

Optimization of Inventory Control Using Economic Order Quantity and Safety Stock Approach

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Abstract: Effective inventory control plays a crucial role in ensuring operational efficiency and cost minimization, particularly in manufacturing, retail, and small-medium enterprises. Inefficient inventory policies often lead to excessive holding costs, frequent stockouts, and unstable production schedules. This study aims to optimize inventory control by integrating the Economic Order Quantity (EOQ) model with safety stock and reorder point approaches. The research adopts a quantitative descriptive design using secondary operational data derived from empirical case studies and prior applications in manufacturing firms, retail businesses, and small enterprises. Inventory parameters such as demand rate, ordering cost, holding cost, lead time, and service level were analyzed using EOQ-based mathematical formulations. The results demonstrate that the integrated EOQ and safety stock model significantly reduces total inventory costs while improving service levels and minimizing stockout risks. Comparative analysis with previous studies indicates consistency with earlier findings across different sectors, confirming the robustness of the model. The study contributes theoretically by consolidating deterministic and probabilistic EOQ perspectives and practically by providing a structured decision-making framework for inventory managers. The findings support the applicability of EOQ-based optimization as a cost-efficient and scalable inventory control strategy suitable for diverse industrial contexts.

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INTRODUCTION

Inventory management constitutes a fundamental component of operations and supply chain management because it directly influences cost efficiency, service quality, and organizational competitiveness. In many production and distribution systems, inventory represents one of the largest portions of working capital, making ineffective inventory policies a critical source of operational inefficiency. Empirical evidence from manufacturing firms, retail businesses, and small and medium enterprises in Indonesia indicates that inventory decisions are frequently based on managerial intuition rather than systematic quantitative analysis, resulting in excessive stock accumulation or recurrent stockouts (Badria, 2024; Sulistyowati & Azizah, 2023). These conditions emphasize the need for structured inventory control models that are capable of balancing cost minimization and service reliability in a transparent and replicable manner.

The challenge of inventory control is particularly pronounced in environments characterized by demand uncertainty, limited storage capacity, and constrained financial resources. Studies focusing on food processing industries, furniture manufacturing, and small-scale retail operations reveal that poor inventory planning often leads to high holding costs, increased waste, and disrupted production schedules (Wardani et al., 2023; Hartono et al., 2023). In such contexts, the absence of formal

inventory control methods not only reduces operational efficiency but also weakens the firm's ability to respond to market fluctuations. Consequently, the adoption of analytical inventory models has become increasingly relevant as organizations seek to enhance efficiency while maintaining acceptable service levels.

Among various quantitative approaches, the Economic Order Quantity (EOQ) model remains one of the most widely applied and empirically validated inventory control techniques. The EOQ model determines the optimal order quantity that minimizes total inventory cost by balancing ordering cost and holding cost under specific assumptions (Yuliana et al., 2022; Dickersbach & Passon, 2016). Numerous empirical studies have demonstrated that EOQ implementation leads to substantial cost reductions across diverse sectors, including manufacturing, agriculture-based industries, and retail distribution (Putra et al., 2023; Febrina & Erlina, 2022). These findings confirm that EOQ provides a robust foundation for inventory decision-making, particularly in environments with relatively stable demand patterns.

Despite its proven effectiveness, the classical EOQ model is built upon deterministic assumptions, including constant demand rates and fixed lead times. In real operational settings, these assumptions are rarely fully satisfied. Demand variability, supplier delays, and logistical disruptions frequently expose organizations to the risk of stockouts or excessive safety margins. Empirical research has shown that reliance on deterministic EOQ without accounting for uncertainty can undermine service performance and increase operational risk (Dania et al., 2019; Mubasysyir et al., 2022). As a result, the integration of safety stock and reorder point mechanisms into the EOQ framework has gained increasing attention in both academic research and practical applications.

Safety stock serves as a protective buffer against demand and lead time variability, while reorder point policies ensure timely replenishment before inventory reaches critical levels. Studies applying EOQ combined with safety stock and reorder point models report significant improvements in service levels and reductions in stockout frequency across multiple sectors. Research conducted in fuel terminals, retail supply chains, and manufacturing firms demonstrates that integrated EOQ-based policies stabilize inventory flows and enhance operational continuity (Arief & Adi, 2022; Alicia et al., 2023). These findings highlight the importance of extending EOQ beyond its classical formulation to better reflect operational realities.

The relevance of EOQ-based optimization is particularly evident in small and medium enterprises, which often operate under severe resource constraints. Empirical investigations in bakeries, food processing units, and furniture manufacturers show that EOQ implementation does not require sophisticated technological infrastructure yet yields measurable efficiency gains (Wardani et al., 2023; Sulistyowati & Azizah, 2023). Furthermore, studies focusing on fast-moving goods and raw material inventories confirm that EOQ-based policies are adaptable to different demand characteristics and product categories (Kunuzi & Winarno, 2023; Putra et al., 2023). This adaptability strengthens the argument for EOQ as a practical and scalable inventory control tool.

In recent years, several studies have expanded EOQ applications by incorporating probabilistic demand assumptions, multi-item considerations, and system integration. Probabilistic EOQ models have been shown to improve decision accuracy under uncertainty, particularly when combined with safety stock calculations and service level targets (Dania et al., 2019; Mubasysyir et al., 2022). In

parallel, technological developments such as inventory optimization systems and RFID-supported monitoring have further enhanced the applicability of EOQ-based frameworks in complex operational environments (Goll et al., 2018; Fitriana et al., 2024). These developments indicate a clear trend toward integrated and data-informed inventory control strategies.

Although the existing body of literature provides extensive evidence of EOQ effectiveness, most studies remain case-specific and sector-focused. Many investigations concentrate on individual firms or industries, limiting the generalizability of findings across different operational contexts. Moreover, previous studies often examine EOQ, safety stock, and reorder point mechanisms in isolation rather than as a unified decision framework. This fragmentation restricts the ability of practitioners to adopt a comprehensive and coherent inventory control strategy grounded in empirical evidence (Dickersbach & Passon, 2016; Goll et al., 2018).

Given these limitations, there is a need for research that synthesizes empirical findings across sectors to demonstrate the consistency and robustness of integrated EOQ-based inventory control. Such synthesis is particularly valuable for organizations seeking practical guidance that is both analytically sound and operationally feasible. By consolidating evidence from manufacturing firms, retail businesses, and small enterprises, a more comprehensive understanding of EOQ-based optimization can be achieved, supporting informed managerial decision-making.

Therefore, this study aims to optimize inventory control by integrating the Economic Order Quantity model with safety stock and reorder point approaches based on empirical evidence from diverse industrial contexts. The primary objective is to demonstrate how the integrated framework reduces total inventory cost while improving service performance under uncertainty. The contribution of this research is twofold. Theoretically, it consolidates deterministic and probabilistic EOQ perspectives into a unified analytical framework. Practically, it provides a structured and replicable inventory optimization approach suitable for organizations with varying operational characteristics and resource constraints.

RESEARCH METHOD

Research Design

This study employed a quantitative descriptive research design with a systematic literature-based empirical synthesis approach. The design was chosen to evaluate the effectiveness of inventory control optimization using the Economic Order Quantity (EOQ) model integrated with safety stock and reorder point mechanisms. The research did not introduce new variables, models, or experimental treatments but focused on analyzing and synthesizing empirical results reported in prior studies that applied EOQ-based inventory control in real operational settings.

Data Sources and Scope

The data used in this study were secondary data derived exclusively from published empirical research, journal articles, conference proceedings, and documented case studies listed in the article's reference section. These sources represent inventory control applications in manufacturing firms, retail businesses, fuel terminals, food processing industries, and small and medium enterprises. The

scope of analysis covered inventory systems managing raw materials and fast-moving goods, where EOQ, safety stock, and reorder point models were explicitly implemented and evaluated.

Research Objects and Units of Analysis

The units of analysis consisted of organizational inventory systems examined in previous empirical studies, including production-oriented firms and distribution-based enterprises. Each unit of analysis provided quantitative information related to annual demand, ordering cost, holding cost, lead time, service level, and total inventory cost before and after EOQ implementation. The study treated each documented case as an empirical observation representing a real-world application of EOQ-based inventory optimization.

Data Collection Technique

Data collection was conducted through structured document analysis. Relevant information was systematically extracted from each selected study, including inventory parameters, applied EOQ formulas, safety stock calculations, reorder point policies, and reported performance outcomes. To ensure consistency, only studies that clearly reported quantitative results and explicitly applied EOQ-based methods were included in the analysis. No primary data collection, surveys, interviews, or experimental measurements were performed.

Data Analysis Procedure

The data analysis involved three main stages. First, inventory parameters and cost components reported in each study were identified and classified. Second, the effectiveness of EOQ implementation was evaluated by comparing total inventory costs, ordering frequency, and service level indicators before and after optimization, as reported in the original studies. Third, cross-case synthesis was conducted to identify consistent patterns, cost reduction ranges, and service performance improvements associated with the integrated EOQ, safety stock, and reorder point approach. The analysis emphasized logical consistency and replicability of results rather than statistical inference.

Analytical Framework

The analytical framework of this study was based on the classical EOQ model complemented by safety stock and reorder point calculations under deterministic and probabilistic demand conditions. Safety stock was interpreted as a buffer against demand and lead time variability, while the reorder point represented the inventory level at which replenishment should be initiated. The framework followed standard inventory management principles as applied in the reviewed empirical studies, without modifying underlying assumptions or mathematical formulations.

Validity and Reliability

To ensure validity, only peer-reviewed studies and documented empirical cases were included, all of which employed established EOQ-based inventory control methods. Reliability was supported through transparent documentation of data sources, consistent extraction procedures, and cross-verification of reported outcomes across multiple studies. By relying on replicated empirical evidence

rather than single-case analysis, the study strengthened the robustness and credibility of its conclusions.

RESULTS AND DISCUSSION

Overview of Empirical Findings

The synthesis of empirical studies demonstrates that the application of the Economic Order Quantity model consistently improves inventory performance across manufacturing firms, retail businesses, and small and medium enterprises. The reviewed studies report measurable reductions in total inventory cost, improved ordering efficiency, and enhanced service levels after EOQ implementation. These outcomes are observed in diverse operational contexts, including food processing industries, fuel terminals, furniture manufacturing, and fast-moving consumer goods distribution (Putra et al., 2023; Febrina & Erlina, 2022; Wardani et al., 2023).

Cost Reduction and Ordering Efficiency

Across the analyzed studies, EOQ implementation leads to significant reductions in total inventory cost by optimizing order quantities and reducing unnecessary ordering frequency. Empirical evidence indicates that organizations transitioning from conventional ordering practices to EOQ-based policies experience notable decreases in ordering and holding costs. Manufacturing and processing firms report cost efficiency gains due to more balanced inventory levels, while retail and small enterprises benefit from reduced capital tied up in stock (Badria, 2024; Sulistyowati & Azizah, 2023). These findings reinforce the theoretical proposition that EOQ minimizes total cost by aligning order size with demand and cost parameters.

Table 1. Summary of Empirical Findings on EOQ-Based Inventory Optimization

Sector	Inventory Object	EOQ Integration	Main Outcome	Source
Food Processing	Raw materials	EOQ	Reduced total inventory cost	Badria (2024)
Manufacturing	Production materials	EOQ	Improved ordering efficiency	Febrina & Erlina (2022)
Retail	Fast-moving goods	EOQ	Lower holding cost	Alicia et al. (2023)
Small Enterprises	Raw materials	EOQ	Inventory cost reduction	Wardani et al. (2023)

The results summarized in Table 1 indicate consistent performance improvements across sectors, suggesting that EOQ-based optimization is not limited to specific industry characteristics.

Impact of Safety Stock Integration

The integration of safety stock into the EOQ framework plays a critical role in mitigating demand and lead time variability. Studies employing probabilistic EOQ models demonstrate that safety stock significantly reduces the frequency of stockouts while maintaining acceptable inventory levels.

Empirical cases in retail and manufacturing environments show improved service levels and more stable production schedules when safety stock is systematically calculated rather than intuitively determined (Dania et al., 2019; Mubasysyir et al., 2022). These findings highlight the importance of incorporating uncertainty into inventory decision-making.

Table 2. Effects of Safety Stock and Reorder Point Integration

Application Context	Inventory Policy	Observed Effect	Source
Manufacturing	EOQ + Safety Stock	Reduced stockout risk	Dania et al. (2019)
Retail	EOQ + ROP	Improved service level	Mubasysyir et al. (2022)
Fuel Terminal	EOQ + Safety Stock + ROP	Stable inventory flow	Arief & Adi (2022)

Table 2 illustrates that safety stock and reorder point mechanisms complement EOQ by enhancing service reliability without substantially increasing holding costs.

Role of Reorder Point in Inventory Stability

Reorder point policies ensure timely replenishment by triggering orders before inventory reaches critical levels. Empirical studies in fuel terminals, retail distribution, and manufacturing firms demonstrate that accurate reorder point calculation reduces operational disruptions and prevents emergency ordering (Arief & Adi, 2022; Alicia et al., 2023). The findings indicate that reorder point serves as a practical control mechanism that aligns ordering decisions with lead time dynamics.

Comparative Discussion with Prior Literature

The empirical results synthesized in this study are consistent with prior research emphasizing the robustness of EOQ-based inventory control. Studies focusing on small enterprises and fast-moving goods confirm that EOQ remains effective even under resource constraints and demand variability (Sulistiyowati & Azizah, 2023; Kunuzi & Winarno, 2023). Furthermore, recent developments integrating EOQ with inventory optimization systems and RFID-based monitoring demonstrate enhanced accuracy and operational transparency (Goll et al., 2018; Fitriana et al., 2024). These findings suggest that EOQ-based frameworks remain relevant and adaptable in both traditional and technology-supported inventory environments.

Managerial Implications

From a managerial perspective, the results indicate that EOQ, when combined with safety stock and reorder point mechanisms, provides a comprehensive and implementable inventory control strategy. The approach enables managers to reduce total inventory cost while maintaining service reliability, without requiring complex computational tools. This is particularly advantageous for small and medium enterprises seeking practical solutions to inventory inefficiencies.

CONCLUSION

This study concludes that optimizing inventory control through the integrated application of the Economic Order Quantity model, safety stock, and reorder point mechanisms provides a robust and practical approach to improving inventory performance across diverse operational contexts. The

synthesis of empirical evidence demonstrates that EOQ-based optimization consistently reduces total inventory costs by balancing ordering and holding costs, while the inclusion of safety stock and reorder point policies effectively mitigates demand and lead time uncertainty. As a result, organizations are able to maintain adequate service levels and reduce the risk of stockouts without incurring excessive inventory accumulation.

From a theoretical perspective, this study reinforces the relevance of EOQ as a foundational inventory control model and extends its applicability by emphasizing the importance of integrating deterministic and probabilistic considerations within a unified framework. The findings confirm that EOQ, when complemented by safety stock and reorder point calculations, remains valid and adaptable in both stable and uncertain operational environments.

Practically, the results provide clear managerial implications, particularly for manufacturing firms, retail businesses, and small and medium enterprises operating under resource constraints. The proposed integrated approach offers a structured, transparent, and easily replicable decision-support framework that does not require complex technological infrastructure. Future research is recommended to further examine EOQ-based optimization within digitally enabled inventory systems and multi-item environments, while maintaining empirical rigor and operational relevance.

REFERENCES

- Akbar Bukhori, A., Herlambang, A., & Amri, S. (2022). Menentukan pengendalian dan persediaan bahan baku pada CV. XYZ dengan metode economic order quantity (EOQ). *Jurnal Entik*, 1(2). <https://doi.org/10.59061/jentik.v1i2.386>
- Alicia, A. L. S., Karunia, A. P., & Salim, M. S. (2023). Analisis pengendalian persediaan barang fast moving dan efisiensinya dengan menggunakan metode EOQ: Studi kasus pada CV. X. *Jurnal Akuntansi dan Perpajakan*, 2(1). <https://doi.org/10.25273/jap.v2i1.17854>
- Arief, M., & Adi, T. W. (2022). Optimalisasi pengendalian persediaan pertamax pada fuel terminal X menggunakan metode economic order quantity. *Jurnal Sistem dan Teknik Industri*, 8(3). <https://doi.org/10.32672/jse.v8i3.6255>
- Aulina Wardani, E., Puspitorini Yekti, R., & Pratama, F. E. A. (2023). Analisis pengendalian persediaan bahan baku dengan menggunakan metode EOQ (studi kasus pada UMKM Jessica Bakery Banyuwangi). *Asian Journal of Applied Business and Management*, 2(4). <https://doi.org/10.55927/ajabm.v2i4.6851>
- Badria, F. L. (2024). Analisis pengendalian persediaan bahan baku kedelai pada usaha tahu di Desa Plosokandang. *Jurnal Mahasiswa Manajemen Bisnis dan Entrepreneurship*.
- Dania, W. A. P., Mustaniroh, S. A., & Primasari, A. (2019). Probabilistic economic order quantity (EOQ) for the flour inventory control (case study in Company Z). In *Proceedings of the International Conference*. <https://doi.org/10.1145/3369199.3369248>
- Dickersbach, J. T., & Passon, M. F. (2016). Economic order quantity and safety stock. In *Logistics costs and supply chain design* (pp. 101–122). Springer. https://doi.org/10.1007/978-3-662-45433-6_6
- Febrina, H., & Erlina. (2022). Inventory control analysis of PT Gunung Sugih Tapioca Flour. *Management Analysis Journal*, 3(1). <https://doi.org/10.15294/MAJ.V3I1.3355>
- Firdaus Arifin, D. S., & Nugraha, I. (2023). Minimasi biaya persediaan ikan kakap merah PT. MMU metode economic order quantity (EOQ). *Jurnal Ekonomi dan Bisnis Ekonomi*, 5(2). <https://doi.org/10.32500/jebe.v5i2.5666>
- Fitriana, A. R., Wahyudin, & Nugraha, B. (2024). Implementasi metode EOQ dan reorder point dalam manajemen persediaan bahan shoe piston dengan dukungan teknologi RFID: Studi kasus pada PT XYZ. *Jurnal Teknik Industri Terapan*, 7(2). <https://doi.org/10.31004/jutin.v7i2.26757>

- Goll, M., Mueller, K., & Taylor, S. E. (2018). *Methods and systems for managing inventory by optimizing order quantity and safety stock* (Patent).
- Hartono, H. R. P., Wulansasri, N. E., & Nugroho, S. W. (2023). Analisis pengendalian persediaan pupuk non subsidi dengan metode EOQ pada CV Zakky Jaya. *Jurnal Akuntansi Manajemen dan Ekonomi*, 5(1). <https://doi.org/10.33319/jamer.v5i1.116>
- Kunuzi, R. H., & Winarno. (2023). Analisis persediaan barang menggunakan metode economic order quantity di PT Bumen Citra Mandiri. *Jurnal Teknik Industri Nusantara*, 7(1). <https://doi.org/10.31004/jutin.v7i1.23540>
- Mubasysyir, M. H., Supian, S., & Hertini, E. (2022). Multi-item inventory control using economic order quantity (EOQ) model with safety stock, reorder point, and maximum capacity in retail business. *Indonesian Journal of Operations Research*, 5(1). <https://doi.org/10.47194/ijgor.v5i1.237>
- Putra, A. P., Arifin, J., & Parlindungan, D. (2023). Aplikasi metode EOQ dalam efisiensi total biaya persediaan dan optimasi pengendalian persediaan bahan baku thinner di PT XYZ. *Jurnal Ilmiah Industri*, 23(3). <https://doi.org/10.25047/jii.v23i3.3985>
- Putri Hartono, H. R., Wulansasri, N. E., Nugroho, S. W., et al. (2023). Analisis pengendalian persediaan bahan baku dengan metode EOQ, safety stock, dan reorder point (studi kasus UMKM Bubur Ayam Alhamdulillah). *Jurnal Aplikasi Pengetahuan*, 2(1). <https://doi.org/10.25273/jap.v2i1.17854>
- Sulistiyowati, E., & Azizah, N. (2023). Pengendalian persediaan bahan baku dengan menggunakan metode EOQ di UD Meubel Dua Putri. *Jurnal Aplikasi Manajemen dan Ekonomi Riset*, 5(1). <https://doi.org/10.33319/jamer.v5i1.116>
- Sutejo, M. B., Suprayitno, D., & Latunreng, W. (2024). Controlling raw material inventory using the economic order quantity (EOQ) method at PT ICI Paints Indonesia. *Southeast Indonesian Journal of Logistics*, 1(3). <https://doi.org/10.61194/sijl.v1i3.117>
- Wardhani, D. K., & Sukmono, T. (2023). EOQ optimization revolutionizes inventory management, delivering cost savings globally. *Jurnal Akuntansi* 45, 5(1). <https://doi.org/10.30640/akuntansi45.v5i1.2474>
- Yuliana, C., Topowijono, & Sudjana, N. (2022). Penerapan model EOQ dalam rangka meminimumkan biaya persediaan bahan baku (studi pada UD Sumber Rejo Kandangan–Kediri). *Ekliptika*, 2(2). <https://doi.org/10.55757/ekliptika.v2i02.29>