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Cost Implication of Inventory Management in Organised Systems

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ABSTRACT

This paper investigates the role of cost implication in inventory management in order to improve Institutions' Stores. The study takes a critical look at the costs involved and the use of economic order quantity as a tool that minimizes the total inventory costs, the time saved between the manual and the automated operational system using a Nigerian University Store, AYZ University (not the real name because of the ethical issue), as a case study. The study was being guided by the following objectives; to have stocks available when required, to maintain accurate stock records and facilities, and to recommend area improvement of the inventory system at AYZ University Stores. Findings revealed that the economic order quantity is seen as a control technique that is attributed to determine the inventory costs and how it can be minimized. The data collected from the store were analyzed and the results obtained shows that the existing system which is majorly manual based is not effective when it comes to time management and efficiency. A new automated system, computerized maintenance store system (CMMS) was proposed for development and implementation for the AYZ University Store for her end users of the store and her clients from within and outside the University system. This would be greatly improved in terms of both financial and time cost of inventory management.

Keywords-- Cost Implication, System Maintenance, Inventory Management, Economic Order

2010 Mathematics Subject Classification: 12Y05

I. INTRODUCTION

According to James (1973), the objectives of most business include; survival and growth, fulfillment of social responsibilities and realization of satisfaction/profit. The level of returns on investments, enables companies/organized sectors to take advantage of business opportunities, undertake research and innovations which further makes for growth and survival in the long run. This help companies to discharge their social responsibilities and its obligations to the owners. In order to maintain this status quo, it becomes important that positive effects be made to reduce operational costs of the business, increase production and boost the sales of their products. One major component of this cost in many manufacturing organizations that deserves top management's attention is the investment in inventories otherwise referred to as stock. In most organizations, the inventory or stock figure is the largest single item in the current assets group. Excess or shortage of stocks can contribute to the failure of the business. An inventory of a manufacturing company includes – raw materials, work-in-progress (WIP) and finished goods. Raw materials are the basic input materials that are converted into finished goods through the manufacturing process. Normally, the raw materials are purchased and stored for future production. Work-in-progress or semi-finished goods represents products that need extra work before they became finished goods for sale. In an ideal process, stocks or raw materials and work-in-progress facilitates production while stock of finished goods is required for marketing operations.

Horngren (1982) stated that the "optimum inventory level is somewhere between the two danger points". The two danger points are inadequate inventories and excessive inventories. Inadequate inventories disrupt operations and may lead to loss of sales, and loss of goodwill. On the other hand, excessive inventories introduce unnecessary carrying costs and obsolesce risks. Infact, the optimal level is somewhere between these danger points. One of the prime aims of this study is to x-ray the computation and maintenance of this level which guarantees the maximization of profit and this is the essence of efficient and effective inventory management. Therefore, the primary focus of this research is on techniques of managing and controlling stocks for profit maximization as it is practiced in Redeemer's University Stores, the emphasis being placed on cost.The previous works of Onanaye (1998), Automated Stock Control System: University of Agriculture as a case study, and Famodimu (2015), Cost Implication of Inventory Management using blending plant at Apapa as a case study both form the basis of this present study.

1.1 Problem Statement

It is nearly impossible for an inventory management system not to have issues in a firm or an organization. Naddor (1966) suggested that we have an

inventory problem when we need to decide about when to initiate a purchase order (when to buy) and how much to buy (determine the lot size). The major problems faced in the AYZ University's Store would include the following:

- Lack of stock review in the frequent and periodical check of items in the store.
- Lack of when to reorder store items results in an imbalance of stock records.
- Lack of an automated system such as computerized maintenance store system (CMMS), which saves time management and efficiency.

1.2 Aim and Objectives of Study

The aim of this study is to provide the desired level of customer service, to allow cost-efficient operations, and to minimize the cost of inventory management. To achieve the above aim, the following objectives were pursued:

- To maintain availability of materials whenever and wherever required in optimal way.
- To meet a high percentage of demand without creating excess stock levels.
- To maintain adequate accountability of inventory assets.

1.3 Scope of Study

The scope of study covers the cost implication of stock management at the AYZ University Store.

II. COSTING, COST TERMS AND CONCEPTS

Costing is said to involve the ascertainment of costs, for example, of products, services, activities, machines, department. Typical purposes of ascertaining these costs may be stock valuation, pricing, make or buy decisions or judgment of operating efficiency.

Control in the enterprise implies the provision of information so that management may take some corrective action where necessary to bring events back on track.

In this light, the terms costing and management control include the preparation of costs for various decision purposes and of information to support organizational planning and control activities.

Costing information would be the basis of setting minimum prices, making special offers and the range of mark of possibilities. The extent to which individual stores had discretion to make pricing decisions would dictate the degree of detail available in stores or whether this information is maintained centrally.

2.1 Theoretical Framework

The two main inventory theories in inventory management are: inventory management theory which is also known as mathematical inventory theory and the theory of constraints. There are several mathematical models/theories in inventory management depending on the predictability of demand (Heizer and Render,2006). The two common models in scientific inventory theory are deterministic and stochastic inventory models. According to Morgenstern (2007), when demand in future can be determined through forecasting with some precision, deterministic model would be used to set inventory policy. Stochastic on the other hand, is used where the demand in a given period is variable-cannot be predicted.

Theory of Constraints (TOC) is a management philosophy developed by Goldratt (1984) in his book, The Goal. It postulates that an organization is a system, and every system has at least one constraint limiting it from achieving its goal of making (more) money. In order to improve the performance of the system, these constraints must be identified (described) and corrective measures taken. Identifying the constraints help to focus the limited resource to the weakest part for the system to improve.

There are constraints that complicate successful inventory management: uncertain demand, costs lead times, production prices etc (Gunus and Guneri, 2007). Underlying this research is the belief that inventory management in MSEs is faced with some challenges such as escalating inventory costs, untrained personnel, inaccurate record keeping and demand variability.

2.1.1 Inventory costs on inventory management

This study assumed that determination, location and control of costs related to inventory are a major challenge facing effective and efficient inventory management. Sople (2010) included that a lot of working capital is tied in inventory. Similarly, Chase et al (2009) showed that inventory control is vital as it holds up money. Calculating and balancing costs of inventory with appropriate level of responsiveness is very difficult so companies tend to limit costs. This cost containment may lead to low service levels thereby compromising on the competitive ability of an organization.

Inventory costs could emanate from holding costs, costs of stock outs, acquisition costs. First, acquisition costs: acquisition costs include preliminary costs for preparing requisition, negotiation costs; placement costs such as order preparation, stationery costs and post-placement costs which include receipt of goods, material handling, inspection and payment of invoices. Secondly, holding costs are storage cost-space, rates, light, heat and power costs; labor costs that relate to handling, clerical and inspection; cost of insurance; interest on capital tied up: costs of deterioration, obsolescence and pilferage. Other costs related to stock outs: costs associated with lack of inventory. These costs are; loss of production output, costs of idle time, loss of customer goodwill and costs of rectifying the stock out.

2.1.2 Demand variability on inventory management

It was also assumed that change in demand or demand distortion directly affects the management of inventory. According to Tersine (1982), the demand variations affect inventory levels and costs and ultimately the profits. When demand forecast is about low demand but the demand is high, stock outs will be realized therefore compromising on customer responsiveness (Hamisi, 2010). Inversely, high stock levels during low demand period results in high inventory. Demand distortion is basically due to inaccurate information on supplies, inaccurate demand forecasts, batch ordering, price variations and promotions which stimulate forward buying (stock up). Lack of coordination among supply chain members through information sharing creates demand variation throughout the supply chain. This is often referred to as a bullwhip effect. Generally, high demand variability leads to deterioration of inventory management and performance.

2.1.3 Stock Record System

According to Jessop and Morrison (1994), a stock record system is the means of capturing and storing information and a facility for the analysis and use of this information so that the operation of the stores function and the control of stock can be performed in an effective manner. Records and techniques should be appropriate to the items in question and the cost implication considered. An organization should carefully choose the best system suitable to it to avoid a situation whereby a lot of money would be spent on maintaining a very expensive system for items of low value. A record system can be manual or computerized.

Carter and Price (1993), highlights the use of modern technology and argues that computers have the ability to store and retrieve information. The authors argue that many companies now use computers to hold and constantly update stock records. Cole (1997), defines a stock record system as a formal set of records that contain information about stock held within the stores system. The range of this information will depend upon the system employed and the scope of the operation. A similar description of stock records system has been given by Saleemi (2007), who says that stock records refer to documents which give information regarding the movement of stock. These include records kept for both account and costing purposes.

2.1.4 Stock Record Practice

Inventory personnel must review various inventory records to ensure accuracy. During the review, they should ensure that quantities are legible and have a correct unit of issue, and that all added items are identified and legibly recorded. A major difference exists when the physical count of a stock item differs from the confirmed stock record balance by 10 percent or more. A minor difference exists if the count differs less than 10 percent. Adequate, updated and correct inventory records are to be set up and maintained in the stores. All transactions of all inventories are to be properly documented.

According to GOK Supplies Manual (2010), it is important for a stores organization to have a common supply language which is used to positively and uniquely identify any item in a supplies range. This is achieved through the introduction of a single name for an item of supply and a code number assigned to it. Jessop and Morrison (1994), say that the normal way of identifying an item is by simple description. It is therefore necessary to develop a stores code which gives each item of stock a letter, figure or a combination of both which is then used to identify them. It is important to mention here that each item should have only one code.

2.1.5 Common User Items Movement Documentation

The work of capturing data relating to various stores activities taking place in the storeroom is an important aspect of a stock record system. Without a record of the movement of the items in the supplies system accountability is not possible and employees may take advantage of lack of documentation to misappropriate the organizations stores. It is not enough to have records but the records must be up-to-date. Before goods are withdrawn from a storeroom, there must be some authority for the transaction. This is because according to Jessop and Morrison (1994), items in stock represent money and therefore should not be misappropriated or improperly used. The Gok Supplies Manual (2010), states that supplies documents should be kept in a secure place where only the authorized staff can access them. Stock records cards and forms should be available at all times to replace the completed ones. This will prevent a situation where stock recording can be done on ordinary papers which can be easily mislaid. Stock record forms should be of the correct design otherwise data in the forms can be illegible. Appropriate calculators are required by the stock recording staff so that errors in arithmetic are not made on stock records if the staff has to use their mental ability.

2.1.6 Staff skills

Lyson (2000), defines training as a planned process to modify attitudes, knowledge or skill behavior through learning experience to achieve effective performance. Carter and Price (1993), indicate that training of staff is vital if full use is to be made of their abilities. Incompetent employees can render an organization virtually ineffective. Recruitment of the right kind of people in the organization and their training should therefore be done.

2.1.7 Inventory Management

According to Chopra et al. (2007) and Sople (2010) inventory exist in business because of a mismatch between demand and supply. Inventory could be in the form of raw materials, work-in-progress or finished products. Inventory is therefore important in anticipating future

demand and avoiding lost sales. However, the critical decisions in inventory control are when to order and how much to order so as to meet customer requirements, working capital requirements and profitability (Hatten 2012, Christopher, 1992; Hamisi, 2010; Sople, 2010; Chopra et al. 2007).

2.2 Inventory Management Techniques

An inventory system is the set of policies that controls and monitors inventory level and determine what level should be maintained, how large orders should be made and when stock should be replenished. The control of an inventory enables materials to become available whenever and wherever required by stocking adequate number and kind of stocks. The sum total of those related activities essential for the procurement, storage, sales, disposal or use of material can be referred to as inventory management. It is now the responsibility of the inventory managers in charge to stock up when required and utilize available storage space resourcefully, so that available storage space is not exceeded. They also have to maintain that accountability of inventory asset as their responsibility so as to meet the set budget and decide upon what to order, how to order and when to order so that stock is available on time and at the optimum cost (benedict and argeridis, 1994)

2.3 Inventory Control Techniques

The right approach to inventory control utilizing the modern inventory control processes and the new and more refined techniques can provide for a dynamic optimization of inventories to maximize customer service with decreased inventory and at lower costs. The inventory stocks are usually maintained using two systems (Francis and de Souza, 2004).

2.3.1 Two-bin System

It is a perpetual inventory system where each item stock is held in two bins. Firstly, a sufficient supply is kept to meet current demand over a designated period of time. Secondly, safety stock is available to meet the demand during the lead time necessary to fill the order. When the bin stock has been spent, reordering occurs and the stock in the second bin is used to cover requirements.

2.3.2 Ordering System

An organization's objective should be in consonance with the wealth maximization principles. To achieve this, an organization should determine the optimum level of inventory. Sufficient inventory should be maintained. It should be neither excessive nor inadequate. To manage inventory efficiently and effectively, answer should be sought to the following two questions: (a) How much should be ordered; and (b) When should it be ordered. These questions are determined by two sub-systems, i.e., economic order quantity and reorder point.

2.4 Economic Order Quantity

The economic order quantity refers to the order size that will result in the lowest total of order and carrying cost for an item of inventory. If an organization places unnecessary orders, it must maintain large stocks of goods and will have excessive carrying costs. By calculating EOQ, an organization identifies the number of units to order that results in the lowest total of these two costs. There are so many mathematical models available to calculate the economic order quantity. Generally they minimize the cost function.

2.5 Re-order Point Sub-System

An important question in any inventory management system is when an order should be placed so that an organization does not run out of goods. The answer is expressed in terms of units of inventory provided by reorder point sub - system. The reorder point is the level of inventory at which an order is placed in the amount of the EOQ. If an organization places the order when the inventory reaches the reorder point; the new goods will arrive before the organization runs out of goods to sell.

2.6 Perpetual Inventory System

This system is also known as automatic inventory system. It is a system of records maintained by the controlling department, which reflects the physical movement of stocks and their current balance. "It is a method of recording inventory balance after every receipt and issue to facilitate regular checking and to obviate closing down for stock taking.

2.7 Continuous Stocktaking System

An essential feature of perpetual inventory system is a continuous physical stock - taking. This is done by an independent internal audit staff that compares the physical quantity with the quantities shown in the bin card and the stores or the stock ledger. This helps in finding out the discrepancy between the balances as shown by books and by physical verification and taking of remedial measures at the earliest.

III. METHODOLOGY: BASIC ECONOMIC ORDER QUANTITY MODEL

This is the most basic of all inventory models that helps inventory manager answer the question "how much should I order". This model is based on the philosophy of determining an order quantity that minimizes the total cost of inventory. The only two relevant EOQ inventory costs are the holding costs and ordering costs. Following are the some of the assumptions that underlie the determination of EOQ:

- The demand for this item is known and fairly constant.
- The lead time is constant.
- The lead time is known and fixed
- The ordering cost, holding cost, and the unit price remain constant. i.e. no discounts are involved.

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- Orders are being placed to avoid stock outs.
- Safety stock is zero

The EOQ can be computed using the following formula:

$$EOQ = \sqrt{\frac{2CD}{UH}} \quad (1)$$

Where, C = Ordering cost
D = Annual demand
H = Holding cost
U = Unit price

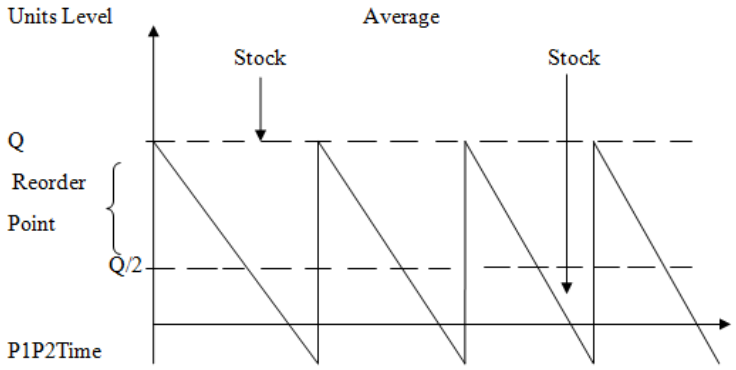

Fig 1 A simple deterministic inventory model

From the above diagram, let Q represents quantity ordered and the distance from P1 to P2 be the time between orders (P). The average inventory level can be calculated to determine the cost of items.

$$\text{Average Stock} = \frac{Q}{2} \quad (2)$$

Where Q = Quantity ordered

The following are important variables in developing mathematical expressions for the annual ordering and carrying costs.

Quantity ordered = Q
Annual demand = D
Ordering cost = OC
Holding cost = HC

The annual ordering cost (AOC) = (number of orders) × (ordering cost)

$$= \frac{D}{Q} \times OC$$

$$= \frac{D}{Q} OC \quad (3)$$

The annual holding cost (AHC) = (average stock) × (holding cost)

$$= \frac{Q}{2} \times HC$$

$$= \frac{Q}{2} HC \quad (4)$$

The total inventory cost = AOC + AOC + D×OC

$$= \frac{D}{Q} + \frac{D}{Q} + \mathbf{DOC} \quad (5)$$

3.1 Holding Costs

Holding costs can be expressed as the average stock held in store multiplied by the price. It depends on the quantity ordered and held in store. The quantity held in store is the average quantity which when held in store, decreases gradually from Q units to zero. The diagrams below illustrate an annual demand of 8000 units.

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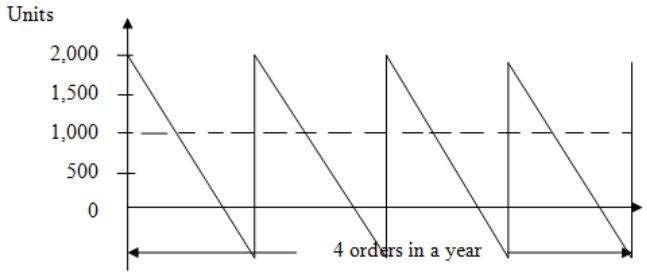

Fig 2 Average stock for 4 orders in a year

As shown in the figure above, the quantity being ordered at any time (Q) is 2,000 being 8000/4 = 2,000 units. Since only half of this Q is held in any reorder period, average stock is Q/2 = 2000/2 = 1,000 units.

When 8 orders is made in the year however, Q becomes smaller being 8,000/8 = 1,000 units per order. The average stock is Q/2 = 1000/2 = 500 units. This illustrates therefore that the average inventory and the number of orders per year are inversely related i.e. as one increases, the other decreases. The figure below describes the average stock for an 8 order in a year system.

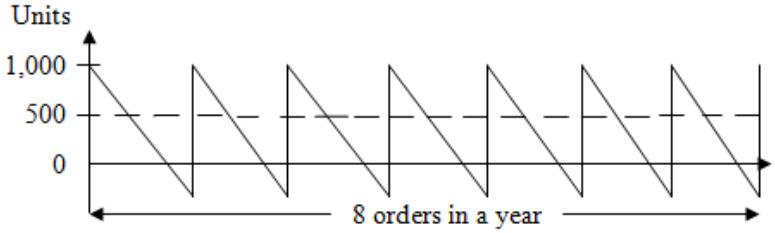

Fig 3 Average stock for 8 orders in a year

3.2 Ordering Costs

Ordering costs are the expenses incurred to create and process an order to a supplier. These costs are included in the determination of economic order quantity for an item.

There will be an ordering cost of some size, no matter how small an order may be. The number of orders that occur annually can be found by dividing the annual demand by the quantity ordered. It can be expressed using the formula:

Number of orders per year = D/Q (6)

Where, D = Annual demand

Q = Quantity ordered

Annual Ordering Cost = $\frac{\mathbf{D}}{\mathbf{Q}} \times$ OC (7)

Where OC is the ordering cost.

3.3 ABC Classification System

ABC (Activity based costing) analysis is an inventory categorization method which consists in dividing items into three categories (A, B, C):

- A being the most valuable items.
- C being the least valuable ones.

The ABC approach states that an organization should rate items from A to C based on the following rules:

- **A-items** are goods with highest annual consumption value rate of 70-80%. They are given top priorities.
- **B-items** are the interclass items, with a medium annual consumption value rate of 10-20%.
- **C-items** are, on the contrary, items with the lowest annual consumption value of 5-10%. They are given least priorities.

The annual consumption value is calculated with the formula:

Annual consumption value = (Annual demand) × (item cost per unit)

Note: The annual consumption value is also called the annual cost.

Creating a Database Design for AYZ University Stores Using MS Access

3.3.1 Database Design

Database design is the act that focuses on the design of the database structure that will be used to

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store and manage end-user data.

MS Access is an application on the computer used for creating a Database.

There are four procedures to be used in creating AYZ University Store Database:

i. Open MS Access on a PC.
ii. When displayed, create a new blank database by renaming the database table.
iii. Then rename the head and subhead for the customer at this stage.
iv. At the final stage, input the customer's ID details in those row and column fields.

Customer Table

Cust ID	Last Name	First Name	Street Address	City	State	Code No	Category	Price(N)	Qty	Total Amt	Customer Since
1	Tobi	Adanri	13, Federal Rd	Benin	Edo	5028X	Plumbing	250	5	1250	03/04/2008
2	Williams	Tony	5, Ayodele Str	Lekki	Lagos	279X	Office Equipment	600	9	5400	05/05/2006
3	Dayo	Roberts	11415 N 35th Ave	Phoneix	Arizona	8056X	Computer Accessories	400	4	1600	01/03/2010
4	Sarah	Banjo	410, Neal Road	Birmingham	Alabama	400X	Vehicle Parts	500	3	1500	15/08/2003
5	Damilola	Anjola	9850 N, Robinson Ave	Texas	United States	5600X	Furniture	800	8	6400	04/09/2004
6	Bisi	Adewale	10, Essien Road	Ikot Ekpene	Akwa Ibom	900X	Toiletries	750	9	6750	10/10/2007

Table 1: Prototype of a created MS Access File Database

3.3.2 Concept of Files, Records and Fields

- **Files:** A file is a collection of related records. For example, a student file that contains several records where each record holds all the relevant information about one student.
- **Record:** A record is the complete set of information that is stored for an item. Records are made up of fields, each of which holds one piece of information.

A personnel file might contain records that have three fields:

(a) Name Field
(b) Address Field
(c) Phone Number Field

- **Field:** A field is a location in a record, in which a particular type of data is stored. For example, CUSTOMER_RECORD might contain fields to store First_name, Last_name, Address, City, etc. Individual fields are characterized by their maximum length and the type of data (alphabetic, numeric, date) that can be placed in them.

3.3.3 AYZ University Files

Files are collection of related records. A file might contain data about the students currently enrolled at AYZ University as an example.

Two files are specified for AYZ University Stores and they are as follows:

(i) Receipt Files: are records of received orders from suppliers when demands are made from customers for items.

The structure can be shown below:

S/N	FIELD NAME	DESCRPTN	TYPE	DIM	AC	AD	QD	QO	QR
1	ART CODE	Article Code	ALPHA NUMERIC	5	A250X	-	-	-	-
2	ART DESC	Article Description	CHARACTER	4	-	PARTS	-	-	-
3	QTY ORD	Quantity Ordered	NUMERIC	3	-	-	3	-	-
4	QTY REC	Quantity Received	NUMERIC	7	-	-	-	7	-
5	QTY DAM	Quantity Damaged	NUMERIC	5	-	-	-	-	5

Table 2 Receipt file of received order store items from supplier

(ii) Issue Files: are used to record items issued out from the store.

The structure can be shown below:

S/N	FIELD NAME	DESCRPTN	TYPE	DIM	AC	AD	DI	DN	QI
1	ART CODE	Article's Code	ALPHA NUMERIC	5	B230X	-	-	-	-
2	ART DESC	Article's Description	CHARACTER	7	-	REPAIRS	-	-	-
3	DATE ISSUE	Date of issued item	DATE	9	-	-	MAY 5, 1994	-	-
4	DEPT NAME	Dept's Name	CHARACTER	6	-	-	-	STORES	-
5	QTY ISSUE	Quantity Issued	NUMERIC	8	-	-	-	-	8

Table 3 Issue file of issued order store items from the stores

3.4 System Maintenance

This presents the development of a computerized maintenance stores system (CMSS) in AYZ University Store. A CMMS is a practical tool for managing equipment information. It can yield benefits in time saving, resource utilization and effectiveness when compared to other manually operated methods. Maintenance is a data-intensive activity that requires generating frequent reports as soon as possible to ensure the data are useful (Connolly et al., 1998: Rob and Coronel, 2000). The use of computerized maintenance documentation and parts requisition system is an effective means to keep an up-to date catalogue of stores items with changes. It investigates the information requirements and stores operation. The system design partitions the data according to various categories, thereby ensuring quick and easy access to the items belonging to each group. The evaluation of the system stresses its operational effectiveness by comparing the time requirements in manual versus computerized stores operation.

IV. DATA PRESENTATION AND ANALYSIS

The data presented for this work will involve the results obtained from the economic order quantity which are the; holding cost, ordering cost, annual demand and also the reorder levels. The analysis will involve the ABC analysis classifying them into A being the most valuable items, C being the least valuable ones.
These are going to be used to compute an inventory system for the stores.

4.1 Presentation of Data for an Economic Order Quantity at the AYZ University Stores

The following data gives the information of a particular consumable store items received from suppliers

Annual demand (D)	65,000 units
Ordering cost (OC)	₦ 750
Holding cost (HC)	₦ 75
Unit cost (UC)	₦ 250

The data above shows the annual demand (D), ordering cost (OC), holding cost (HC) of consumable items if the stores. These parameters will be used to calculate the EOQ models as explained in the previous chapter.

4.2 Finding the EOQ

The economic order quantity (EOQ) is determined from the equation (1) as:

$$EOQ = \sqrt{\frac{2 \times 65{,}000 \times 750}{75}}$$

=1,140.1475425 units per order

4.3 Finding the Annual Inventory Cost

Using the equation (2), the average inventory is given by:

$$\text{Average Inventory} = \frac{1{,}140.1475425}{2} = 570.073771$$

According to Equation (3), the annual inventory holding cost is given by:

$$\text{Annual inventory cost} = \frac{1{,}140.1475425}{2} \times 75 = ₦42{,}755.53283$$

4.4 Finding the Ordering Cost

Using the equation (4), the no of orders is given as;

$$\text{No of orders} = \frac{65{,}000}{1{,}140.1475425} = 57.010 \approx 57 \text{ times}$$

According to the Equation (2), annual ordering cost will be given as;

$$\text{Annual ordering cost} = \frac{65{,}000}{1{,}140.1475425} \times 750 = ₦4{,}275.76$$

According to the Equation, total ordering cost will be given by;

Total inventory cost = ₦4,275.76 +₦4,275.76 + (65,000 × 75)
= ₦8,551.52 + ₦4,875,000
= ₦4,883,551.52

4.5 Interpretation of result for EOQ

From the result above; we see that the comparison of the order quantity from EOQ is minimal to the total inventory cost of inventory. i.e. 1,140.1475425 units per order minimizes ₦4,883,551.52

4.6 Presentation of Data for an ABC classification analysis at the AYZ University Stores

The Table 4 shows the cost per unit and annual demand of 10 store items

Item No	Cost per unit	Annual demand
A1	50	3000
B2	12	4000
C3	45	1500
D4	10	6000
E5	20	1000
F6	500	500
G7	1500	300

H8	20	600
I9	10	1750
J10	5	2500

Table 4 Table showing cost per unit and annual demand of 10 store items

The following parameter from the table above would be used to calculate the annual cost

4.6 Finding the Annual cost

Using the formula, the annual cost is given by:

Annual cost = Cost per unit × Annual demand

Using the Annual cost equation (2), we have the following results as shown in the table below:

Item No	Annual cost
A1	₦ 150,000
B2	₦ 48,000
C3	₦ 67,500
D4	₦ 60,000
E5	₦ 20,000
F6	₦ 250,000
G7	₦ 450,000
H8	₦ 12,000
I9	₦ 17,500
J10	₦ 12,500

Table 5 Table showing the results of each store item using the annual cost

4.7 Finding the Total Annual Cost

Using the formula, the total annual cost is given by the summation of the total annual cost:

Total annual cost = ΣAnnual cost

This implies that:

Total annual cost = Σ(150,000 + 48,000 + 67,500 + 60,000 + 20,000 + 250,000 + 450,000 + 12,000 + 17,500 + 12,500) = ₦ 1,087,500

4.2.8 Finding the percentage (%) Annual Cost

Using the formula, the % annual cost is given by:

$$\text{Percentage Annual cost} = \frac{\text{Annualcost}}{\text{Totalannualcost}} \times \frac{100}{1}$$

Item No	% Annual cost
A1	13.7931034%
B2	4.4137931%
C3	6.20689655%
D4	5.51724138%
E5	1.83908046%
F6	22.9885057%
G7	41.3793103%
H8	1.10344828%
I9	1.6091954%
J10	1.42528736%

Table 6 Table showing the results of each store item using the % annual cost

4.9 Interpretation of Result for the ABC Classification Analysis

From the result above, the following can be deduced:

- Items (A1, F6, and G7) belong to the 70-80% A category with the highest priorities.
- Items (B2, C3, and D4) belong to the 10-20% B category with less priorities than the A.
- Items (E5, H8, I9, and J10) belong to the 5-10% C category with the least valuable.

4.10 System's Effectiveness

A comparison of the operational effectiveness between the manual system and CMMS was made. Transactions were broken down into categories of materials acquisition, receipt, disbursement and return. The times to perform manual clerical stores operations for inventory

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transactions, searches and reports were estimated by the Store's Manager. The clerical work involved the preparation of materials acquisition orders and the updating of inventory cards were recorded. The results showed that the average time saved per item requisitioned using CMMS is one minute. Regarding materials receipt, disbursement and return, the clerical time saved in these operations are summarized in the table below:

Categories	Manual System	CMMS	Time Saved
Inventory Transactions			
Materials Acquisition per item	2 mins	1 min	1 min
Materials Receipt per item	1 min	0.5 min	0.5 min
Materials Disbursement per item	1 min	0.5 min	0.5 min
Materials Return per item	1 min	0.5 min	0.5 min
Searches			
Part information per item	1 min	0.5 min	0.5 min
Equipment Information	3 mins	0.5 min	2.5 min
Reports			
Maintenance History per Equipment	30 mins	2 mins	28 mins
Product Listing of Items per category	120 mins	2 mins	118 mins
Product Listing by Supplier	60 mins	2 mins	58 mins
Product Listing of Items to Order	120 mins	2 mins	118 mins

Table 7 Comparison of Manual versus CMSS operations

From the comparison analysis, all of the manual clerical work times were greater than the times of the CMMS. In particular, tremendous time saving was achieved on the making of inventory reports. In the manual system, the store's manager and attendants have to sort through inventory cards, requisition and equipment maintenance history forms to create a report. The prototype system presently deals with parts inventory and equipment management (i.e. maintenance history, components listing) in the stores. The features of the cost implication involving Redeemer's University's Store exposed us to know the management of stock items and necessary procedures in maintaining accountability. The identification of the best system suitable to store and retrieve information was highlighted, and summaries of the effectiveness of stock record system were discussed.

The methodology involved the application of EOQ model that minimizes cost, database structure that required the use of MS Access for creating a customer record table and the classification into the highest valuable items to the least valuable ones using the ABC Classification system.
The analysis and system maintenance involved the EOQ which minimizes the total cost, the effective operation from the manual system to a computerized system was considered.

V. RECOMMENDATIONS

The following recommendations were made from the findings of this work:

i. Stock procedures should be employed for proper documentation and retrieval of items.
ii. The management of the stores should be improved in the areas of stock reviews, the purchase of stock items and when to reorder to avoid imbalance of stock items.
iii. Implementation of the automated system should be considered by the AYZ University Management as a better alternative to the manual system.

VI. CONCLUSION

The aim of this paper is to determine the cost implication with effect to the stock management system. The Economic order quantity model that determines order that minimizes cost, the design for easy access to customer records, and the effect of a computerized system that supports the present manual system and the improvements made upon them for a better output result.

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