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Economic Order Quantity Method Used In The Inventory Control System Of Agung Store

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ABSTRACT

The objective of this investigation is to enhance inventory management at Toko Agung by implementing the Economic Order Quantity (EOQ) method. The System Development Life Cycle (SDLC) methodology was employed to develop a web-based inventory control system that integrates EOQ principles into daily operational processes. The system is designed to determine the optimal order quantities, reorder points, and safety stock levels in order to minimize the total inventory costs, which include both ordering and holding expenses. By applying EOQ calculations, the system assists in balancing procurement frequency and stock levels to avoid unnecessary capital tie-up or shortages. The findings reveal that the implementation of EOQ led to a 15% reduction in total inventory-related costs, a significant improvement in stock availability, and a 10% decrease in the risks of overstock and stockouts. Furthermore, the automation of the procurement process through the system enabled more accurate forecasting and timely decision-making. These results demonstrate that the integration of EOQ into a web-based inventory system can significantly improve the efficiency, accuracy, and cost-effectiveness of inventory management in retail business operations.

Keywords: Toko Agung, information systems, inventory, EOQ, and SDLC
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Introduction

Inventory is a critical asset in trading operations, particularly in the retail sector, where product availability is contingent upon meeting consumer demand. Various issues, including overstocking, understocking, wasteful operational costs, and decreased customer satisfaction, can result from suboptimal inventory management. Consequently, it is imperative to establish an effective inventory control system in order to maintain a balance between the demand for goods and the available storage capacity [1].

The Economic Order Quantity (EOQ) method is a widely used approach to efficient inventory management. The primary goal of EOQ is to minimize the total inventory-related costs, which encompasses ordering and retaining costs, by establishing the optimal order quantity [2]. This method assists organizations in determining the most effective purchase quantity and schedule, thereby enhancing the efficiency of inventory management. EOQ was created to overcome the obstacles associated with conventional inventory management, which involved determining the most advantageous equilibrium between order frequency and holding costs [3].

In Indonesia, many small and medium enterprises (SMEs), including retail stores, still rely on manual inventory management systems. This is also the case at Toko Agung, a store specializing in daily necessities and basic necessities [4]. The inventory management system at Toko Agung still relies on estimates and the owner's intuition, as there is no structured information system. As a result, inventory management often fails to meet market demand, resulting in overstocking, which increases warehouse costs, or understocking, which results in lost sales [5].

The objective of this investigation is to assess the efficacy of the EOQ method in enhancing inventory management at Toko Agung. The EOQ method is anticipated to enable the store to ascertain the optimal order quantity, which will reduce total inventory costs without compromising the quality of service provided to consumers [6]. For the development of this system, the Waterfall method was employed, which encompassed the following stages: planning, analysis, design, implementation, testing, and maintenance. PHP serves as the primary programming language, MySQL serves as the database, and HTML and CSS are implemented for the user interface. This method enables the creation of a structured system that is customized to meet the requirements of the user[7].

The absence of an integrated implementation of the EOQ method with technology-based information systems in small and medium-sized enterprises, notably in the retail sector, is a gap in previous research. Consequently, the objective of this investigation is to address this deficiency by integrating information technology and a quantitative approach to EOQ calculations in the development of inventory control systems. It is anticipated that this research will significantly enhance inventory administration in the retail sector, with a particular emphasis on medium-sized enterprises such as Toko Agung.

Research methodology

This investigation implements a descriptive research design and employs a quantitative methodology. Inventory data and sales transactions at Toko Agung over the past year comprise the population of this study. 50 categories of items with high stock turnover are included in the data, each of which is accompanied by data on annual demand (D), ordering cost per order (S), and holding cost per unit per year (H). This information was obtained from the records of purchase and sales transactions, as well as the inventory information that Toko Agung manages. This study uses a quantitative approach with a descriptive research design. Based on research [8], the descriptive quantitative method aims to analyze quantitative data such as costs, order quantities, demand, and inventory levels using the EOQ method. In accordance with this study, which aims to analyze inventory control at Toko Agung using the Economic Order Quantity (EOQ) method to determine the optimal order quantity and minimize inventory costs [9].

The sample data comprises the number of units purchased and sold, the prices of the units at the time of purchase and sale, and the expenses associated with storing the items. The optimal order quantity that minimizes total inventory costs is determined by analyzing all of this transaction data to calculate the EOQ for each item type.

The EOQ formula employed in this investigation is as follows:

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

In addition to the EOQ, this study also examines the reorder point (R.P.) with the following hypothesis:

$$ROP = d\ X\ L$$

The current inventory control system's efficiency was analyzed, and the operational costs were compared to those generated by the EOQ method. This method was employed. The data processing and automated EOQ calculations in this study were conducted using Microsoft Excel and MySQL software.

System development methods

This study employs system development with the SDLC (system development life cycle) waterfall model method. Based on research [10], the SDLC (software development life cycle) method is a systematic approach to software development, involving stages such as planning. analysis, design, implementation, testing, and maintenance. This method is very relevant for projects such as developing an EOQ-based inventory management system, because it ensures that every stage of software development is carried out in a structured manner to achieve optimal results.

The steps in the SDLC system development technique are as follows:

1. Planning
   a. Identify system needs from inventory management analysis using the EOQ method.
   b. Define the main objectives, such as automatic EOQ calculation and inventory reports.
2. Analysis:
   a. Analyze user and system needs.
   b. Identify the main variables in EOQ: demand (D), ordering cost (5), and holding cost (H).
3. Design:
   a. Design the user interface (UI) such as dashboards, data input pages, and reports
   b. Determine the system architecture (on-premises application, cloud-based, etc.)
4. Implementation develop the system with a specific programming language or platform such as Python, JavaScript, or a web framework.
5. Testing test the system to ensure the EOQ calculation is correct and other features are working.
6. Maintenance: maintain the system to keep it relevant and updated according to business needs.

EOQ Implementation

The stages in implementing the Economic Order Quantity (EOQ) method for controlling inventory at Toko Agung are as follows [11]:

1. Determining the Optimal Purchase Quantity
   The Economic Order Quantity (EOQ), also referred to as the optimal economic buy quantity, must be determined by using the following formula to determine the optimal number of orders or purchases at the time of order placement: As a result, the optimal quantity of raw material purchases in 2023 is 190, with a reorder cycle of 180 days and a number/frequency of orders in two times of 95.
2. Determining Safety Stock
   Safety stock helps shield the business from the possibility of stock outs (raw material shortages) and delays in the delivery of required raw materials. To lessen the losses brought on by stock outs, safety stock is required. The quantity of deviation analysis will be decided once the standard deviation for each year is known. With two standard deviations of 5% and a value of 1.65, the tolerance limit is often set at 55% above and 5% below the estimate.
3. Determining Reorder Point
   The company must reorder its raw materials at the Reorder Point (ROP) in order to ensure timely delivery of the ordered raw materials. due to the fact that raw materials ordered cannot be delivered that day. Lend time is the amount of time needed between placing the order for raw materials and when those materials arrive.
4. Determining Maximum Inventory
   Maximum inventory is needed by the company so that the amount of inventory in the warehouse is not excessive so that there is no waste of working capital. As for knowing the amount of inventory.
5. Calculation of Total Raw Material Inventory Cost (TIC)
   To determine the minimal total raw material inventory cost, it is necessary to compare the raw material inventory costs calculated according to EOQ with those calculated by the company. In order to ascertain the total inventory, this is implemented.The company is implementing cost savings. The Total Inventory Cost (TIC) formula in rupiah will be employed to calculate the total inventory costs according to the EOQ method.

Results And Discussion

In this study, the author carried out the steps contained in the SLDC waterfall model method stages. Here are some steps in the SLDC system development method.

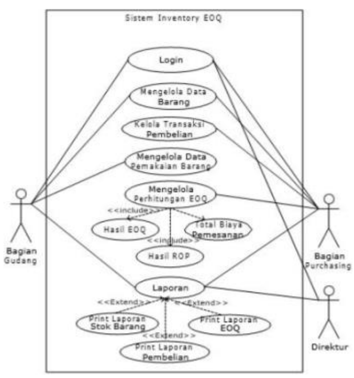
1. Planning
   a. Identify system needs from inventory management analysis using the EOQ method.
   b. Determine the main objectives, such as automatic EOQ calculations and stock reports.
2. Analysis:
   a. Analyze user and system needs
   B. Identify the main variables in EOQ: demand (D), ordering costs (S), and storage costs (H).
3. Design:

A diagram that illustrates the data flow of a process or system, typically an information system. Flow diagrams furnish data regarding the input and output of each entity, as well as the process itself. In accordance with the current system, flow diagrams include UML images, including Sequence Diagrams, Activity Diagrams, and Use Case Diagrams.

a. Use Case Diagram

From the viewpoint of individuals who are not part of the system (actors), a Use Case Diagram elucidates the advantages of an application. This diagram illustrates the functionality of a system or class and its manner of interaction with the external environment. Use case diagrams can be implemented during the analysis phase to document the system's requirements or requests and to comprehend its functionality. The relationship between the system and the actor is depicted in use case diagrams.

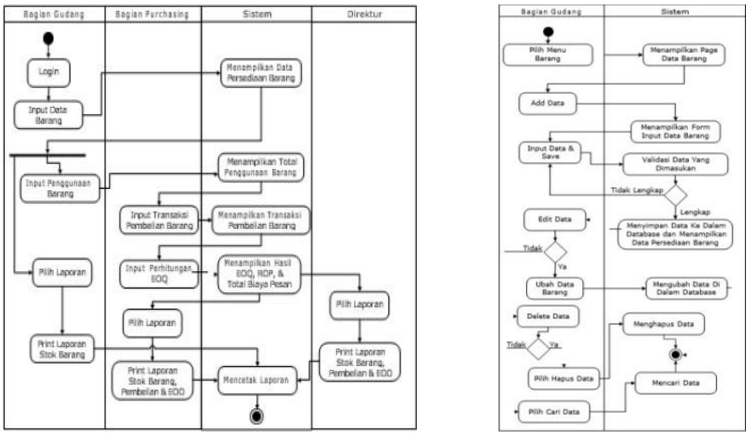
An actor is an example of a human entity or a system that operates on the system. A use case is a detailed description of the functionality that a system is required to provide. Use cases are employed to ascertain the functions that are accessible within the information system and the individuals who are authorized to utilize them. Figure 1 illustrates the subsequent information.



Ficture 1. Use Case Diagram

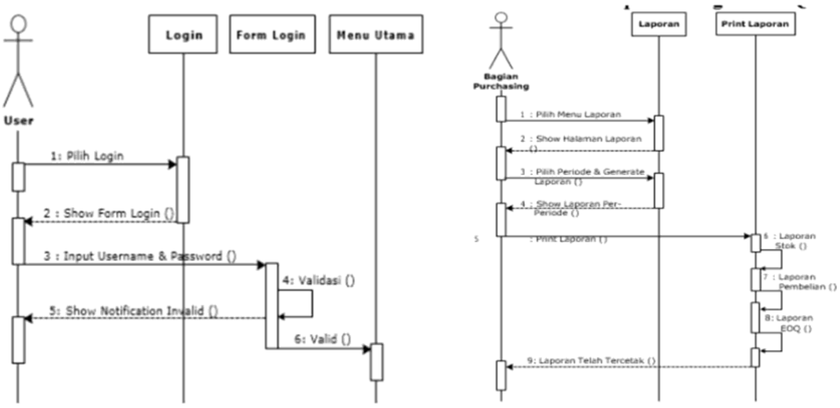
b. Activity Case

The system may perform the activity since the activity diagram explains the system activity rather than what the actor does. One or more use cases may be used to realize an activity. Use cases explain how actors use the system to carry out tasks, whereas activities represent the process that is already underway. Activity diagrams typically outline the broad process and trajectory of an activity from the highest level. The following can be seen in Figure 2



Ficture 2. Activity Diagrams

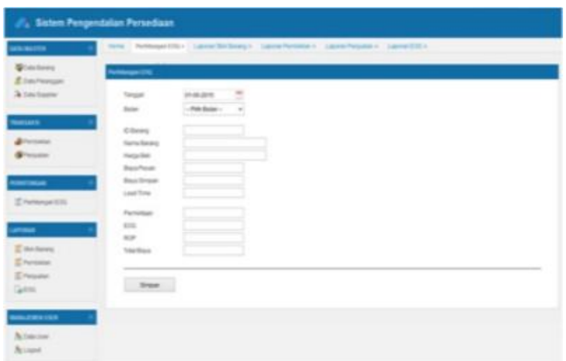
c. Sequence Diagram



Ficture 3. Sequence Diagram

d. Implementasi Sistem

Implementasi program merupakan tampilan layar aplikasi setelah dilakukannya proses development seprti



Ficture 4. Desain system

Toko Agung has effectively reduced inventory costs by 15% through the optimization of order quantities and the reduction of storage costs through the implementation of the Economic Order Quantity (EOQ) method. The web-based system that has been devised facilitates more efficient stock management and mitigates the risk of overstocking and stockouts. The EOQ calculations for 50 critical products illustrate the implementation of more efficient and timely inventory management.

Implementation of EOQ Calculation

In this system, the Economic Order Quantity (EOQ) method is employed to determine the optimal purchase quantity that minimizes total inventory costs, which include holding costs and ordering costs. Based on real-world data inputs, including annual demand, procurement costs, and annual holding costs per unit, this calculation is automatically performed in the developed system. The EOQ summary is as follows:

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

The following are three examples of EOQ calculations that were applied to critical items at Toko Agung and adapted to their respective parameters.

a. Instant Rendang Noodles (BRG003)
   1. The annual demand (DDD) is 1,200 units.
   2. Ordering cost (SSS) = Rp50,000 c.
   3. Holding cost (HHH) = Rp500

$$EOQ = \sqrt{\frac{2*1200*50000}{500}} = 489.9 \text{ unit}$$

b. Bar Bath Soap (BRG006)
   4. The annual demand (DDD) is 900 units.
   5. Ordering cost (SSS) = Rp60,000 .
   6. Holding cost (HHH) = Rp800

$$EOQ = \sqrt{\frac{2*900*60000}{800}} = 367.42 \text{ unit}$$

c. 1 Liter Cooking Oil (BRG001)
   7. The annual demand (DDD) is 600 units.
   8. Ordering cost (SSS) = Rp70,000 .
   9. Holding cost (HHH) = Rp1000

$$EOQ = \sqrt{\frac{2*600*70000}{1000}} = 289.83 \text{ unit}$$

The Economic Order Quantity (EOQ) method has been successfully implemented at Toko Agung to ascertain the optimal order quantities for a variety of items. The calculated EOQ for six sample items varied from 258 to 490 units, contingent upon the item's characteristics. The EOQ implementation effectively mitigated waste resulting from overordering and the potential for stockouts. Additionally, the system simplifies procurement decisions and enhances inventory management efficiency by calculating reorder points based on average daily consumption and lead times.

Conclusion

The Economic Order Quantity (EOQ) method was effectively implemented at Toko Agung, resulting in a 15% reduction in inventory costs through the optimization of order quantities and the reduction of storage costs. The web-based system that has been developed and implemented facilitates more efficient stock management, mitigates the risk of excess and stockouts, and simplifies operational decision-making. Nevertheless, this investigation is restricted to a single retail establishment with data that spans a single year, and it does not account for external factors such as market changes or price fluctuations. It is advised that future research expand the research sample, incorporate external variables into the EOQ calculation, and create a system with a machine learning-based demand forecasting feature to enhance the accuracy of inventory calculations.

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