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Implementation of ROP and EOQ in the Stock Management Information System at Panglong Siagian Bersaudara Based on Website

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Abstract

Advances in information and communication technology have encouraged the transformation from manual systems to digital-based systems, including in stock management. This research aims to develop a website-based stock management information system using the Reorder Point (ROP) and Economic Order Quantity (EOQ) methods for Panglong Siagian Bersaudara. ROP is used to determine reorder time, while EOQ calculates the optimal number of items that must be ordered to minimize total costs. The system was designed using the Rapid Application Development (RAD) method, resulting in a fast and structured design. The implementation results show that the system is able to increase stock management efficiency by reducing the risk of shortages or excess items, optimizing storage costs, and supporting real-time data-based decision making. With the integration of ROP and EOQ, this system provides a comprehensive solution for stock management at Panglong Siagian Bersaudara.

Keywords: Stock Management, Reorder Point (ROP), Economic Order Quantity (EOQ)

1. Introduction

The rapid advancement of information and communication technology in the current digital era has brought significant changes in various sectors, including in stock management [1]. Previously manual information systems have now shifted to digital-based systems to improve efficiency and accuracy [2]. Stock management, which is a crucial element in the business world, requires a reliable system to ensure product availability and avoid shortages or excess stock [3]. With a website-based information system, companies can manage stock more effectively, reduce the potential for human error, and facilitate real-time decision making [4].

Panglong Siagian Bersaudara is a business engaged in the sale of building materials, where stock management is a very crucial element. In daily operations, Panglong must ensure that stock is always available in sufficient quantities to meet customer needs without experiencing stock shortages (stockouts) that can disrupt the smooth running of the business. On the other hand, storing excessive stock can incur significant additional costs, such as warehouse rent, maintenance costs, and the risk of damage to goods. Currently, stock management at Panglong Siagian Bersaudara is still not computerized, namely by using written records and simple spreadsheets. In practice, every time there is a purchase or sales transaction, employees record the number of incoming and outgoing goods in a notebook or spreadsheet file.

This process takes quite a long time, especially when having to match transaction data with the amount of physical stock in the warehouse. In addition, the absence of an automation system makes data management prone to errors, such as miscalculations, unsynchronized data, or even loss of important data. Employees must also check stock regularly by counting goods in the warehouse. This process is not only time-consuming, but also has the potential to disrupt smooth operations when checks are carried out during working hours. In addition, the difficulty of predicting future stock needs often makes management face challenges in determining the number of goods to be reordered, so that the risk of stock shortages or excess stock becomes higher. With the current stock management system,

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Panglong Siagian Bersaudara faces various challenges, such as time efficiency, data accuracy, and optimization of storage costs. This shows the urgent need for a more modern and automated solution to manage stock effectively and efficiently.

In a competitive business world, efficient stock management is essential to maintaining smooth operations and customer satisfaction [5]. Panglong Siagian Bersaudara, as a business engaged in the sale of building materials, faces challenges in ensuring that stock is always available without incurring excessive storage costs. Problems such as stockouts due to late orders and excess stock that increase storage costs often occur because stock management is still done manually. Therefore, the implementation of the Reorder Point (ROP) and Economic Order Quantity (EOQ) methods in a website-based stock management information system is considered the right solution [6]. The ROP method will ensure that reorders are made at the right time before stock runs out, while EOQ helps determine the optimal number of items to be ordered to minimize the total cost of stock management [7]. With a computerized and integrated system, Panglong Siagian Bersaudara is expected to be able to overcome stock management problems, increase efficiency, and optimize the availability of goods in the warehouse at a more controlled cost. The difference between this study and previous studies, such as the study conducted by Setiawan [8] entitled "Using EOQ in Retail Store Stock Management," lies in the focus of implementation. Setiawan only uses the EOQ method, while this study combines EOQ and ROP to provide more comprehensive results in stock management. In addition, Setiawan's research focuses on retail stores in general, while this study is more specifically applied to panglong or building stores. This approach provides added value because it adapts to the needs and characteristics of different businesses.

2. Research Methods

The data collection process is carried out using the Research and Development (R&D) method. The R&D research method is a research method used to produce certain products and test the effectiveness of these products [9].

Figure 1. Research and Development (R&D) Method

The stages or steps in this method are as follows [10]:

1. Potential and Problems

At this stage, the author conducted pre-research at Panglong Siagian Bersaudara to obtain potential and problems.

2. *Data Collection*

Data collection will be carried out in three stages, namely:

a. This observation is carried out systematically. In this case, the author conducted direct observations at Panglong Siagian Bersaudara to obtain information (Samsudin et al., 2022).
b. Interviews were conducted to obtain the required data. In this case, the author conducted an interview with Mr. Atma Wijaya Siagian S.Ikom as the Owner of Panglong Siagian Bersaudara.
c. Literature study was conducted by studying many previous studies, both in the form of journals, theses and also by studying books related to the problems of this research [12].

3. Product Design

At this stage, the author uses a system development method, namely the Rapid Application Development (RAD) method for product design that will produce a product in the form of a system.

2.1 *System Development Method*

This study uses the Rapid Application Development (RAD) model to build an information system. RAD or Rapid Prototyping is a software development process model that is classified as an incremental (multilevel) technique [13]. RAD emphasizes short, brief, and fast development cycles. RAD uses an iterative method in developing a system where the working model of the system is constructed at the beginning of the development stage with the aim of determining user requirements [14].

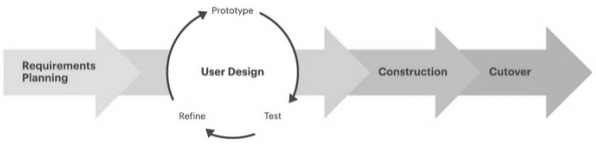

Figure 2. Rapid Application Development (RAD) Method

1. Requirements Planning

At this stage, the author conducts observation and interview activities to identify the purpose of the application or system and identify what information needs are needed. This stage requires an active role from both parties, namely between the author and the Panglong Siagian Bersaudara.

2. RAD Design Workshop

At this stage, the proposed system design is carried out so that the needs and analysis are better understood. Then the proposed system is expected to run well and be

able to solve the problems properly. This application modeling is done using the Unified Modeling Language (UML) [15].

3. Implementation

At the implementation stage, the author will apply this research to a Website-Based Stock Management Information System in Panglong Siagian Bersaudara. The system is built based on the process design and interface design that have been created previously. Then the system will be tested using black box testing.

2.2 *Reorder Point (ROP) Method*

According to Rangkuti reorder point is the ordering point that must be carried out by a company, in connection with the existence of lead time and safety stock [16]. ROP answers the question of when to start placing orders. ROP or what is commonly called the limit/reorder point including the ROP model request occurs when the amount of inventory in stock continues to decrease so that we must determine how much the minimum limit of inventory levels must be considered so that there is no shortage of inventory. The expected amount is calculated during the grace period, it may also be added with safety stock which usually refers to the probability or possibility of stock shortages during the grace period [17].

The following is the ROP formula with a variable level of raw material usage obtained from Rangkuti (2005:157) as follows:

$$ROP = d\ x\ l$$

Description:
ROP = Reorder Point (unit)
d = Daily raw material usage (unit/day), namely annual raw material usage divided by the number of working days in the year
L = Lead time for new orders (days)
SS = Safety stock or safety stock (unit)

2.3 *Economic Order Quantity (EOQ) Method*

The data analysis method in this study uses the Economic Order Quantity (EOQ) method. The EOQ technique can be used to help determine efficient inventory. This EOQ model not only determines the optimal order quantity but more importantly concerns the financial aspects of decisions about the order quantity [18]. Economic Order Quantity (EOQ) according to Haming and Mahfud [19], is the number of units ordered at the lowest (economical) or optimal cost. Meanwhile, according to Heizer and Render [20], EOQ is one of the oldest and most widely known inventory control techniques, this inventory control method answers 2 (two) important questions, when to order and how much to order.

In determining or solving the economical order quantity, this can be done in 3 ways (Sinaga, 2023), namely:

1. Tabular Approach

Determining the economical order quantity with a tabular approach is done by compiling a list or table of the number of orders and the amount of costs per year. The number of orders containing the smallest amount of costs is the economic order quantity.

2. By using the formula (Formula Approach)

The method of determining the number of economic orders by deriving in mathematical formulas can be done by considering the minimum amount of inventory costs.

The calculation of EOQ can be calculated using the formula:

$$\text{EOQ} = \sqrt{\frac{2.\text{R}.\text{S}}{\text{H}}}$$

Description:
EOQ = Optimal number of items per order
R = Annual demand for inventory items in units (Demand)
S = Shipping costs (Delivering Cost)
H = Storage costs (Carrying Cost)

To be able to calculate how many times a company can make purchases in a year, it is necessary to calculate the frequency of inventory. The calculation to calculate the amount of inventory with the formula is as follows:

$$\text{Estimated number of orders} = \frac{\text{R}}{\text{EOQ}}$$

The calculation to calculate the annual ordering cost with the shipping cost formula is as follows:

$$\text{Shipping cost} = \frac{\text{R}}{\text{EOQ}}\ \text{x S}$$

The calculation to calculate the annual storage cost with the storage cost formula is as follows:

$$\text{Storage cost} = \frac{\text{EOQ}}{2}\ \text{x H}$$

The calculation to calculate the average annual inventory with the formula is as follows:

$$\text{Average inventory} = \frac{\text{EOQ}}{2}$$

3. Graphical Approach

Determining the economic order quantity with the graphical approach is done by depicting carrying cost and delivering cost graphs in one image, where the horizontal axis is the number of orders per year, and the vertical axis is the amount of delivering cost, carrying cost and total cost.

3. Results and Discussion

3.1 Reorder Point

Reorder point will be used to determine when the right time is to reorder. The use of reorder point can avoid stock outs that can result in the cessation of service to consumers. To be able to calculate the reorder point of a product, you can use the formula:

$$ROP = d\ x\ l$$

Where:
ROP: Stock point for reordering
d: Average sales per day
l: Order duration

For example, to calculate the reorder point using historical data from the dataset provided. The following is historical data on sales of 1x8 cm random wood from December 2023 to November 2024:

Table 1. Sales of 1x8 Random Wood

Month	Amount
December 2023	100
January 2024	90
February 2024	100
March 2024	85
April 2024	100
May 2024	90
June 2024	90
July 2024	90
August 2024	90
September 2024	85
October 2024	85
November 2024	90

From the data displayed, the amount of wood sales during the year is known, to be used in calculating the reorder point we can use this data to calculate the average sales per day.

$$d = \frac{\sum \text{Monthly Sales}}{365}$$

$$d = \frac{100 + 90 + 100 + \cdots + 90}{365} = \frac{1095}{365} = 3 \text{ sticks/day}$$

After knowing the average daily sales. To calculate the reorder point, the length of the ordering time is also needed. Where the ordering time for 1x8 cm random wood is 7 days so that the reorder point is as follows:

$$ROP = dxl = 3\ x\ 7 = 21 \text{ sticks}$$

So it is known, the right time to reorder and avoid running out of stock during the ordering period is when the warehouse stock is 21 sticks. The following are the results of the Reorder Point for other goods using the formula used previously.

Table 2. Reorder Point Results of Goods

Goods	Daily Ordered	Order Time	Reorder Point
Coconut Wood uk 1x2cm	2.9	7	20.3
Green Bamboo	1.6	7	11.2
Zinc Nails 2 inci	0.2	5	2
Regular Nails 1 inci	0.2	5	2

3.2 Economic Order Quantity

Economic Order Quantity or EOQ is the most economical quantity of goods ordered. The calculation of EOQ before reordering goods aims to determine the most ideal quantity of goods ordered based on ordering costs and storage costs. To be able to calculate EOQ, you can use the formula:

$$EOQ = \sqrt{\frac{2.R.S}{H}}$$

Where:
EOQ: Stock point for reordering
R: Number of goods needed for a year
S: Shipping costs
H: Storage costs per unit

Like the example above, the example of the EOQ calculation also uses arbitrary wood measuring 1x8cm as an example. Where the annual requirement for arbitrary wood measuring 1x8 cm is 1095. Then the details of the ordering costs are as follows:

Table 3. Shipping Costs

No	Name Cost	Amount
1	Gasoline	50.000
2	Parking	10.000

From the details of the shipping costs above, it is known that the total cost for each shipment of goods

is IDR 60,000. Next is to determine the cost of storing goods with the following details:

Table 4. Storage Costs

No	Name Cost	Total	Amount Per Year
1	Electricity	250.000/bulan	3.000.000
2	Warehouse Rent	20.000.000/tahun	20.000.000

From the details above, it is known that the cost of storing goods per year is Rp. 23,000,000. After knowing the total shipping costs and storage costs for all goods in the warehouse. However, for the EOQ calculation for each item, the total cost must be divided by the total number of goods in the warehouse and because during storage, the goods do not store all the needs for a year at one time, so the average number of goods stored at one time must be used. For example, the following is the EOQ calculation for random wooden goods measuring 1x8cm with a warehouse having 20 types of goods with an average monthly storage.

$$EOQ = \sqrt{\frac{2.R.S}{H}}$$

$$EOQ = \sqrt{\frac{2x1095x60000}{\left(\frac{2300000}{20x(\frac{1096}{12})}\right)}} = \sqrt{\frac{131400000}{12602.74}}$$

$$= 102.1 \text{ pieces}$$

From the explanation of the calculation example above, it is known that the number of EOQ for any wood measuring 1x8 cm is 102.1. So it can be concluded that the ideal number of orders for any wood measuring 1x8cm is 102 pieces in each order. The following are the results of the Economic Order Quantity of other goods using the formula used previously.

Table 5. Results of Economic Order Quantity of Goods

Goods	EOQ
Coconut Wood uk 1x2cm	93
Green Bamboo	65
Zinc Nails 2 inci	9
Regular Nails 1 inci	9

4. System Design

After knowing the ideal ordering point and order quantity for each item, the next stage is to design a system that can accommodate and use previous calculations appropriately and effectively. Here is the design of the Panglong Siagian Bersaudara Stock Management Information System:

Use Case

A use case diagram is a diagram that shows the interaction between the system and the user in each use case. Here is a depiction of the use case diagram for the Panglong Siagian Bersaudara Stock Management Information System:

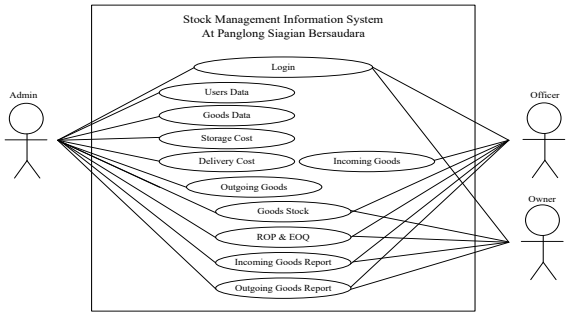

Figure 2. Use Case Diagram

From the depiction of the use case diagram above, it is known that this system will later have 3 levels of actors, namely the admin who holds full control of the system, then the warehouse officer who is in charge of updating every transaction of goods both incoming and outgoing, and the owner who functions to check the stock condition and every transaction made.

Activity Diagram

Activity diagram is a type of diagram that shows the process flow of an activity in the system.

Admin Manages Goods Data

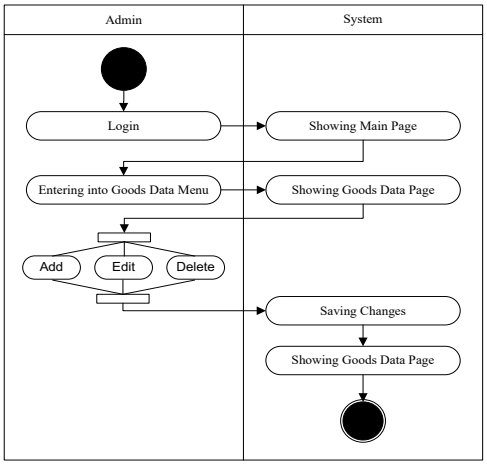

Figure 3. Activity Diagram Admin Manages Goods Data

The activity diagram of the admin managing goods data displays the admin process flow in adding goods data to the system. Each item data added by the admin has information on the item name, annual needs,

and order duration which are useful for calculating ROP and EOQ later.

Officer Reports Outgoing Goods Transaction

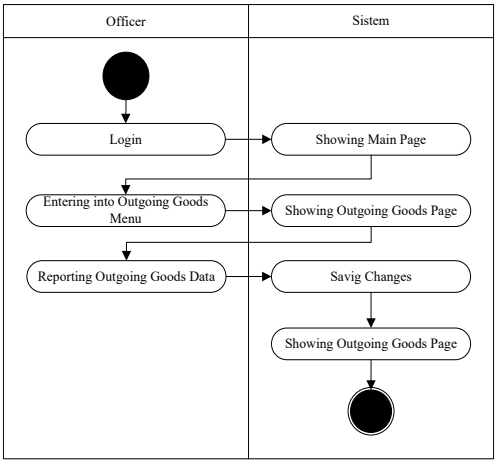

Figure 4. Activity Diagram Officer Reports Transaction

Officer reports outgoing goods transaction depicts the officer's process in recording outgoing goods transactions from the warehouse in the system. This recording is useful for finding out historical data on sales of goods at Panglong.

Owner Checks Stock Condition

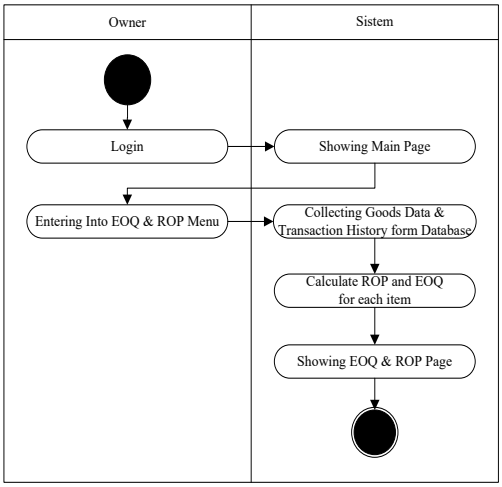

Figure 5. Activity Diagram Owner Checks Stock Condition

The owner's activity diagram checks stock condition depicts the owner's process flow in checking goods and stock to later determine the order and number of orders for Panglong shopping goods.

Class Diagram

A class diagram is a depiction of the database structure into classes and the interaction of these classes in handling the process. The following is a class diagram for the design system:

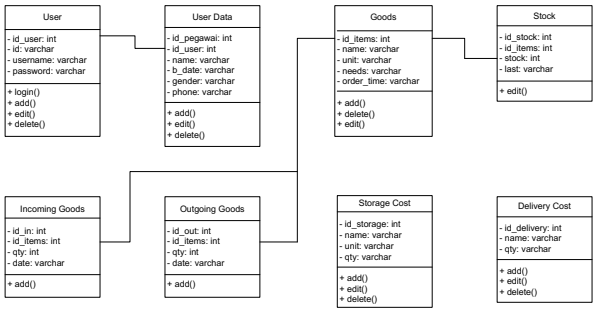

Figure 6. Class Diagram

System Flowchart

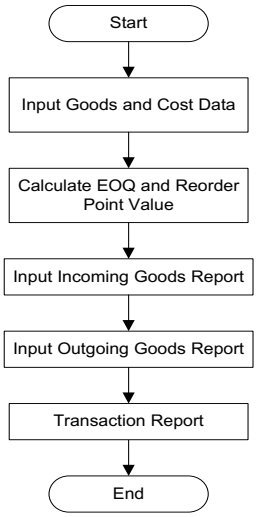

Figure 7. System Flowchart

5. Implementation

After the design is successfully carried out, the next stage is to implement the design into the system. The following are the results of the system design implementation.

Item Data Page

The item data page is a page that can be accessed by the admin to manage item data stored in the system to be used later in calculating EOQ and ROP.

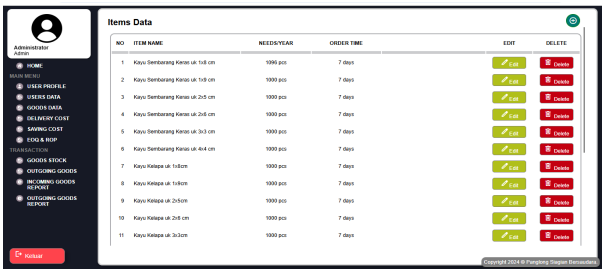

Figure 8. Item Data Page

Report Outgoing Item Page

The report outgoing item page is a page that can be accessed by warehouse officers. Through this page, officers can record every outgoing item transaction in the system which will later be useful as historical data for items in the system.

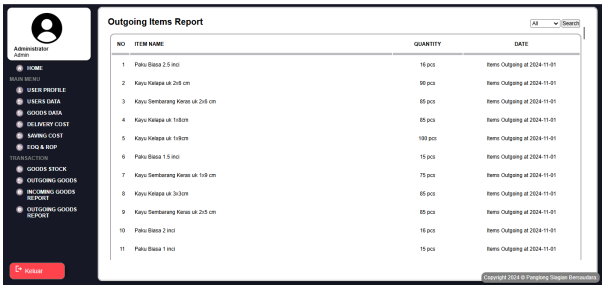

Figure 9. Report Outgoing Item Page

EOQ & ROP Page

The EOQ & ROP page is a page that displays the results of EOQ & ROP calculations from data stored in the system. Which will later be useful for the owner in making decisions.

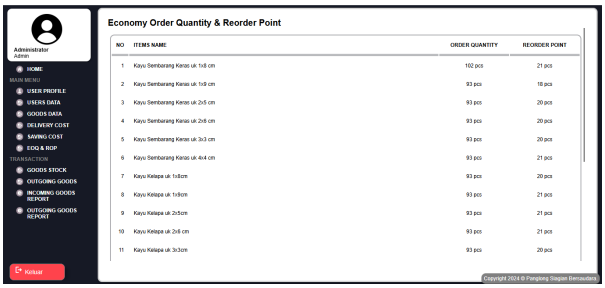

Figure 10. EOQ & ROP Page

4. Conclusion

From the results of observations and research conducted, it is known that using Reorder Point in stock management can provide suggestions for ordering points for goods to avoid running out of stock during the ordering period. And determining the Economic Order Quantity in stock management can help provide suggestions for the most ideal order quantity based on ordering costs and storage costs. So that implementing both in the stock management system is expected to help stock management to be more efficient both in terms of time and cost.

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