Application of EOQ, Safety Stock and ROP methods in the Information System for Production of Raw Materials

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Abstract

The raw material inventory management process is very important because if raw materials that are not durable are stored for too long causing damage so this results in losses for the company. Inventories can be controlled using the Economic Order Quantity (EOQ) method. This method can produce calculations of economic order quantities with minimal costs. An information system with an EOQ calculation function to control the amount of raw materials from the inventory process using the EOQ method by considering Safety Stock and Reorder Points (ROP), and presenting accounting reports in the form of journals, ledgers, purchasing reports and production data reports. The implementation of EOQ by considering Safety Stock and RO in the information system will make it easier for companies to control the available raw materials.

Keywords: Economi Order Quantity, EOQ, Safety Stock, Reorder Points, ROP, Raw Material

1. Introduction

Raw materials that are not durable and whose availability are based on the season, as well as erratic weather factors cause the availability of raw materials is not always the same. there are several raw materials for production if it has passed the time limit, then the quality of raw materials will decrease so that it cannot be used anymore to be produced. Ordering of raw materials is done weekly, one time ordering about 40 tons. The company orders new raw materials at one supplier. The purchasing department will re-order raw materials when it is deemed that the inventory in the warehouse is running low. There is no exact number of minimum inventory problems in the warehouse to determine the reorder of a raw material. Sometimes the order of 40 tons of raw material is too much for one month, when the raw material is stored too long in the warehouse, the quality of the raw material will decrease or even be damaged so it must be discarded and very detrimental to the company. In addition, the company still records conventional raw materials, which are still using notebooks, so that errors in data processing often occur, and it becomes difficult, especially when wanting to know the availability of raw materials.

Thus, a careful calculation method is needed along with efficiency and is able to reduce the cost of raw material inventory as optimal as possible for that using the Economic Order Quantity (EOQ) method by considering Reorder Points (ROP) and Safety Stock. EOQ is the optimal control of requests or ordering of items with the least possible inventory costs. The lowest possible cost is the storage cost (Carrying cost) and the order cost (Ordering cost).

The application of EOQ, Safety Stock, and ROP methods in the Raw Material Inventory Information System can assist companies in planning optimal supply control of raw materials by ensuring the needs and smoothness of the company's activities in the right quantity and quality as well as with optimal costs in order to assist in the management process availability of raw materials.

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2. Methodology

Research approach

This research uses a scientific research approach that is by studying and observing the company's business processes, as well as science and technology.After carefully knowing the company's business processes, the subsequent application of the company's business processes into the development of information systems.

The phenomena about what is experienced by the subject such as behavior, perception, motivation, action, and others. Holistically, in a descriptive way in the form of words and language.
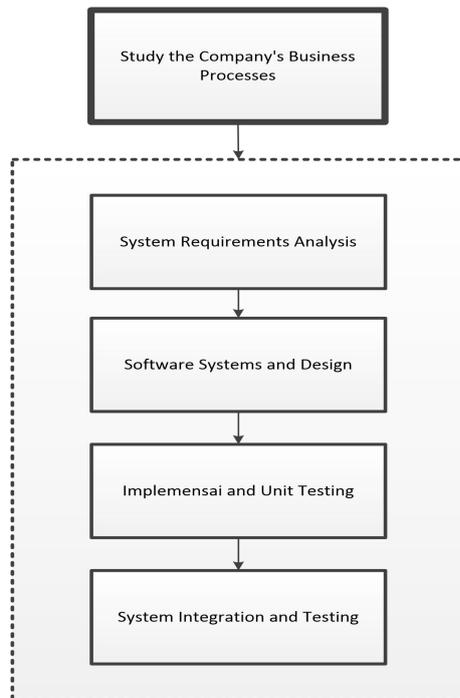

Figure 1: Research approach

3. Result and Discussion

Company Business Process
The following results are observations of business processes at the company.

1. The process of purchasing raw materials
    The inventory section makes a list of raw materials, then produces a list of raw materials. From the document the list of raw materials is given to the purchasing department. After that the purchase makes an order and validates the proof of sale. Then from the evidence of the sale makes a report on the receipt of raw materials. Reports on receipt of raw materials are given to the inventory section, the inventory section updates the stock of raw materials, then produces a book of raw material stocks.

2. Sales Planning Process
    The sales department creates sales target data, then generates sales data last month which is submitted to the sales department. The sales department will then determine the sales target and produce two copies of the sales target document. The sales department will then create a raw material request form and produce a raw material request form that will be archived by the sales department itself.

3. Production process

The production department provides the raw material request form to the inventory section. Then the inventory will check the availability of raw materials. If raw materials are available, it will be issued which produces a record of raw materials coming out, then produces a raw material inventory book and raw material documents. The raw material documents are submitted to the production department. Then the production department will process it into finished goods and will produce finished goods documents which are self-archived by the production department. If the raw material is not available, the request form for the raw material is given to the purchasing department, then the purchasing department will purchase the raw material.

Economic Order Quantity (EOQ)
Economic Order Quantity (EOQ) is the number of orders that have minimum order and storage costs. Thus, to determine the economical number of orders, it is necessary to see the increase in order costs and storage costs as well as the average inventory size. Purchases (orders) based on this EOQ can be carried out if using the following assumptions:
1. The purchase price of materials per unit is constant.
2. The material is easily obtained.
3. The amount of production using these materials is stable, meaning that the need for these raw materials is relatively stable throughout the year.

In general, the EOQ calculation model (formula) is as follows:
1. Specifies the number of messages each time:

$$Q_o = \sqrt{\frac{2OD}{TH}}$$

2. Determine order frequency

$$n_0 = \frac{D}{O_o}$$

3. Determine the optimum total cost

$$TO(Q) = \frac{TO_oH}{2} + n_0O$$

Information:
Qo   = EOQ value (number of units ordered)
D   = demand for a period of time
O   = cost per order
T   = time period
H   = storage fee per periodno = number of orders for a period
TO (Q)   = optimum total cost

Safety Stock
Safety Stock or rescue inventory is additional inventory carried out to protect or anticipate the occurrence of material shortages (stock out). Stock out may occur due to the use of raw materials that are greater than originally estimated or delays in receiving raw materials ordered.
The factors that determine the amount of Safety Stock are the use of average raw materials, time factor or lead time.
1. Use of raw materials on average

The average use of raw materials in the past needs to be considered because after re-ordering, customer demand before the ordered goods come must be fulfilled by using existing inventory. Customers' needs or demands are usually fluctuating and cannot be predicted with certainty. Therefore, even if we have predicted or estimated the use of inventory for customer needs or requests, there will always be an unavoidable risk, namely running out of inventory before the order material arrives. So for that, Safety Stock is needed to keep the company running smoothly.

2. Time factor or Lead Time

Lead Time is the difference or time lag between when an order is made until the arrival of the ordered item at the inventory warehouse. The time lag is not the same between one order with another. Therefore, Safety Stock is needed to anticipate the problem of production bottlenecks which is caused by delays in ordering materials.

To estimate the amount of Safety Stock, the following method can be used.

> **Safety Stock = (Maximum Usage - Average Usage) x Lead**

3. Reorder Point (ROP)

Reorder Point or reorder point is the minimum time to re-order so that order materials can be received on time. In determining the Reorder Point, the following factors must be considered.1. The use of material during the grace period before the ordered goods arrive.2. Total Safety Stock.

From the factors above, the Reorder Point can be found using the following formula.

> **Reorder Point = (Lead Time - Average usage) + Safety**

Analysis of the proposed system

The related company consists of 6 business processes, namely the business process of purchasing raw materials, the business plan of sales planning, the business processes of production of raw materials to finished goods, the business processes of Eoq calculation, the business processes of calculating Safety Stock and Reorder Points, the business processes of making journals and ledger.

1. Sales Planning Business Process

   The proposed system in the sales planning business process is as follows.
   a. From the Sales target file, the sales department calculates the sales target based on sales data of the previous two months and is saved in the product file.
   b. From the product file is then recorded production needs and saved into a production needs file.

2. Business Process for Ordering Raw Materials

   The proposed system in the business process of purchasing raw materials is as follows.
   a. Inventory section Input raw material data, then recorded stored in raw material file.
   b. Purchasing section Inputs supplier data, then recorded and stored in supplier file. From the Stock Safety File and the raw material file, the purchase can be display order requests for raw materials.
   c. After that the purchase part to input the purchase data and saved into a file purchase. Then the data is displayed, so we can check the list purchase of raw materials.
   d. Purchase invoice is input by the purchasing department, and will automatically update data of raw materials that enter and generate journals.

3. Sales Business Process

   The proposed system in the sales business process is as follows.
   a. Sales department input sales amount.
   b. The sales department will check the availability of product stock, if the product stock is empty, the production department will do the production first.
   c. After the stock, there is a sales department doing sales transactions and displaying sales data. At this stage, it will automatically automatically journ the sales transaction.
   d. The sales department updates the product stock.

4. Business Process of Production of Raw Materials into Finished Goods

   The proposed system in the business process of producing raw materials into finished goods is as follows.

a. The production department inputs the amount of production and is saved in a production detail fileand production file.
b. Then from the production detail file will update the raw material data.
c. The inventory section inputs the product and stores it in the production file.

5. EOQ Calculation Business Process
The proposed system in the eoq calculation business process is as follows.
   a. The production section, select the menu and then input BOM based on the product file andThe raw material file, then saved in the BOM file.
   b. Then the purchasing section calculates eoq and saved into eoq file.

6. Business Process Calculation of Safety Stock and Reorder Points
The proposed system in the business process calculation of Safety Stock and Reorder Points is as following.
   a. The purchasing section calculates Safety Stock and Reorder Points based on raw material files and Purchase files are then stored in the Safety Stock File.
   b. Purchasing and inventory sections can display the Safety Stock calculation results and Reorder Points.

7. Business Process of Making Journals and Ledgers
The proposed system in the business process of making journals and ledgers is as follows.
   a. The finance department Inputs the account and saves it in the Account file.
   b. After that, the finance department input a period to display the journal.
   c. From the journal file will generate automatically into the ledger.

Proposed System Excellence

As for some of the advantages of the proposed system, among others.
1. This new system can help companies manage raw material purchases production based on EOQ results and from purchase transactions able to do calculationsfor Safety Stock and Reorder Points.
2. This new system can help companies to manage production activities based on the purchase of raw materials for production to meet sales targets.
3. This new system can help companies to manage sales based on sales target results.
4. This new system can help companies to display general journals, ledger, purchase reports, and production data reports.

Overview of the System to Be Built

Analysis of system requirements outline discusses the functional requirements of the application system, software requirements, and hardware requirements.

1. Systems Functional Requirements Analysis
The functionality required in this application include the following.
   a. The Master Data Process
   This process contains master data management information, containing the following activities.
      1) Manage product data recording, is a menu that is used to input, edit, and view product data.
      2) Manage the recording of raw material data, a menu used for input, edit, and view raw material data.
      3) Manage supplier data, which is a menu used for Input, edit, and view supplier data.
      4) Manage the recording of Bill of Material (BOM), a menu used for Input, edit, and view BOM data.
      5) Manage account data, which is a menu used for Input, edit, and view account data.
   b. The Process of Managing Sales Targets for Production Needs
   This process contains information about the sales target data carried out by the sales department, the process consists of Input, edit, and see the sales period, the sales target for that period, and the unit sales target.
   c. EOQ Calculation Process

This process contains information about the calculation of EOQ, the process consists of input the amount, the cost of ordering, the purchase price of inventory and storage costs and see the results of the calculation of EOQ.

d. Safety Stock Calculation Process

This process contains information about the Safety Stock calculation process consisting of Input and edit maximum usage, average usage and Lead Time and see the results of Safety Stock calculations.

e. Reorder Point Calculation Process

This process contains information about calculating Reorder Points. The process consists of Viewing the results of a Reorder Point calculation. Reorder Point calculations take data from the Safety Stock calculation functionality.

f. Purchase Management Process

This process consists of managing the procurement of raw materials and managing the purchase itself. Raw material supply management, is a menu used for the calculation of raw material procurement. Calculation of raw material procurement takes data from the safety stock calculation functionality and production data functionality.

Purchasing data management, is a menu used to input the purchase amount (if the raw material to be purchased is like onion, then the purchase amount will appear automatically with the EOQ calculation) because it retrieves data from the EOQ calculation functionality, purchase price, supplier name (takes data from supplier data functionality), see purchase data, print purchase lists of raw materials, and update incoming raw materials.

g. Production Data Management Process

This process contains information about production data carried out by the production department, the process consists of input, edit, and see the name of the product being produced, the number of production on that day, and the unit of production.

h. Journalizing and Reporting Processsa

1) Journal and General Ledger Processing Process on Purchase Transactions The Big Book is a processed process from journal data. Ledgers will be displayed based on the input period and a certain account number.

2) The Process of Making a Purchase Report and Raw Material Inventory Report in the process of making a purchase report and raw material inventory reports take data from the purchasing functionality. This process is to find out the data of purchases made every time a purchase transaction.

i. Sales Process

In this process is a menu that is used to input the number of sales each day, stock products (taking data from production functionality), and view sales data.

System Planning

The design of this system aims to assist companies in planning optimal supply control of raw materials by ensuring the needs and smoothness of company activities in the right quantity and quality as well as with optimal costs in order to assist in the management of raw material availability.

The design of the application built is object oriented (object oriented) using the Unified Modeling Language (UML).

This system has 5 entities, namely the sales department, the inventory department, the purchasing department, the financial department, and the production department.
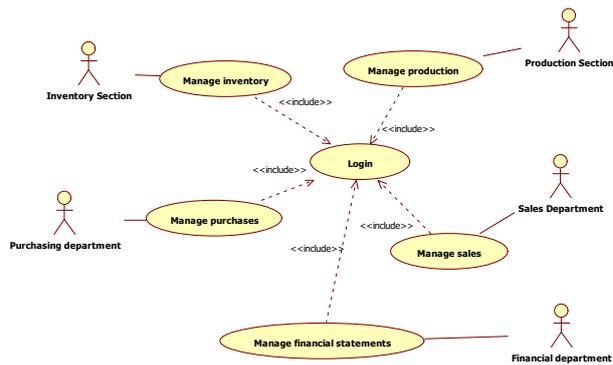
Figure 2: Use Case Diagram of Raw Material Inventory
Management System

System Testing

System Testing is done by means of Black Box Testing. The functionality tested by black box testing includes master
data functionality, purchasing functionality, production functionality, and sales functionality.

1. Login Functionality Testing
   Based on the black box testing results, it can be concluded that the login functionality has been successfully
   implemented 100% in the application according to the expected input and output criteria.
2. Testing of COA Master Data Functionality
   Based on the black box testing results, it can be concluded that the COA master data functionality has been
   successfully implemented 100% in the application according to the expected input and output criteria.
3. Testing of Master Data Functionality of Raw Materials
   Based on the results of black box testing, it can be concluded that the raw material master data functionality has
   been successfully implemented 100% in the application according to the expected input and output criteria.
4. Product Data Master Functionality Testing
   Based on the results of black box testing, it can be concluded that the product master data functionality has been
   successfully implemented in the application according to the expected input and output criteria.
5. Testing the Master Data Supplier Functionality
   Based on the results of black box testing, it can be concluded that the supplier master data functionality has been
   successfully implemented 100% in the application according to the expected input and output criteria.
6. Testing Purchasing Functionality
   Based on the black box testing results, it can be concluded that the purchase functionality has been successfully
   implemented 100% in the application according to the expected input and output criteria.
7. Production Functionality Testing
   Based on the results of black box testing, it can be concluded that the production functionality has been
   successfully implemented 100% in the application according to the expected input and output criteria.
8. Sales Functionality Testing
   Based on the results of black box testing, it can be concluded that sales functionality has been successfully
   implemented 100% in the application according to the expected input and output criteria.

4. Conclusion

The following conclusions based on analysis, design, testing of systems that are built based on the theory used include:

1. This system can help users to manage the purchase of raw materials based on the results of EOQ and from the purchase transaction is able to do calculations for Safety Stock and Reorder Points.
2. This system can help users to manage production activities based on the results of purchasing raw materials for production to meet sales targets.
3. This system can help users to display public journals, bessar books, purchase reports, production data reports.

References

[1]   S. M. Iman Santoso, Akuntansi Keuangan Menengah (Intermediate Accounting), Bandung: Refika Aditama, 2010.

[2]   R. Pura, Pengantar Akuntansi 1 Pendekatan Siklus Akuntansi, Erlangga, 2013.

[3]   I. Fahmi, Pengantar Manajemen Keuangan, Bandung: Alfabeta, 2012.

[4]   A. Diana and L. Setiawati, Sistem Informasi Akuntansi, Yogyakarta: Andi, 2011.

[5]   R.A.S. Surya, Akuntansi Keuangan Versi IFRS, Yogyakarta: GRAHA ILMU, 2012.

[6]   A. Kristanto, Perancngan Sistem Informasi, Yogyakarta: Gava Media, 2011.

[7]   Krismiaji, Sistem Informasi Akuntansi, 3rd ed., Yogyakarta: Sekolah Tinggi Ilmu Manajemen YKPN, 2010.

[8]   Rizky, Konsep Dasar Rekayasa Perangkat Lunak, Malang: PRESTASI PUSTAKA, 2010.

[9]   Rosa and M. Salahuddin, Modul Pembelajaran Rekayasa Perangkat Lunak (Terstruktur dan berorientasi Objek), Bandung, 2011.

[10]   U. Nugraha and M. L. R. Pardiniasa, "Analisis Sistem Informasi Pemasaran Produk Berbasis WEB Dengan Pemodelan UML," *Prosiding Seminar Ilmu Komputer dan Teknologi Informasi,* vol. 2, 2017.