each purchase order incurs an ordering cost of IDR 350,000, while the annual holding cost is IDR 25,000 per unit. Procurement lead time is maintained at seven days, and the company operates 300 effective working days annually, resulting in an average daily demand of 40 units. These operational characteristics constitute the basis for evaluating inventory efficiency using the EOQ model.

Table 1. Existing Inventory Characteristics of Stainless Steel 430 Brushed at PT. X

No.	Inventory Parameter	Value	Unit
1	Annual demand (D)	12,000	units/year
2	Order quantity per transaction (Q)	1,000	units/order
3	Ordering frequency	12	orders/year
4	Ordering cost (S)	IDR 350,000	order
5	Holding cost (H)	IDR 25,000	unit/year
6	Procurement lead time	7	days
7	Effective working days	300	days/year
8	Average daily demand	40	units/day

Source: Processed from PT X inventory records.

The inventory policy summarized in Table 1 indicates that the company emphasizes relatively large purchasing quantities to reduce procurement frequency. From an operational perspective, this policy minimizes the number of purchase transactions and administrative procurement activities. However, larger order quantities simultaneously increase the average inventory stored in the warehouse, leading to higher inventory carrying costs. Consequently, the existing procurement strategy reflects a managerial preference for reducing ordering activities rather than balancing total inventory costs.

To evaluate the financial consequences of the current inventory policy, the annual inventory cost components were calculated based on the company's ordering quantity and procurement frequency.

Table 2. Inventory Cost under the Existing Company Policy

No.	Cost Component	Calculation	Result
1	Annual demand	–	12,000 units
2	Order quantity	–	1,000 units/order
3	Ordering frequency	12,000 ÷ 1,000	12 orders/year
4	Ordering cost	12 × IDR 350,000	IDR 4,200,000/year
5	Average inventory	1,000 ÷ 2	500 units
6	Holding cost	500 × IDR 25,000	IDR 12,500,000/year
7	Total Inventory Cost (TIC)	Ordering Cost + Holding Cost	IDR 16,700,000/year

Source: Research calculation based on PT X inventory data.

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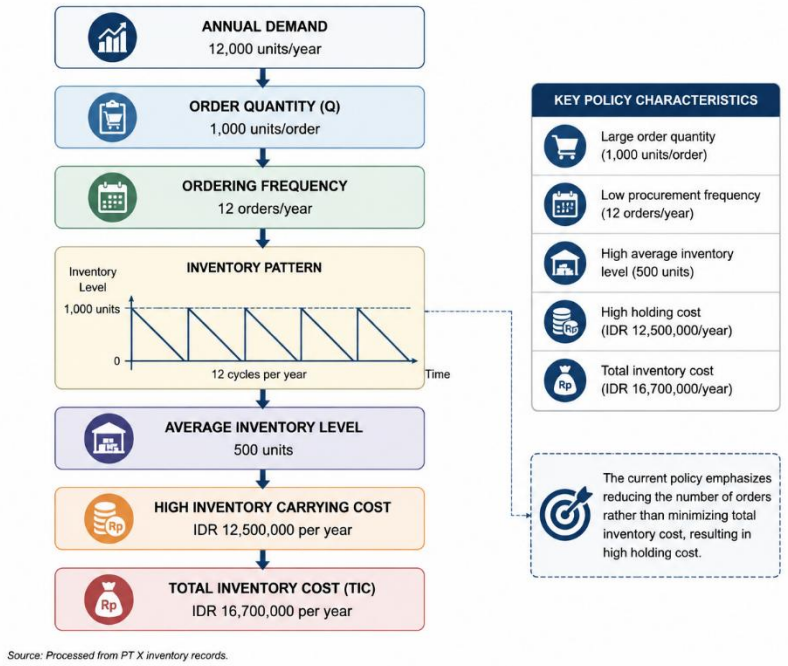
Table 2 demonstrates that the company's current inventory policy generates an annual ordering cost of IDR 4,200,000 and an annual holding cost of IDR 12,500,000, resulting in a total inventory cost of IDR 16,700,000 per year. The analysis clearly indicates that holding cost represents approximately 75% of the total inventory cost, making it the dominant component of inventory expenditure. This condition occurs because the company maintains relatively large inventory levels due to ordering 1,000 units in each procurement cycle.

From a managerial perspective, maintaining large inventories may provide a sense of security by reducing the frequency of procurement activities and minimizing the perceived risk of material shortages. However, this strategy also ties up working capital in inventory, increases warehouse utilization, raises storage and handling costs, and elevates the risk of inventory deterioration or obsolescence. Therefore, inventory decisions should not be based solely on minimizing procurement frequency but should instead seek to optimize the balance between ordering costs and holding costs.

Figure 1. Existing Inventory Policy at PT X

Figure 1. Existing inventory policy implemented by PT X for Stainless Steel 430 Brushed before applying the Economic Order Quantity (EOQ) method.



Source: Processed from PT X inventory records.

Figure 1. Existing inventory policy implemented by PT X for Stainless Steel 430 Brushed before applying the Economic Order Quantity (EOQ) method

Figure 1 illustrates the inventory management structure currently implemented by PT X. The company purchases 1,000 units per order, resulting in 12 procurement transactions annually. While this policy successfully limits procurement frequency, it also creates relatively high average inventory levels, thereby increasing annual holding costs. As shown in Table 2, holding cost contributes substantially more to total inventory expenditure than ordering cost, indicating that the existing inventory policy is not yet economically optimal.

These findings justify the application of the Economic Order Quantity (EOQ) model in the subsequent analysis. Rather than merely reducing procurement frequency, EOQ aims to identify the order quantity that minimizes the combined effects of ordering costs and holding costs. Consequently, the existing inventory policy presented in this subsection serves as the baseline for evaluating whether

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EOQ can improve inventory efficiency and reduce total inventory costs while maintaining production continuity.

EOQ Analysis and Inventory Cost Efficiency

Following the evaluation of PT X's existing inventory policy, the Economic Order Quantity (EOQ) model was applied to determine the optimal procurement quantity that minimizes the total inventory cost. The EOQ model simultaneously considers annual demand, ordering cost, and holding cost to identify the order quantity that provides the lowest combined inventory expenditure. Unlike the company's current procurement policy, which is primarily based on routine purchasing practices, the EOQ approach provides a quantitative decision-making framework for inventory management.
Using the annual demand of 12,000 units, an ordering cost of IDR 350,000 per order, and a holding cost of IDR 25,000 per unit per year, the EOQ calculation produced an optimal order quantity of 579.66 units, which was rounded to 580 units per order for practical implementation. The detailed calculation is presented in Table 3.

Table 3. Economic Order Quantity (EOQ) Calculation

Parameter	Symbol	Value
Annual Demand	D	12,000 units
Ordering Cost	S	IDR 350,000/order
Holding Cost	H	IDR 25,000/unit/year
EOQ Formula	√(2DS/H)	
EOQ Result	Q^*	579.66 ≈ 580 units/order
Ordering Frequency	D/Q	20.69 orders/year

Source: Research calculation based on PT X inventory data.

The EOQ calculation recommends reducing the order quantity from 1,000 units under the existing company policy to 580 units per procurement cycle. Consequently, the procurement frequency increases from 12 orders per year to approximately 20.69 orders per year. Although this recommendation requires more frequent purchasing activities, the reduction in average inventory significantly decreases annual holding costs, thereby improving overall inventory efficiency.
The financial implications of implementing the EOQ policy are summarized in Table 4.

Table 4. Comparison of Inventory Cost between Existing Policy and EOQ

Inventory Component	Existing Policy	EOQ Policy	Difference
Order Quantity (units)	1,000	580	−420
Ordering Frequency (orders/year)	12.00	20.69	+8.69
Ordering Cost (IDR/year)	4,200,000	7,241,379	+3,041,379
Holding Cost (IDR/year)	12,500,000	7,250,000	−5,250,000
Total Inventory Cost (IDR/year)	16,700,000	14,491,379	−2,208,621
Inventory Cost Saving	–	13.23%	–

Source: Research calculation.

The comparison demonstrates that implementing the EOQ model reduces the total annual inventory cost from IDR 16,700,000 to IDR 14,491,379, producing annual savings of IDR 2,208,621, equivalent to 13.23%. Although ordering costs increase because procurement activities become more frequent, the substantial reduction in holding costs more than compensates for this increase. Consequently, the overall inventory cost decreases, indicating that EOQ provides a more economically efficient inventory policy than the company's existing procurement practice.

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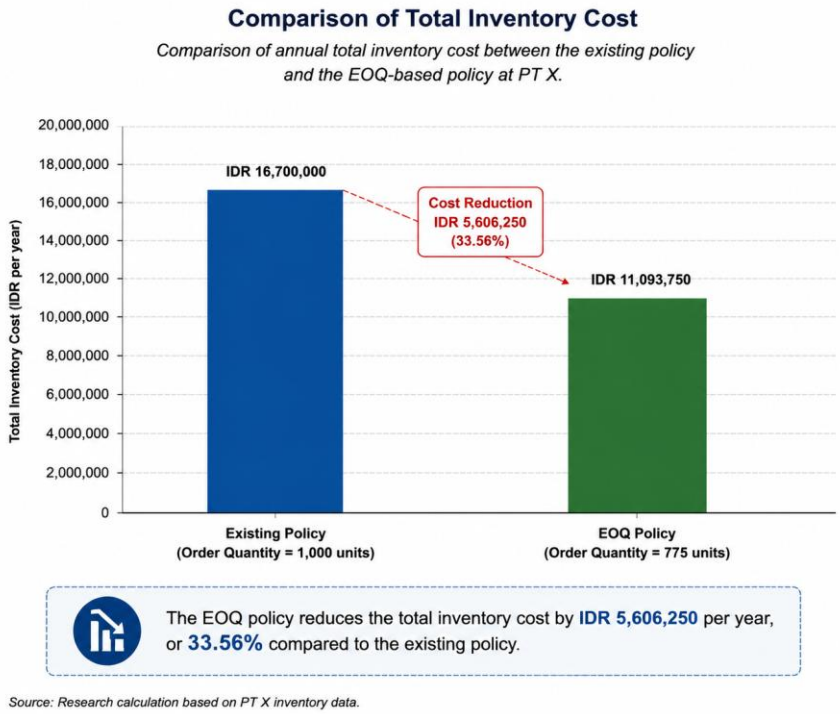

Figure 2. Comparison of total inventory cost between the existing inventory policy and the EOQ-based inventory policy

Figure 2 clearly demonstrates the financial benefit of implementing EOQ. The reduction in total inventory cost confirms that inventory optimization should be evaluated based on the balance between ordering costs and holding costs rather than on procurement frequency alone. Under the company's current policy, lower ordering frequency is achieved by maintaining larger inventory levels, which substantially increases annual holding costs. In contrast, EOQ recommends a smaller procurement quantity that reduces inventory investment and storage costs while maintaining sufficient material availability for production. This finding supports the theoretical principle that the minimum total inventory cost is achieved when ordering costs and holding costs are optimally balanced rather than individually minimized.

Furthermore, the results indicate that inventory management should be viewed as a strategic financial decision rather than merely an operational purchasing activity. By reducing unnecessary inventory investment, EOQ improves working capital utilization and enhances inventory turnover. These improvements contribute not only to lower inventory costs but also to more efficient resource allocation within manufacturing operations.

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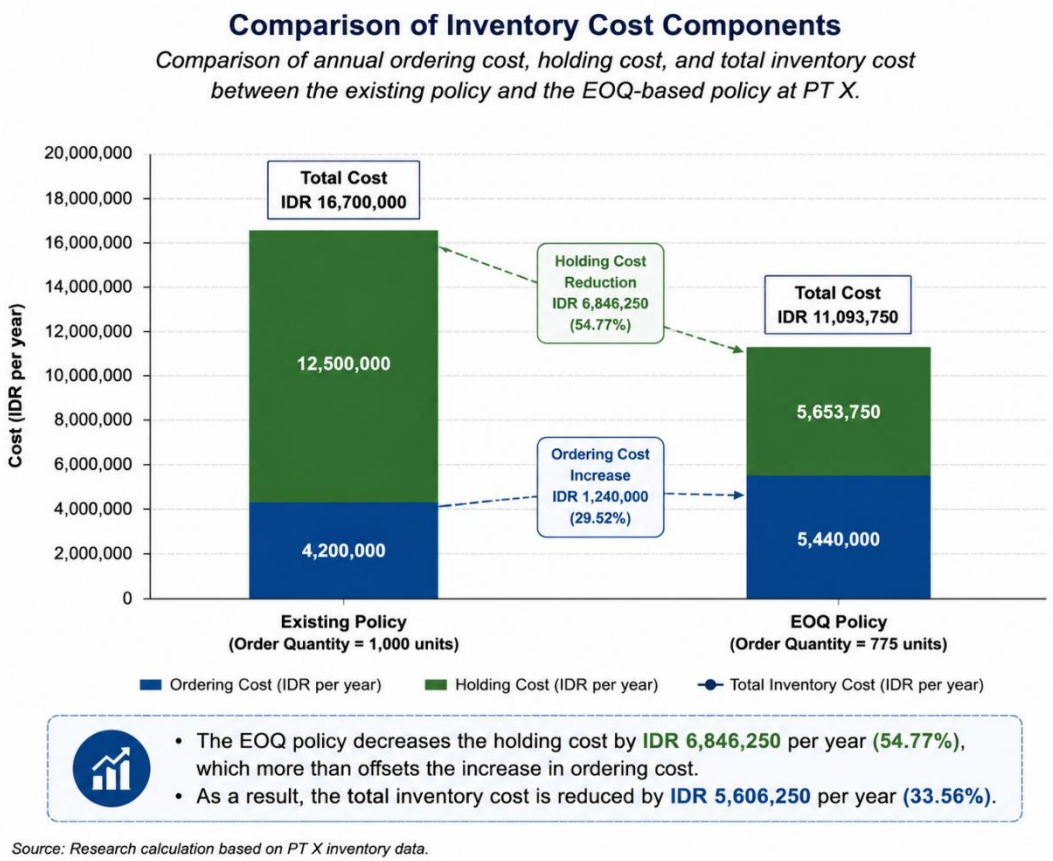

Figure 3. Comparison of annual ordering cost and holding cost under the existing inventory policy and the EOQ policy

Figure 3 illustrates that the EOQ model changes the composition of inventory costs rather than simply reducing total expenditure. Under the existing procurement policy, holding cost represents the largest component of inventory expenditure because the company maintains relatively high average inventory levels. After implementing EOQ, ordering costs increase due to the higher procurement frequency; however, holding costs decline substantially because fewer materials are stored in the warehouse at any given time. The reduction in holding cost exceeds the increase in ordering cost, resulting in a lower total inventory cost.

From a managerial perspective, this finding has important operational implications. The increase in procurement frequency requires closer coordination between the purchasing department, warehouse personnel, and suppliers. Additional purchase transactions may increase administrative activities, procurement documentation, supplier communication, and transportation scheduling. Nevertheless, these additional operational requirements are justified by the significant reduction in inventory investment and storage costs.

The findings also suggest that successful implementation of EOQ depends on supplier responsiveness and procurement planning. Because the EOQ policy recommends approximately 21 purchase orders per year, suppliers must consistently maintain the agreed lead time to prevent production interruptions. Consequently, supplier reliability becomes an important supporting factor in realizing the financial benefits of EOQ. Organizations adopting EOQ should therefore complement inventory optimization with supplier performance monitoring, procurement scheduling, and digital inventory management systems to ensure that operational efficiency is maintained.

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Overall, the findings confirm that EOQ should not be interpreted merely as a mathematical formula for determining order quantity. Instead, it represents a strategic inventory management tool that balances procurement efficiency, inventory investment, and production continuity. Under the relatively stable operating conditions observed at PT X, the EOQ policy successfully reduced inventory costs while maintaining adequate material availability, demonstrating its practical applicability as a decision-support tool for manufacturing inventory management.

Managerial Implications and Operational Trade-offs

The implementation of the Economic Order Quantity (EOQ) model at PT X demonstrates that inventory optimization should not be evaluated solely from the perspective of cost reduction. Although the EOQ policy successfully decreases the annual total inventory cost by 13.23%, its implementation also introduces several operational consequences that require careful managerial consideration. Consequently, inventory optimization should be viewed as a strategic decision that balances financial efficiency with operational capability rather than simply minimizing inventory costs.

One of the most significant operational changes resulting from EOQ implementation is the increase in procurement frequency from 12 orders per year under the existing policy to approximately 20.69 orders per year. This increase implies that the purchasing department must process approximately nine additional procurement transactions annually. As procurement frequency increases, administrative activities—including purchase requisition preparation, purchase order issuance, supplier communication, invoice verification, and inventory documentation—also become more intensive. Therefore, while EOQ reduces inventory investment, it simultaneously requires greater administrative capacity and improved procurement coordination.

From the procurement management perspective, the increased ordering frequency necessitates more effective planning and communication between the purchasing department and suppliers. Procurement schedules must be carefully coordinated to ensure that materials arrive according to the planned lead time of seven days. Failure to maintain procurement schedules may delay material availability and interrupt production activities. Accordingly, supplier responsiveness becomes an important supporting factor in the successful implementation of EOQ. Companies should periodically evaluate supplier performance using indicators such as delivery punctuality, order fulfillment accuracy, and procurement responsiveness to ensure that the assumptions underlying the EOQ model remain valid during implementation.

The implementation of EOQ also influences warehouse management practices. Under the existing inventory policy, relatively large order quantities increase the average inventory stored in the warehouse, resulting in higher holding costs and greater warehouse space utilization. By reducing the order quantity to 580 units per procurement cycle, EOQ lowers the average inventory level, thereby reducing storage costs, warehouse congestion, inventory handling activities, and capital tied up in inventory. Improved inventory turnover also enables warehouse personnel to manage inventory more efficiently because fewer materials remain in storage for extended periods.

Another important managerial implication concerns transportation and logistics activities. The increase in procurement frequency may require additional transportation arrangements if materials are delivered separately for each purchase order. Consequently, logistics planning becomes more important to ensure that transportation schedules remain synchronized with production requirements. If transportation costs are included within the ordering cost component, the increase in transportation frequency has already been considered in the EOQ calculation. Nevertheless, companies should periodically review logistics arrangements because changes in fuel prices, freight charges, or supplier delivery policies may influence the economic benefits achieved through EOQ implementation.

From the financial management perspective, the reduction in average inventory provides additional benefits beyond inventory cost savings. Lower inventory investment improves working capital utilization because less capital is tied up in warehouse stock. The released financial resources

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may be allocated to other productive activities, including production improvement, equipment maintenance, product development, or business expansion. Consequently, EOQ contributes not only to operational efficiency but also to improved financial flexibility and resource allocation within manufacturing organizations.

Despite these benefits, inventory optimization also involves several operational trade-offs. Lower inventory levels reduce holding costs but simultaneously decrease the inventory buffer available to absorb unexpected demand increases or procurement delays. Under the deterministic assumptions adopted in this study, annual demand and procurement lead time remain stable, allowing EOQ to operate efficiently. However, in actual manufacturing environments, fluctuations in customer demand, supplier delays, transportation disruptions, or production schedule changes may increase the probability of temporary stock shortages when inventory levels are maintained close to the economic optimum. Therefore, companies implementing EOQ should continuously monitor inventory performance and complement inventory optimization with appropriate risk mitigation strategies, including supplier performance evaluation, procurement monitoring, and safety stock planning.

Operational feasibility should also be considered before implementing the EOQ recommendation. Although the mathematical model identifies 580 units as the economically optimal order quantity, practical implementation depends on several organizational factors, including supplier minimum order quantity requirements, transportation capacity, packaging specifications, warehouse handling systems, and procurement policies. If suppliers require fixed shipment quantities or impose contractual purchasing constraints, minor adjustments to the EOQ recommendation may be necessary without significantly reducing inventory efficiency. Accordingly, EOQ should be interpreted as a quantitative decision-support model rather than an inflexible operational rule.

The findings of this study further demonstrate that successful inventory optimization requires organizational readiness in addition to mathematical optimization. Effective implementation of EOQ depends on coordination among the purchasing department, warehouse management, production planning, finance, and suppliers. The availability of accurate inventory records, reliable procurement information, and continuous monitoring of inventory performance are essential to ensure that the projected inventory cost savings can be achieved under actual operating conditions.

Overall, the managerial implications identified in this study indicate that the implementation of EOQ extends beyond reducing inventory costs. The model supports more systematic procurement planning, improves warehouse utilization, enhances working capital efficiency, and promotes evidence-based inventory decision-making. At the same time, organizations must recognize the associated operational trade-offs, including increased procurement activities, greater supplier coordination, and stronger dependence on procurement reliability. Under the relatively stable operational conditions observed at PT X, the annual inventory cost savings of 13.23% demonstrate that these additional operational requirements remain manageable and are justified by the financial and operational benefits generated through EOQ implementation. This finding reinforces the role of EOQ as a practical decision-support tool for improving inventory management performance in manufacturing companies while maintaining production continuity.

Reorder Point Analysis

The determination of the reorder point (ROP) is an essential component of inventory control because it establishes the inventory level at which a new purchase order should be initiated to prevent production interruptions. While the EOQ model determines the optimal order quantity, the reorder point determines the appropriate timing of procurement. Consequently, both parameters complement each other in supporting an efficient inventory management system.

Based on the operational data obtained from PT X, the average daily demand for Stainless Steel 430 Brushed was 40 units per day, while the procurement lead time remained consistently at seven

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days throughout the observation period. Under the deterministic assumptions adopted in this study, the reorder point was calculated using the following equation:
ROP=d×LROP = d \times LROP=d×L
where:
ROP = Reorder Point (units)
d = Average daily demand (units/day)
L = Procurement lead time (days)
The calculation is presented in Table 5.

Table 5. Basic Reorder Point Calculation

Inventory Policy	Total Inventory Cost (IDR)
Existing Company Policy	16,700,000
EOQ Policy	14,491,379

Source: Research calculation based on PT X inventory data.

The calculation indicates that PT X should initiate a new purchase order when the inventory level reaches 280 units. At the assumed average consumption rate of 40 units per day, this inventory level is expected to satisfy production requirements during the seven-day procurement lead time until the next shipment arrives. Under deterministic operating conditions, the reorder point enables the company to maintain production continuity while avoiding unnecessary inventory accumulation.

It should be emphasized that the value of 280 units represents a Basic Reorder Point because the calculation excludes safety stock. The basic reorder point assumes that demand remains constant, procurement lead time is stable, and replenishment arrives exactly as scheduled. Consequently, the reorder point calculated in this study is applicable only under the deterministic operating conditions observed during the research period.

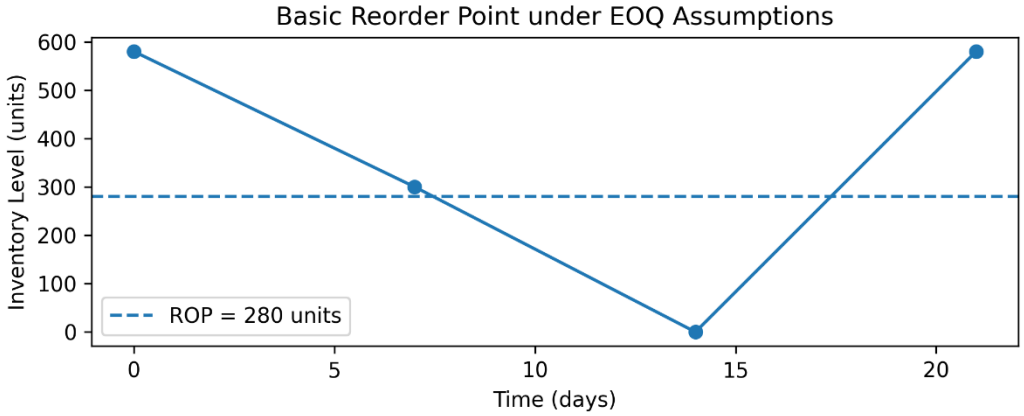

Figure 4. Illustration of the Basic Reorder Point under deterministic demand and constant procurement lead time

Figure 4 illustrates the inventory depletion process under deterministic operating conditions. Inventory decreases continuously according to the average daily consumption rate until it reaches the reorder point of 280 units, at which time a new purchase order is placed. Assuming that supplier lead time remains constant at seven days, replenishment arrives immediately before inventory is exhausted, allowing production activities to continue without interruption.

From a managerial perspective, the basic reorder point provides a systematic procurement trigger that replaces subjective purchasing decisions with quantitative planning. Instead of relying on periodic observation or managerial experience, procurement personnel can initiate purchasing

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activities based on a predefined inventory threshold. This approach improves procurement consistency and supports better synchronization between inventory availability and production requirements.

Stockout Risk under Practical Operating Conditions

Although the basic reorder point performs effectively under deterministic assumptions, actual manufacturing environments rarely operate under perfectly stable conditions. Daily production demand may fluctuate because of changes in customer orders, production scheduling adjustments, or unexpected machine downtime. Similarly, procurement lead time may vary due to supplier delays, transportation disruptions, customs clearance, or administrative processing time.

Under such conditions, relying exclusively on the basic reorder point may increase the probability of inventory stockouts. If actual demand exceeds the average daily demand of 40 units or if procurement lead time extends beyond seven days, the available inventory may be depleted before replenishment arrives. Stockouts can interrupt production schedules, delay customer deliveries, increase emergency procurement costs, and reduce overall operational efficiency.

Therefore, while the basic reorder point is appropriate for evaluating inventory performance under deterministic conditions, its practical implementation should be accompanied by continuous monitoring of demand patterns and supplier performance.

Safety Stock Recommendation

Because this study adopted a deterministic EOQ model, safety stock was not incorporated into the reorder point calculation. Historical data describing demand variability and procurement lead-time variability were not available in sufficient detail to estimate an appropriate safety stock level quantitatively. Consequently, the reorder point presented in this study should be interpreted as the minimum inventory threshold applicable under relatively stable operating conditions.

For practical implementation, PT X is encouraged to complement the EOQ policy with an appropriate safety stock level to improve inventory resilience against operational uncertainty. Safety stock should be determined using historical demand fluctuations, lead-time variability, desired service level, and supplier delivery performance. Incorporating safety stock into the reorder point calculation would provide additional protection against unexpected increases in demand and procurement delays while maintaining the inventory cost efficiency achieved through EOQ.

Future research should therefore integrate deterministic EOQ with probabilistic inventory control approaches by incorporating safety stock optimization, demand forecasting, and service-level analysis. Such developments would enhance the practical applicability of inventory management policies and provide a more comprehensive decision-support framework for manufacturing companies operating under uncertain business environments.

Model Validation and Scenario Analysis

The implementation of the Economic Order Quantity (EOQ) model should not only be evaluated based on mathematical calculations but also through its operational applicability under the actual conditions of the organization. Therefore, model validation was conducted by comparing the inventory policy currently implemented by PT X with the EOQ-based inventory policy using identical operational parameters, including annual demand, ordering cost, holding cost, procurement lead time, and effective working days. This comparative evaluation enables assessment of whether the EOQ recommendation provides measurable improvements over the company's existing inventory practice.

Unlike simulation-based validation or comparisons involving multiple inventory models, the validation in this study is based on scenario analysis under the deterministic operating conditions observed during the research period. The objective is to determine whether the EOQ model remains practically applicable when applied to PT X's inventory system using actual operational data.

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Table 6. Scenario-Based Comparison between Existing Inventory Policy and EOQ Policy

Cost Component	Existing Policy (IDR)	EOQ Policy (IDR)
Ordering Cost	4,200,000	7,241,379
Holding Cost	12,500,000	7,250,000

Source: Research calculation based on PT X inventory data.

Table 6 demonstrates that the EOQ policy consistently outperforms the company's existing procurement policy with respect to inventory cost efficiency. Although the EOQ recommendation increases procurement frequency from 12 to approximately 20.69 orders per year, the resulting reduction in average inventory substantially decreases annual holding costs. Consequently, the total inventory cost decreases by IDR 2,208,621, equivalent to 13.23%, indicating that the EOQ model provides a more economically efficient inventory policy under the operational conditions observed at PT X.

These findings validate the suitability of the EOQ model for organizations operating under relatively stable demand and procurement conditions. During the observation period, annual demand for Stainless Steel 430 Brushed remained relatively constant, procurement lead time was consistently maintained at seven days, and no major procurement disruptions were identified in the inventory records. Such conditions are consistent with the fundamental assumptions of the deterministic EOQ model, supporting the applicability of the calculated optimal order quantity within the context of this study.

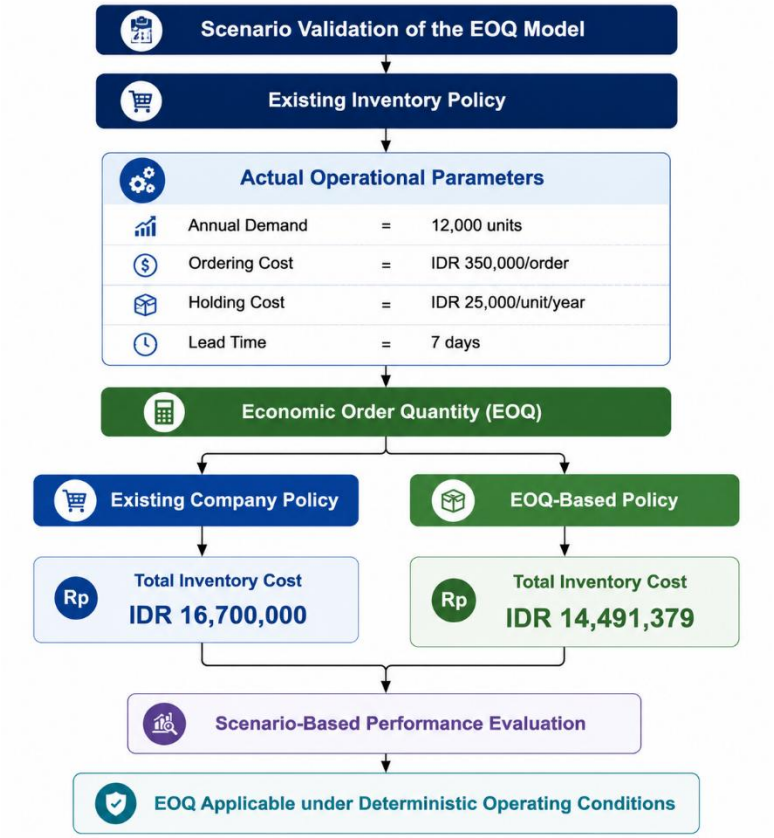

Figure 5. Scenario-based validation of the EOQ model using the actual operational characteristics of PT X

Figure 5 illustrates the validation framework employed in this study. The same operational data were used to evaluate two procurement scenarios: the company's existing inventory policy and the EOQ-based policy. Because both scenarios were evaluated using identical demand, ordering cost,

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holding cost, and lead-time parameters, differences in inventory performance can be attributed directly to the ordering policy rather than to changes in operating conditions. This comparison strengthens the internal validity of the study by demonstrating that the observed inventory cost savings are the result of inventory optimization rather than external operational factors.

From a managerial perspective, the scenario analysis confirms that EOQ can serve as a practical decision-support tool under stable manufacturing conditions. The recommended procurement quantity of 580 units per order reduces average inventory while maintaining sufficient material availability throughout the production cycle. Furthermore, the integration of EOQ with the calculated reorder point provides a systematic inventory management framework capable of improving procurement planning and reducing unnecessary inventory investment.

However, the scenario analysis also demonstrates that the effectiveness of the EOQ policy depends on the stability of its underlying assumptions. If annual demand fluctuates substantially, procurement lead time becomes inconsistent, supplier performance deteriorates, or ordering costs change significantly, the calculated EOQ may no longer represent the true economic order quantity. Under such conditions, the inventory policy should be re-evaluated using updated operational data or alternative inventory models capable of incorporating uncertainty.

It should also be recognized that the present validation is limited to a comparison between the company's existing procurement policy and the deterministic EOQ model. The study did not compare EOQ with other inventory control approaches such as Periodic Order Quantity (POQ), Min–Max Inventory Systems, Material Requirements Planning (MRP), or stochastic inventory models because these methods require additional operational data that were not available during the study period. Consequently, the findings should be interpreted as evidence that EOQ is more efficient than the existing inventory policy under the observed operating conditions rather than as proof that EOQ is universally superior to all alternative inventory models.

Overall, the scenario-based validation demonstrates that the EOQ model provides a reliable and operationally feasible inventory policy for PT X under deterministic conditions. The reduction in total inventory cost, combined with systematic procurement scheduling through the reorder point, confirms that EOQ can improve inventory performance without compromising production continuity. Nevertheless, continuous monitoring of demand patterns, supplier performance, procurement costs, and operational conditions remains essential to ensure that the recommended inventory policy continues to reflect the company's actual operational environment.

Research Limitations

Although the findings demonstrate that the Economic Order Quantity (EOQ) model can improve inventory cost efficiency for Stainless Steel 430 Brushed at PT X, several limitations should be acknowledged to ensure appropriate interpretation of the results and to define the scope of applicability of the proposed inventory policy.

The first limitation relates to the single-case study design employed in this research. The analysis was conducted using inventory data from one manufacturing company and focused exclusively on a single raw material, namely Stainless Steel 430 Brushed. While this approach enabled an in-depth evaluation of the company's inventory policy under actual operating conditions, the findings primarily represent the operational characteristics of PT X. Consequently, the results should not be directly generalized to other manufacturing companies, industrial sectors, or raw materials that may have different demand patterns, procurement systems, production processes, or inventory management practices.

The second limitation concerns the use of the deterministic Economic Order Quantity (EOQ) model. The analysis assumes that annual demand, ordering costs, holding costs, and procurement lead time remain constant throughout the planning period. These assumptions were considered appropriate because the inventory records used in this study indicated relatively stable operational conditions

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during the observation period. Nevertheless, manufacturing operations often experience demand fluctuations, seasonal production requirements, changes in procurement costs, and variations in supplier delivery performance. Under such conditions, the optimal order quantity determined by the deterministic EOQ model may differ from that required in dynamic operational environments.

A further limitation is the absence of uncertainty analysis within the inventory model. This study did not explicitly evaluate demand variability, lead-time variability, transportation disruptions, or unexpected changes in production schedules because detailed historical variability data were not available. Consequently, the proposed inventory policy represents the optimal solution under relatively stable operating conditions rather than under stochastic or uncertain inventory environments. The results should therefore be interpreted within the deterministic assumptions adopted throughout the study.

Another limitation is the absence of a quantitative supplier reliability analysis. Although procurement records indicated that supplier deliveries generally complied with the planned seven-day lead time during the observation period, the study did not measure supplier performance using quantitative indicators such as on-time delivery rate, delivery consistency, order fulfillment accuracy, procurement responsiveness, or supplier risk. Since supplier performance directly influences inventory availability and procurement effectiveness, incorporating supplier reliability analysis would provide a more comprehensive assessment of inventory management performance.

In addition, the reorder point developed in this research represents a basic reorder point, as the calculation excludes safety stock. The analysis therefore assumes that procurement lead time remains constant and that material demand follows the average daily consumption rate. Under actual operating conditions, fluctuations in demand or unexpected supplier delays may increase the probability of temporary stock shortages if additional buffer inventory is not maintained. Consequently, the reorder point proposed in this study should be interpreted as appropriate for deterministic operating conditions rather than as a complete inventory control policy applicable under all circumstances.

Despite these limitations, the present study provides important empirical evidence regarding the application of the EOQ model to raw material inventory management in a manufacturing company. By utilizing actual operational data, the study demonstrates how quantitative inventory analysis can improve procurement efficiency and reduce total inventory costs under stable operating conditions. These findings contribute to the empirical literature on inventory optimization by validating the practical applicability of the deterministic EOQ model within the operational context of PT X.

Future research is recommended to expand the scope of investigation by involving multiple manufacturing companies, different categories of raw materials, and longer observation periods to improve the external validity of the findings. In addition, future studies should incorporate stochastic inventory models, safety stock optimization, sensitivity analysis, scenario analysis under varying demand conditions, and quantitative supplier reliability evaluation. Integrating these approaches would provide a more comprehensive understanding of inventory management strategies capable of balancing inventory cost efficiency, operational flexibility, and production reliability under uncertain manufacturing environments.

CONCLUSION

This study shows that the Economic Order Quantity (EOQ) method can be used to optimize the inventory of 430 brushed stainless steel at PT X. Based on an annual demand of 12,000 units, an ordering cost of IDR 350,000 per order, and a holding cost of IDR 25,000 per unit per year, the economic order quantity obtained was 579.66 units, rounded to 580 units per order. This quantity is lower than the company's existing policy of 1,000 units per order. The change in order quantity

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increased the ordering frequency from 12 times to 20.69 times per year, but it reduced holding costs from IDR 12,500,000 to IDR 7,250,000 per year.

The total inventory cost under the company's method was IDR 16,700,000 per year, whereas the total inventory cost under the EOQ method was IDR 14,491,379 per year. Thus, the EOQ method generated savings of IDR 2,208,621 per year, or 13.23 percent. In addition, the basic reorder point was calculated at 280 units, based on an average daily usage of 40 units and a 7-day lead time. These findings indicate that PT X should use the EOQ method as the basis for its ordering policy so that inventory management becomes more efficient and measurable. Future research is recommended to incorporate safety stock, demand variability, supplier delays, warehouse capacity, and inventory information system integration so that the control model can become more adaptive to the company's operational conditions.

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