INVENTORY MANAGEMENT IN MANUFACTURING INDUSTRIES: A CASE STUDY OF ELECTRICITY METER COMPANY NIGERIA LIMITED, ZARIA

By

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D E C L A R A T I O N

I hereby declare that this project is the result of my own research work and has to the best of my knowledge never been previously presented in any submission for a higher degree.

All works consulted have been acknowledged in the end of chapter references.

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CERTIFICATION

This project titled "Inventory Management in Manufacturing Industry - A case study of Electricity Meter Company Nigeria limited, Zaria" meets the regulations governing the award of the degree of Masters of Business Administration of Ahmadu Bello University, Zaria and is approved for its contribution to knowledge and literary presentation.

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H. U. Ali
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DEDICATION

I dedicate this work to my family for bearing with me all those times I should have been with them but was not.

A B S T R A C T

This project presents the inventory planning and control systems in use in Electricity Meter Company Nigeria Limited, Zaria.

A questionnaire was designed to gather necessary data which was complemented with other methods of gathering facts such as interviews, observations, etc. The project was aimed at examining the extent to which inventory management theories have been implemented and to what extent it has worked in practice. It also aimed at providing useful suggestions for improvements in line with the findings of the study.

Towards this aim, some inventory management practices such as forecasting methods, inventory models and the application of computers were discussed. The study revealed that intuition and historical experience rather than any scientific methods are in use in the company's inventory management practices. Problems militating against the company inventory management practices include the hard economic situation in the country, difficulty in procuring foreign exchange for the importation of raw materials, and difficulty in determining optimum order quantities.

Consequently, it is recommended that efforts should be intensified in local sourcing of raw materials as well as adopting the use of simple inventory models.

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Chapter 1

1.0 Introduction

Inventory Management is a form of administrative Control that is particularly essential in all manufacturing, wholesale and retail establishments. Inventories often constitute significant portion of a firm's asset and their existence either in the form of finished products, or raw materials is an unavoidable consequence on the flow of production.

The Problem of inventory planning and control is one which is facing all purposeful organisations. A manufacturing firm must keep adequate physical inventories of raw materials, work in process and finished goods in order to meet demands at various stages of the production process. A retailer must keep inventories of hundred of standard fashion and promotional items (physical resources) in order to meet regular as well as seasonal demands of his customers. Banks must maintain an inventory of cash (financial resources) in order to meet their loan commitment as well as daily withdrawals by individual depositors.

Inventory planning and control systems are designed to answer such questions as at what level of inventory to order, how often should re-orders be raised, what quantity to order, what minimum stock level to order etc, with the aim of ensuring that stock out costs are controlled.

Due to the inter-relationship of inventory with almost all facets of the business environment, the solving of inventory problems become more complex as what is best for one component of the organisation frequently is detrimental to the other. For example while the Sales Manager is concerned with prompt services to his customers, the production man is interested in longer manufacturing runs for lower cost and steady employment. The financial Manager at the same time, is interested in the effect of large inventories draining off cash which could be used to make profit.[1]

The above conditions all point to the need for Management and Control of inventories. Inventory management and control involves planning and controlling of inventories in an organisation. "Planning, perse, of inventories will involve forecasting the future demand for a company's product with the aim of investing in inventories to meet such demands. Control of inventories basically entails the issue of how much inventories to carry and when to order for more."[2]

It is in the light of these facts that the researcher is interested in this thesis, in finding out the inventory planning and control of EMCON Ltd Zaria. Emphasis will be laid on the extent to which the most recent development in that field (including the use of computers) are employed.

An attempt will also be made to suggest alternatives or developments to the existing system that will result in the company achieving a more satisfactory level of inventory planning and control.

1.1 STATEMENT OF THE PROBLEM

For many companies the root causes of undue production stoppages and high production costs could easily be traced to unscientific methods of arriving at general inventory policies and crucial inventory decisions. The situation being more acute in a developing country like Nigeria where the practical application of Operation Research techniques in industry and business enterprises is in its infancy. Moreover, the bulk of raw materials inventory and the finished goods inventory used by companies in developing countries have to be imported from the industrial nations of Europe, America and Asia. Thus given rise to higher cost of procurement and higher uncertainty in the availability of such important components as CKD parts, Spare parts, Packaging materials and other basic raw materials.

Considering the fact that success in a business involves such areas as avoiding stock-outs, high capital tied in inventory, avoiding obsolence etc, there is a need for an effective and efficient inventory planning and control system. Since the objective of every business whether in a developed or developing country is to maximize profit, there is a great need for the application of scientific inventory model in the manufacturing industry.

1.2 OBJECTIVES OF THE STUDY

The overall aim of this study is to find out the methods of inventory planning and control being used by EMCON with a view to determining its strengths and shortcomings. In particular an attempt will be made to:

1) Determine the method of forecasting in use by the company.

2) The inventory control system in use by the company i.e. (cyclical, fixed-order quantity, material requirement planning system or any others.)
3) To determine the methods the company uses in its inventory planning and control i.e. is it the use of effective inventory recording system, application of inventory models, the use of computers or any other methods.
4) To find out to what extent the method in use has helped the company improve its inventory management system.
5) To determine what improvements (if any) can be done to the existing control system in order to improve its effectiveness and whether or not it is most suitable for its nature of business.
6) To provide useful suggestion(s) that will help the company improve its inventory planning and control system.

1.3 SCOPE AND LIMITATIONS

The study will focus on the inventory planning and control system of EMCON Limited, Zaria. The project has its own constraints and limitations such as:-
It is a case study and as such can not make generalisations. It has a limited time and therefore it can not pretend to be a detailed and comprehensive study of the subject matter.
Nonetheless, it is hope it will serve as a spring Board for further detailed work in this area.

1.4 METHODOLOGY

This project is a study of inventory management in EMCON as a key to efficient production run.

It will be limited in scope to observed practices in EMCON. The method of data collection will depend solely on:

a) Review of existing relevant literature on inventory planning and control, and managerial practices in EMCON.
b) Documentary evidences from EMCON.
c) Personal interview.
d) Direct observation.

1.5 JUSTIFICATION OF THE STUDY

The researcher's interest in the topic "Inventory Management and Control", lies in the fact that for many firms, inventory is the largest of the current asset appearing on the balance sheet and that inventory problems of too great or too small quantities can cause difficulties to the organisation.

The study shows the extent to which the theoretical framework of solving inventory problems has helped in practice. EMCON, Zaria was used as a case study to bring out this fact, since as a manufacturing company, it is bound to maintain all categories of inventories.

The study tries to portray the need for planning and controlling inventories since inventories are as productive of earnings as other types of capital investment. The need for this is further emphasised in a developing country like Nigeria, where inflation is rampant and lack of or improper management and control of inventories will lead to cost maximization or loss of revenue to a company as a result of inadequate inventories to meet customer demand.

This study will be of immense value to all manufacturing organisations as it will facilitate their inventory management and help solve most of their inventory control problems.

Also, this study will serve as a good base for further researches into inventory management in manufacturing organisations.

1.6 DEFINITION OF KEY TERMS

Inventory:- "The quantity of goods, commodities or other economic resources that are stored or idle at any given point in time. All of the materials, parts, supplies, expense tools, and in-process or finished products recorded in the books by an organisation and kept in its storerooms warehouses, or plants".[3]

Re-order (Order) Point :- "A term used in stock control ordering systems to describe the quantity in a declining stock of which a new order of specified size must be issued if the stock is not to drop below the minimum stock. It is the quantity which will last during the lead time for the batch quantity concerned".[4]

Lead Time:- "The time elapsed between the act of ordering and actually receiving the materials. In manufacturing operations, lead time refers to the time interval between set up of and actual output from the machines".[5]

Purchase Costs:- The amount expended on the inventory during purchase.[6]

Ordering Cost:- "These are incremental costs associated with inventory replenishment. They include all costs incurred in sending inquiries, writing purchase orders, receiving and inspecting goods, paying the bills, and performing related paper work to keep the supplies flowing. Other components are personnel salaries, expenses for telephones, paper forms, and supplies and shipping costs".[7]

Carrying Cost:- These cost are related to holding inventories in stocks. They include interest charges on investment, storage costs, product determination or obsolescence, taxes, depreciation and insurance.[8]

Set-up Cost:- "These are costs required to set up the necessary production process to produce goods".[9]

Stock out (shortage) costs:- "These are costs incurred when customer's demand cannot be fulfilled because the inventory is completely depleted. The stock out consists of loss of good will and loss of profit from that sale."[10]

Safety Stock:- "Extra inventory held to serve as a buffer against possible stock out situation."[11]

Lot size:- " The size of the order that will be purchased to replenish inventory."[12]

EOQ:- "Economic Order Quantity refers to the most economic lot size the firm should order when replenishing inventory".[13]

Purchase Order:- "A document issued by a buyer to a supplier, ordering the supply of specified goods, and generally specifying the quantity required and the price."[14]

Purchase Requisition:- "A document issued by an authorised person in the company to the buyer, instructing him to buy specified goods."[15]

Minimum Stock Level:- "The level below which stock should not be normally allowed to fall."[16]

Maximum Stock Level:- "The level above which stocks should not normally be allowed to rise."[17]

Cyclical Ordering System:- "Is a time-base system which involves schedule periodic reviews of the stock level of all inventory items."[18]

Perpetual Inventory Record:- "An inventory record which is maintained perpetually up-to-date, by recording all transactions which affect the inventory, by recording the new balance after each transaction, and by regular and systematic checking of the record against the stock."[19]

Master Production Schedule:- "This is a time phased projection of the products that are actually intended to be produced."[20]

Bill of material:- "A list showing all the parts that must be provided to complete one or more of a particular assembly or list of the parts or materials used to manufacture a product."[21]

Inventory Policy:- "An organisation's stock holding policy is implemented by a series of rules which determine how and when certain decisions concerning the holding of stock should be made. This series of rules is known as inventory policy."[22]

CHAPTER 2

LITERATURE REVIEW ON INVENTORY MANAGEMENT AND CONTROL

2.0 Introduction

Inventories exist in all business, playing a major role in the determination of a company's internal effectiveness; that is how efficiently the manufacturing operation can be carried out as well as meeting production goals. Thus, retail firms, wholesalers, and manufacturing companies generally have a stock of goods on hand.

Questions such as what types of inventories to hold, how much and when to order are vital to management in considering alternative inventory decisions facing organisations. In the past, the rule of thumb and intuition have been used in deciding inventory management problems but with the development of various Operation Research techniques and the advent of computerisation, inventory management problems are taking a decidedly scientific approach.

The basic inventory decisions involve how many units to order and when to order. In a small firm the manager may keep track of his inventory and make decisions. However, this may not be feasible even in small firms and so many companies have relied on scientific inventory management techniques. And by so doing have saved themselves large sums of money.

Scientific inventory management involves the following basic steps: -

(i) Formulate a mathematical model describing the behaviour of the inventory system.

(ii) Derive an optional inventory policy with regard to this model.

(iii) Create sound and efficient stores control procedures to maintain a record of the inventory and to signal when and how much to replenish.

Recently, computers are now being used in inventory management and control as these scientific techniques of analysing inventory problems require for their successful use the processing power and speed of modern electronic digital computers. The use of computers are necessary to "(1) enable alternative policies to be tested rapidly and "painlessly" before the one selected is implemented, and (2) Provide for more frequent, detailed review of the total situation, whilst restricting management to the base essentials".[23]

2.1 CHARACTERISTICS OF INVENTORY

2.1.1 Definition of Inventories

Inventory also known as, stock, can be broadly defined as "the quantity of goods, commodities or other economic resources that are stored or idle at any given point in time. The economic resources vary in quantity overtime in response to a "demand" process which operates to reduce the inventory level, and a replenishment process which operates to increase it".[24] The American Institute of Accountants defines the term inventory as "the aggregate of those items of tangible property which, (1) are held for sales in the ordinary course of business, (2) are in process of production for such sale or, (3) are to be currently consumed in the production of goods or services to be available for sale".[25]

2.1.2 Classification Of Inventories

Inventories can be classified in a number of ways and the following is one of the most common ones used in manufacturing industry.

(1) Raw materials that have been purchased for use in the manufacturing process.

(2) Works-in-process - Semi finished parts or partly processed raw materials awaiting further processing.

(3) Finished Goods - that are in transit or awaiting distribution to Customers in warehouses at the production site or at some locations a distance from it.

(4) MRO inventories: Maintenance, Repairs and operating Supplies which are consumed in the production process which do not become part of the product, e.g., lubricating oil, soap, machine repair parts.

2.1.3 Function Of Inventories

The basic function performed by inventories be it raw material, work-in-process, or finished goods is decoupling the operations involved in converting inputs into outputs. This allows the successive stages in the purchasing, manufacturing and distribution process to operate somewhat independently of one another, without complete reliance on the schedule of output of prior activities in the production process.

The decoupling function may be performed in at least four ways: -

(i) Process and movement inventories sometimes called pipeline or transit inventories are necessary where significant amounts of time is required to transport goods from one location to another. Thus, the warehouse must carry enough stock on hand to meet demand during the transit time.

(ii) Lot size inventory - where more units are purchased or manufactured than one needed for present use in order to realise economies of scale. The rationale behind this is to obtain quantity price discounts, keep shipping costs in balance, and hold down clerical costs connected with making out requisitions, checking receipts, and handling accounts payable. Similar reasons lead to long production runs on equipment calling for expensive set up or to sizable replenishment order place on factories by filed warehouses.

(iii) Fluctuation stocks are held to cushion the stocks arising basically from unpredictable fluctuations in consumer demand. For example, warehouses and retail outlets maintain stocks to be able to supply consumers on demand, even when the rate of consumer demand may show quite irregular and unpredictable fluctuations.

(iv) Anticipation stocks are needed where goods or materials are consumed on a predictable but changing pattern through the year, and where it is desirable to absorb some of these changes by building and deleting inventories rather than by changing production rates with attendant fluctuations in employment and additional capital capacity requirements. For example, inventories may be built up in anticipation of special sale or to fill needs during a plant shut down

Inventories serve many other functions such as:

1) They make a rotational production system possible, since materials often cannot be relied upon to arrive exactly when they are needed.

2) Inventories can absorb uncertainties in materials supply or customs, demand by acting as a safety buffer.

3) Inventories are one method for creating a smooth flow of production.
4) Inventories display motivational information - it is a common belief that large piles of goods displayed in a super market will lead the customers to buy more.
5) Inventories of some items are kept because of the long curing process e.g. stock levels in the tobacco industry are high because of this reason. Also some items appreciate in value during the time of storage e.g. wines and spirits, timber, etc.

In spite of the beneficial functions of keeping inventories, some costs are associated with inventories. Inventories incur storage, breakage, investments, pilferage (theft), obsolescence, and other carrying costs.

Lastly, inventories can also be used for other purposes apart from those mentioned above. For example, when inventories are displayed they serve as promotional investment. Raw materials and finished goods inventories are frequently accumulated to hedge against price rises, inflation and strikes. Inventories also serve to smooth out irregularities in supply.

If for nothing else, the simple fact that inventories serve these functions implies that they have value to management. However, they should not be regarded as a substitute for management, more so that the inventory question is not a one sided one, which is precisely why inventories are a problem in the operation of a productive system. If there were no optimal level to shoot for, there would be no problem. Anyone could follow the simple rule: "make inventories as big as possible."[26]

On the other hand inventories should not necessarily be minimized. Organisations who carry minimal inventory levels can incur extremely high production and distribution costs. What is needed, therefore, is a way to determine optimal inventory levels in a given situational context. This requires balancing a set of costs that decreases with higher inventory levels. Through inventory control, management seeks decision rules that will optimally balance these controversies costs for a given system.

2.2 INVENTORY MANAGEMENT:

The management of inventories involves two basic functions: Planning for inventories and control of inventories. Inventory management is not an isolated factor but is essentially bound to the purpose of the business, which is likely to be production or sales. It is also related to the nature of the firms' customers as well as the market it serves.

Planning for inventories considers such decisions as what to stores or produce, what are the best sources of procurement of goods, the most suitable transportation arrangements etc. Generally, the objective is to maintain the lowest possible level of investment in inventories that will satisfy the production, sales and financial requirements of the enterprise.

Two main decisions are needed with respect to planning for inventories. The first is the choice of a vendor and considers factors such as quality, price, credit facilities and discount. The other is deciding on the likely demand for the various inventory types the firm has. This will involve forecasting the likely demand pattern.

2.2.1 Forecasting:

A forecast is a prediction of what is going to happen in the future especially if it is based on some kind of knowledge. A forecast can be a simple statement such as "the demand next month will be equal to the demand last month" or it may be an estimate of demand based on a complete study of the economy, the industry, consumer preferences and other factors.[27] There are many useful forecasting techniques although some are distinctly better than others in specific situations. In reality, forecasts are not precise estimates of demand, but probabilistic statements with a certain degree of precision and reliability.

Forecasting is involved in almost all facets of executive decision making concerning activities of business from inception to winding up. No matter what form of inventory is being considered - from raw materials to finished products - a forecast is necessary to decide on quantity and timing. Also, to smoothen seasonal fluctuations in demand and obtain level production will involve some form of forecasting.

A more detailed demand forecast by item is required to plan and control manufacturing for stock. Whether the items to be manufactured for stock are finished end items, parts or perhaps subassemblies to be held in stock until end-items for specific customers' orders are manufactured, a forecast is necessary to decide when to manufacture each item, and how many of each to make. Likewise, a forecast of requirements is necessary in purchasing new materials, parts, or subassemblies, to determine when to purchase an item and how much to purchase such an item. Finally, any attempt to smooth seasonal fluctuations in demand, and obtain level production can be considered only if a forecast is available.

2.2.2 Types of Forecasting:

To handle the increasing variety and complexity of managerial forecasting problems, many forecasting techniques have been developed in recent years. Each has its special use, and care must be taken to select the correct techniques for a particular application. The selection of a method depends on many factors - the context of the forecast, the relevance and availability of historical data, the degree of accuracy desirable, the time period to be forecast, the cost/benefit (or value) of the forecast to the company, and the time available fore making the analysis. These factors must be weighed constantly, and on a variety of levels.

"There are three basic types of forecasting - qualitative techniques, time series analysis and projection, and causal models".[28]

(a) Qualitative Techniques:

These are qualitative-date (expert opinion, for example) and information about special events and may or may not take the past into consideration. Primarily, these are used when data are scarce - for example, when a product is first introduced into a market.

The different types of these techniques are:

(1) Delphi Method - A panel of experts is interrogated by a sequence of questionnaires in which the responses to one questionnaire are used to produce the next questionnaire. Any set of information available to some experts and not to others, is thus, passed on to the others, enabling all the experts to have access to all the information for forecasting.

(2) Market research - the systematic, formal, and conscious procedure for evolving and testing hypothesis about real markets.

(3) Panel Consensus - This technique is based on the assumption that several experts can arrive at a better forecast than one person. There is no secrecy, and communication is encouraged. However, the forecasts are sometimes influenced by personal factors and may not reflect a true consensus.

(4) Visionary forecast - A prophecy that uses personal insights, judgement, and when possible, facts about different sceneries of the future. It is characterised by subjective guess work and imagination, in general, the methods used are non-scientific.

(5) Historical analogy - This is a comparative analysis of the introduction and growth of similar new products that bases the forecast on similarity patterns.

(b) Time series analysis and projection:

This focuses entirely on patterns and pattern changes and thus relies entirely on historical data. These are statistical techniques used when several year's data for a product or product line are available and when relationships and rends are both clear and relatively stable.

The time series is a set of chronologically ordered points of raw data - for examples, a division's sales of a given product, by month, for several years. Time series analysis helps to identify and explain:

- Any regularity or systematic variation in the series of data which is due to seasonality - "the seasonal."
- Cyclical patterns that repeat any two or three years or more
- Trends in the data.
- Growth rates of these trends.

Unfortunately most existing methods do not separate trends from cycles.

It is obvious from this description that all statistical techniques are based on the assumption that existing patterns will continue in the future. This assumption is more likely to be correct over the short term than it is over the

long term, and for this reason these techniques provided us with reasonable accurate forecasts for the immediate future but do quite poorly further into the future (unless the data patterns are extraordinarily stable). For this same reason, these techniques ordinarily cannot predict when the rate of growth in a trend will change significantly. Such points are called turning points.

The forecasting methods under time series analysis and projection include.

(1) Moving average - Each point of a moving average of a time series is the arithmetic or weighted average of a number of consecutive points of the series, where the number of date points is chosen so that the effects of seasonal or irregularity or both are eliminated.

(2) Exponential smoothing - This technique is similar to the moving average, except that more recent data points are given more weight. Descriptively, the new forecast is equal to the old one plus some proportion of the past forecasting error. Adaptive forecasting is somewhat the same except that seasonal are also computed. There are many variations of exponential smoothing: Some are more versatile than others, some are computationally more complex, some require more computer time.

(3) Box - Jenkins - Exponential smoothing is a special case of the box-Jenkins technique. The time series fitted with a mathematical model that is optional in the sense that it assigns smaller errors to history than any other model. The type of model must be identified and the parameters then estimated. This is apparently the most accurate statistical routine presently available but, also one of the most costly and time consuming.

(4) X-II - This technique decomposes a time series into seasonal, trend cycles and irregular elements. Primarily used for detailed time series analysis (including estimating seasonal), but it's uses have been extended to forecasting and tracking and warning by incorporating other analytical methods.

Used with special knowledge, it is perhaps the most effective technique for medium - range forecasting - three months to one year - allowing one to predict turning points and to time special events.

(5 Trend projections

This technique fits a trend line to a mathematical equation and then projects it into the future by means of this equation. There are several variations: The scope-characteristic method, polynomials, logarithms, and so on.

(c) Casual methods (Models):

A causal model is the most sophisticated kind of forecasting tool. It expresses mathematically the relevant causal relationships, (i.e. inventories) and make survey information. It may also directly incorporate the results of a time series analysis.

When historical data are available and enough analysis has been performed to spell out explicitly the relationships between the factor to be forecast and other factors (such as related businesses, economic forces, and socio-economic factors), the forecasts often constructs a causal model.

Typically, a causal model is continually revised as more knowledge about the system becomes available. Causal models are by far the best for predicting turning points and preparing long range forecasts.

Types of causal models:

1) Regression model - This functionally relates sales to other economic, competitive, or internal variables and estimates an equation using the least-squares technique. Relationships are primarily analysed statistically, although any relationship should be selected for testing on a rotational ground.

2) Econometrics model - An econometrics model is a system of interdependent regression equations that describes some sector of economic sales or profit activity, the parameters of the regression equations are estimated simultaneously. As a rule, these models are relatively expensive to develop. However, due to the system of equations inherent in such models, they will better express the causalities involved than an ordinary regression equation and hence will predict turning points more accurately.

3) Intention-to-buy Anticipations surveys - These surveys of the general public (a) determine intentions to buy certain products or (b) derive an index that measures general feeling about the present and the future and estimates how this feeling will affect buying habits. These approaches to forecasting are more useful for tracking and warning than forecasting. The basic problem in using them is that a turning point may be signaled incorrectly (and hence never occur).

4) Input-output Model - A method of analysis concerned with the interindustry or interdepartmental flow of goods or services in the economy or a company and its markets. It shows what flows of inputs must occur to obtain certain outputs. Considerable effort must be expended to use those models properly, and additional detail, not normally availably must be obtained if they are to be applied to specific businesses.

5) Economic input-output model - Econometrics models and input-output models are sometimes combined for forecasting. The input-output model is used to provide long-term trends for the econometrics model; it also stabilizes the econometrics model.

6) Diffusion index - The percentage of a group of economic indicators that are going up or down, this percentage then becoming the index.

7) Leading indicator - A time series of an economic activity whose movement in a given direction precedes the movement of some other time series in the same direction is a leading indicator.

8) Life-cycle analysis - This is an analysis and forecasting of new product growth rates based on s-curves. The phases of product acceptance by the various groups such as innovators, early adapters, early majority, late majority, and laggards are central to the analysis.

2.2.3 Forecasting for inventory control:

"Some of the requirements that forecasting technique for production and inventory control purposes must meet are these:

(1) It should not require maintenance of large histories of each item in the data bank, if this can be avoided.

(2) Computations should take as little computer time as possible.

(3) The technique should identify seasonal variations and take these into account when forecasting; also, preferably, it will compute the statistical significance of the seasonal, deleting them if they are not significant.

(4) It should be able to fit a curve to the most recent date adequately and adapt to changes in trends and seasonal quickly.

(5) It should be applicable to data with a variety of characteristics.

(6) It also should be versatile enough so that when several hundred of items or more are considered, it will do the best overall job, even though it may not do as good a job as other techniques for a particular time." [29]

One of the first techniques developed to meet these criteria is called exponential smoothing, where the most recent data points are given greater weight than previous data points, and where very little data storage is required. This technique is a considerable improvement over the moving average techniques, which does not adapt quickly to changes in trend and which requires significantly more date storage.

Adaptive forecasting, also meets these criteria. An extension of exponential smoothing, it computes seasonals and thereby provides a more accurate forecast than can be obtained by exponential smoothing if there is a significant seasonal.

2.2.4 Forecast Errors:

For sound inventory control, any forecast based on projections of historical data must be monitored as additional actual data are received in order to indicate whether the forecast should be revised. Forecasts must be adjusted not because of individual random variations, but only if a consistent pattern of overestimation or underestimation appears, i.e., when the errors seem to indicate a change in trend.[30]

Generally, errors in forecasting (aside from errors of judgement or miscalculations) occur due to such factors as the weather, economic and political climate, competition, marketing strategy and so on. Errors are more common in estimating safety stock, lead time, quantity and time of reorder. As forecasting errors can lead to costly stockouts or inventory holding costs, it is essential that they are minimised as much as possible.

2.3 Inventory Control:

Inventory control was the first area in business, beginning around 1915, in which qualitative models were applied to aid managers in making better and more efficient inventory decisions. Since that time, increasingly sophisticated analytical tools have been brought to bear on the problems of inventory management.[31] This prominence given to the issue of inventory control over all other practical areas in business clearly demonstrates the importance of inventory to business organisations.

The main aim of inventory control is to strike a balance between the costs of holding too little and too much inventories in order to minimise costs. Other reasons include the need to maximise profit, avoid stockouts, avoid overstocks, keep inventories within available storage capacity, control capital investments, minimise human efforts and maximise sales or share of the market.

Inventory control can thus be defined as "the science-based art of ensuring that just enough inventory (or stock) is held in an organisation to meet both its internal and external demand commitments, economically."[32]

2.3.1 Methods of Inventory Control:

Different inventory control methods abound. Some of these methods will be discussed under the following subheadings:

(1) Inventory Analysis

(2) Inventory models

(3) Use of computers.

(1) Inventory Analysis:

In large manufacturing companies, stocks of direct materials and component parts consist of many thousands of different items. Initial planning and subsequent control of such an inventory are accomplished on the basis of knowledge about each of the individual items and the finished products of which each is a part. "Consequently, the starting point for sound inventory management/control is the development of a complete inventory catalog (record), followed by a thorough ABC analysis".[33]

(a) Inventory records:

It is the responsibility of the stores department to keep records of all goods received into the store and of the physical issue of materials for inventory. Three main documents which constitute the basis for inventory control are commonly in use:

(I) Bin cards

(II) Stores material control record

(III) Stores ledger card.

(i) Bin cards - These are used to record the physical movement, i.e., receipts and issues, of each item of material. Materials are in this case kept in appropriate bins, drawers or other receptacles, some are stacked other racked. For each of these, a separate record is kept on a bin card.

Bin cards also reveal such information as the maximum stock of the material to be carried (these limits having been determined by the production department); the

reorder levels, balance of stock; etc. To facilitate ordering of further supplies, the normal quantity to order is sometimes stated at the head of the card. The various bins in which materials are kept are numbered, the bin card for each being similarly numbered.

(ii) Stores material control card - This is an alternative to bin cards. It is written up in the stores and/or by production control in a loose-leaf book or car file. On this record, quantities only are recorded, all money values being shown only in the store's ledger in the office. An advantage of this record is that the storekeeper has all details close at hand and can note in it such information as quantities ordered, probable requirements for particular contracts and other details.

(iii) Stores ledger card - It is kept in the cost department and is identical with the bin cards, except that money values are shown. Correct stores accounting is as important as accounting for cash, hence the separation of this clerical work from the actual handling of the material. The ledger is usually of the loose-leaf or card type, each account representing an item of material in the store. Note that an inventory record

serves two purposes

(1) It serves a medium of communication enabling personnel located in many different departments to perform their jobs more effectively.

(2) the second benefit accrues to the inventory control operation itself. This benefit takes the form of more complete and correct records through the reduction of duplicate records for identical parts.

Use of an inventory record does not eliminate the possibility of undetected duplicate records, but if carefully developed and maintained, it significantly reduces such a possibility.

(b) ABC Analysis

An ABC method allows stock to be classified according to their values in the following way:

A. The lowest percentage of items accounting for the largest percentage of sales or production requirements

B. The next most active group.

C. The largest number of items with the least usage.

In practice, such an analysis can be made on the basis of either the average inventory investment in each item or the annual Naira usage of each item. The analysis is easy to conduct once inventory has been properly identified and usage records have been maintained for a complete operating cycle. All items are simply ranked in order of their average investment. The total of these values (average inventory investment or annual usage) for all inventory items is then computed. The value of each individual item is next expressed as a percentage of the total. By going down the list and successively cumulating the individual percentages for each item, one can determine which items make up the first 75 percent of inventory investment, the first 90 percent, and so on. If it is convenient to use the three arbitrary classifications noted above, they can be labeled A, B, and C, respectively, and each inventory items become an A, B, or C item. "Results of surveys have shown a situation such as the following"[34]

Category	% of total value	% of total quantity
A	70	10
B	25	35
C	5	55

It can be seen that 10 percent of the items held in stock account for 70 percent of the total value. Those items of medium value represent 35 percent of the total quantity, but account for 25 percent of the value. Finally the low value items in category C represent the largest quantity in use but account for only 5 percent of the total value. (See figure 1 for the graph of the above table).

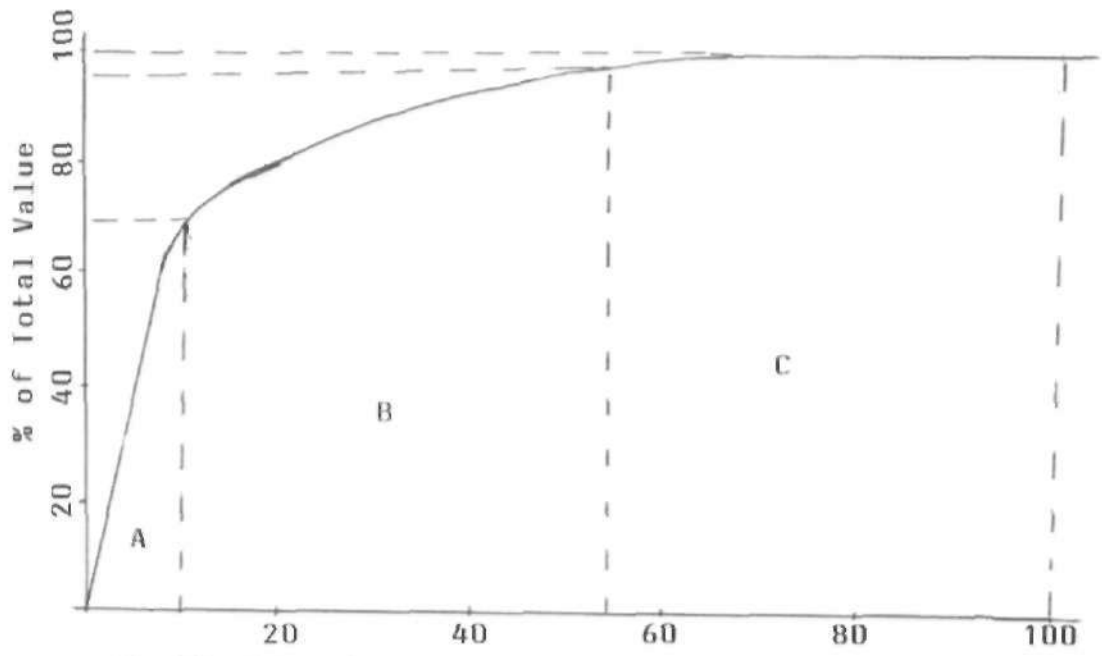

Figure 1: - ABC categories of stock.

Source: *Wheldon's cost Accounting 15th edition, 1983*

The value of ABC analysis to management is that it provides a sound basis on which to allocate funds and time of personnel with respect to the refinement of control over the individual inventory items. Control, in this sense, may take several forms. It may be reflected in minimizing inventory investment, in minimizing indirect costs associated with inventory, in utilizing personnel effectively, or in assuring effective storage, handling, and delivering of material to production operations as scheduled. The concept clearly permeates a number of departmental operations - purchasing, production control, stores and accounting, for example.

Management can use the information generated from such a study intuitively or formally. Some managers informally concentrate departmental efforts on the A and some of the B items. Others develop formal policies and procedures for handling A, B, and items. It should be emphasized, however, that employment of ABC analysis greatly reduces the possibility of error in judgements - by clearly pointing up the specific items on which management can profitably concentrate its efforts.

(2) Inventory Models:

One of the major objective of a stores control system is to ensure that "stock-outs" do not occur, and that surplus stocks are not carried. Some companies attempt to achieve the effective control of stores by intuition or guess work, but most of the large companies have attempted a much more scientific approach by adopting a system of stock levels.

"Mathematical formulae of varying degrees of sophistication have been developed, which attempt to eliminate, guesswork and to produce stock level figures which

are reasonably accurate, but which do not incur an unreasonable cost".[35]
Before discussing the operational research techniques used in determining stock levels, we consider one of the acceptable, but not too difficult formula, which can be used in establishing stock levels:

Re-order Level: - This is the point at which it is essential to initiate purchase requisitions for fresh supplies of the material. This part will be higher than the minimum stock level in order to cover emergencies such as abnormal usage or unexpected delays in delivery from suppliers; it will also be lower than the maximum stock level, otherwise excess stocks would be carried.
Formula:

Reorder level = Maximum consumption during period x maximum reorder period.
Note that in fixing the re-order level, the worst possible expected conditions are used. This should ensure that stock should not be exhausted, at least in the short run.

Minimum Stock Level: - The minimum stock level is the level below which stocks should not be normally allowed to fall. If stocks go below this level, there is the very real danger of a "stock-out" resulting in production stoppages. This stock is a "buffer stock", which would be available in emergencies.
Formula:

minimum stock level = Reorder level - (Normal consumption X
Normal re-order period).

Maximum Stock-Level: - The maximum stock level is the level above which stocks should not normally be allowed to rise. It is desirable that the

level should blow as possible, but of course it must allow for forecast usage of materials and time lags in deliveries.

Formula:

Maximum stock level = Reorder - (Minimum consumption during the period X Minimum Re-order period) + Re-order quantity.

In fixing the maximum stock level, the best possible expected conditions are used. This ensures that even if there is a quick delivery from suppliers, and if there is also a low demand for materials, stock should not rise higher than the maxim stock level authorised.

In setting the above stock levels, the following factors must be taken into account:

(a) the rate of consumption of the materials;

(b) the time necessary to obtain delivery of the materials;

(c) the reorder quantity for the material.

Operation Research Techniques of solving Inventory problems:

The number of factors that can enter an inventory problem is so large that there is literally no end to the different types of inventory models that can be built. "The published literature on the subject is enormous, and inventory theory is probably the most developed aspect of operations research".[36] Since the subject matter is so broad, some arbitrary boundaries are drawn and so a selected set of inventory models are discussed.

Inventory models can be classified in a variety of ways, depending upon the assumptions made with respect to such factors as the criterion of effectiveness (e.g.

cost - minimization and profit - maximization models); static versus dynamic behaviours (this relates to the number of ordering decisions during the planning horizon time period - i.e.., single or multiple orders); length of the planning horizon (finite or infinite); specific behaviour of prices (e.g. constant or variable price schedule); specific nature and behaviour of demand and lead time (e.g., deterministic or probabilistic); and so on.

Figure 2. Shows a classification of inventory problems (models).

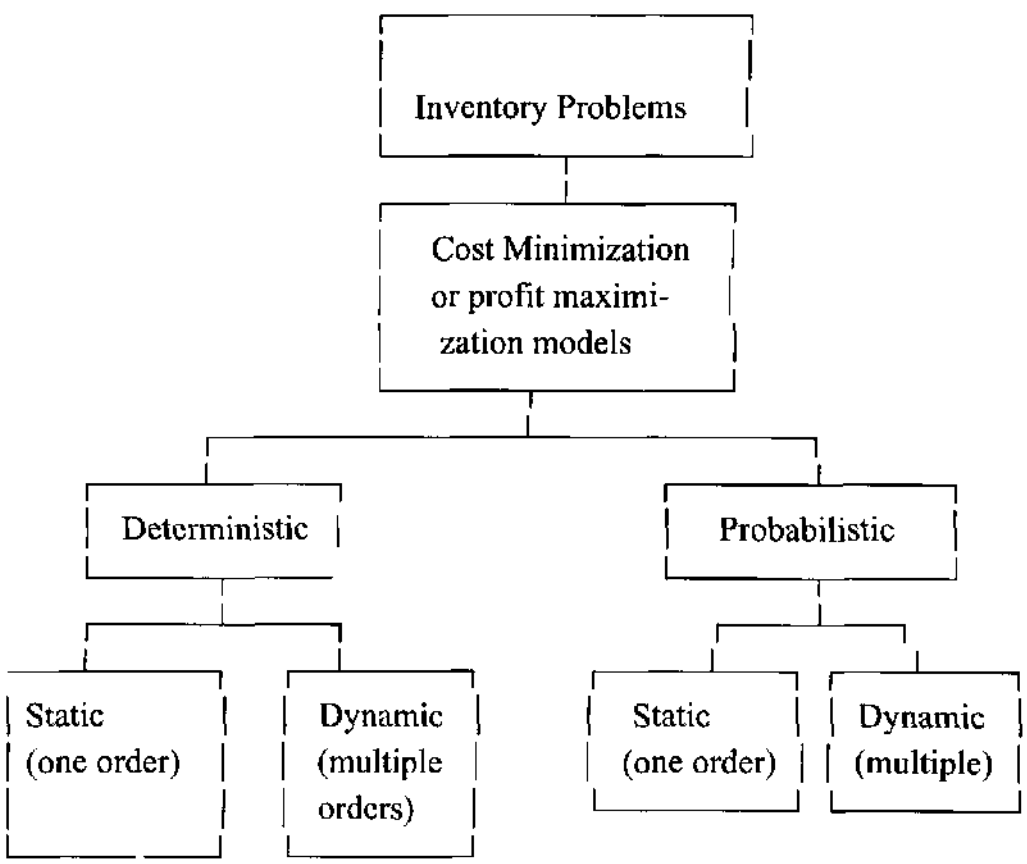

Figure 2: A Classification of Inventory Problems (Models).

Source: *Management - A quantitative perspective by N. Paul Loomba, 1978.*

From the above diagram, it is obvious that there are basically two main categories of inventory model techniques - the Deterministic models and the probabilistic (stochastic) models,

(1) The deterministic models are so called because they are based on the assumption that both demand and lead time are known with certainty. "The deterministic models further sub-divided into six different sub-categories".[37]

(i) Classic EOQ model (shortages not permitted)
(ii) EOQ model (shortage permitted)
(iii) EOQ model with quantity discounts;
(iv) EOQ model for production runs: single product
(v) EOQ model for production runs: multiple products
(vi) EOQ model with resources constraints.

For our purpose, the simple EOQ model (i.e. the classic EOQ model) is discussed because it "is probably more widely used - even by quite sophisticated firms - than any other, and it can be readily expanded to encompass any refinements one cares to make".[38]

The Classic EOQ Model:

The acronym EOQ stands for Economic Ordering Quantity. This is because it is the quantity which is most economic to order; in other words it equates the cost of ordering with the cost of storage of materials.

The EOQ model is the best known and most fundamental inventory decision model. Although, this model is too over-simplified to represent most real-world

decision situation, it is nevertheless, an excellent starting point from which to develop complex and more realistic inventory decision models. This model is potentially applicable when the entire quantity ordered (or produced) can be considered to arrive in the inventory simultaneously and when the demand rate for the item (which is assumed with certainty) is constant. Typical situations to which the classic EOQ model may apply include: use of clerical supplies such as paper clips, pens and note-books; sue of certain industrial supplies such as nuts and bolts and use of toilet supplies in buildings. There are many other situations to which the simple EOQ model could be applied.

As in the case with all models, the validity of EOQ model depends on a number of assumptions which are as follows:-

1) Inventory is replenished when the inventory is exactly equal to zero (no shortages).
2) Demand (usage) rate is known and constant.
3) Lead time, the interval between the time the order is placed and the time it is received, is known and constant.
4) Carrying cost is linear throughout the entire inventory range and varies with average inventory.
5) Price of the product does not depend on the quantity purchased.
6) Ordering of the product is independent of ordering other products.

Many of the above assumptions (requirements) are violated in most real-life situations. This, however, does not mean that the E0Q approach lack usefulness. Rather, the E0Q approach represents the first step in solving the inventory problem and it can be expanded to accommodated exceptions to the above assumptions which occur in practice. For example, the demand rate, is rarely known with

The above graph illustrates the variation of the inventory level over time for the classic EOQ model. The downward-sloping curve indicates that the inventory level is being reduced at a constant rate over time - assumption 1.

When the inventory level reaches the re-order point level, Q units of goods are ordered. The order is received at the time when the inventory level is reduced to zero during the lead time (L). This raises the inventory to Q and the cycle is repeated.

Graphical Representation of EOQ Model

The classic economic order quantity (EOQ) model attempts to arrive at a cost which equates the cost of ordering with the cost of storage of inventory,. The cost of placing orders decrease with the size of orders placed at a time while the cost of holding inventories increase with order size. The total cost of ordering and holding inventories is thus least at that point where the cost of ordering equates the cost of carrying inventory and the quantity at that point is the economic order quantity. It can be graphically represented as in figure 2 below.

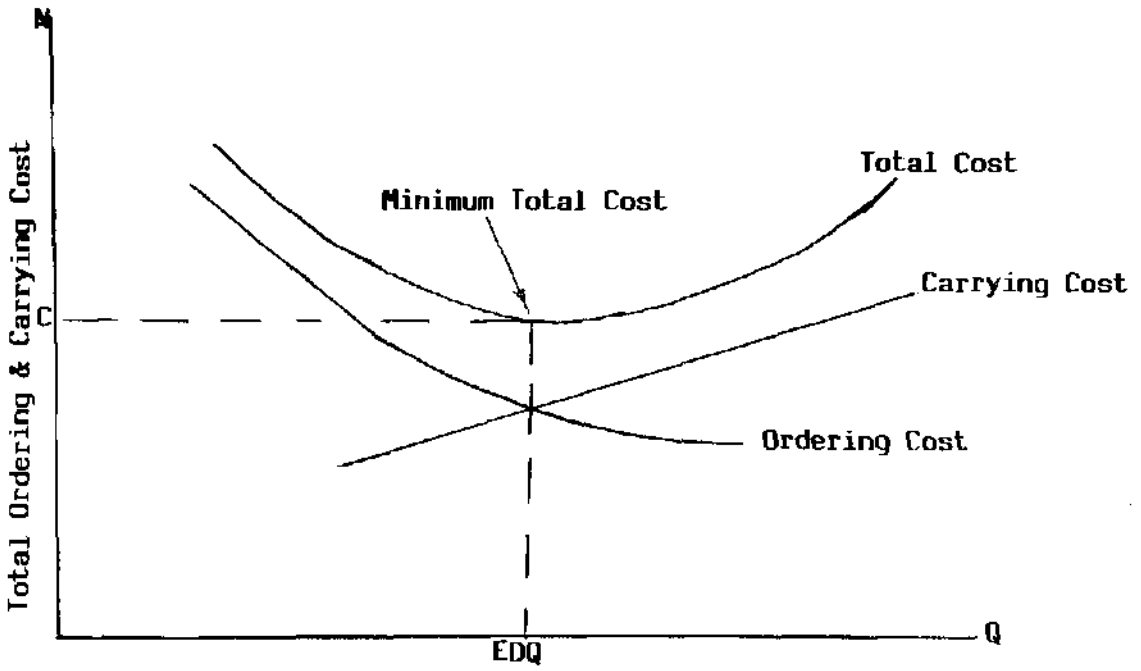

Fig 4. Source: *Essential of Managerial Finance (1979) by J.F. Weston and E.F. Brigham*

certainty and is often subject to extreme fluctuations, and the lead time may also vary widely. Also if the firm has a limited amount of capital the carrying cost may not be linear, but it may increase as the level of inventory increases. In such cases, the EOQ formula may be slightly modified with the appropriate mathematical manipulations to accommodate the unique situations as will be shown later.

When assumptions 6 is violated, however, it is often desirable to abandon the EOQ approach and use a different type of inventory system. For example when several products are ordered from the same supplier, substantial economies may result from combining orders for the several products which indicates an inventory system different from the EOQ system. However, if the violations of the assumptions are not too extreme, the EOQ model may be quite insensitive in the sense that, its applications may result in an order quantity and cost that is not far off from optimal.

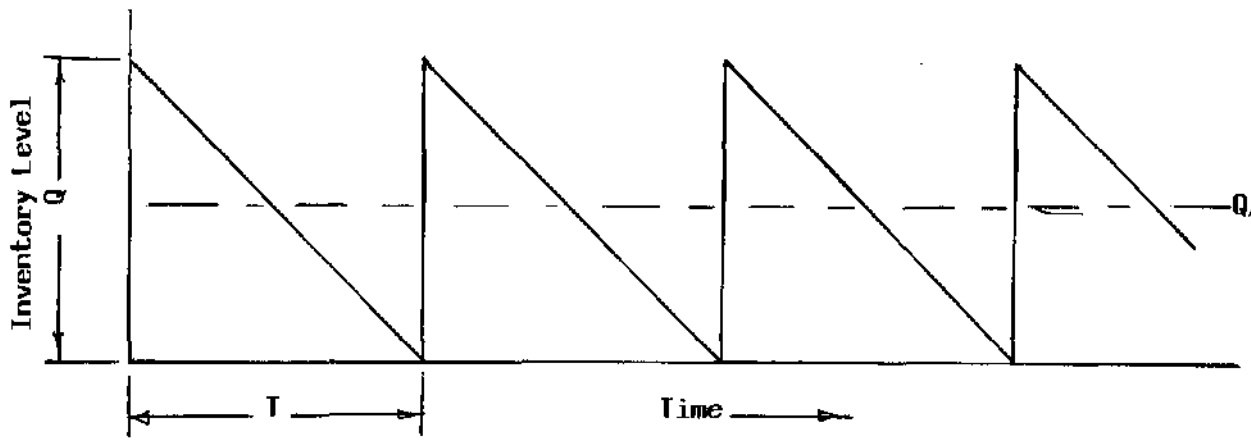

Figure: 3

Source: *Scientific Inventory Management by J Burchan et al*

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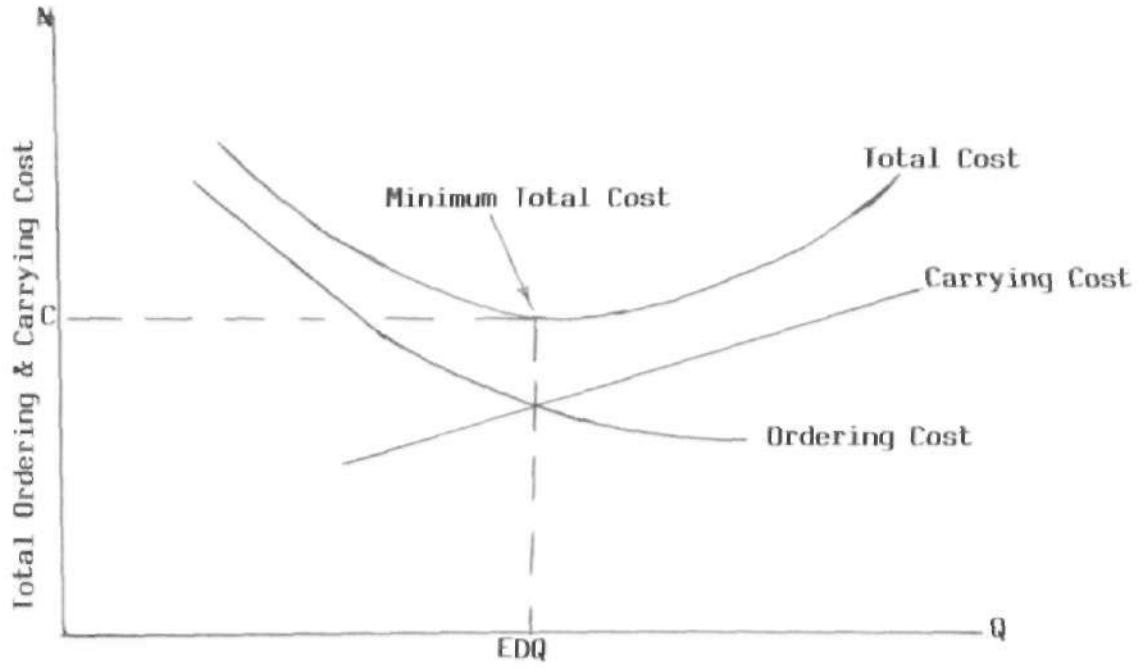

Fig 4. Source: *Essential of Managerial Finance (1979) by J.F. Weston and E.F. Brigham*

The Derivation of EOQ Model

The **EOQ** model can be mathematically formulated as follows:-

Let Q = Order quantity

D = Demand on annual basis

Cc = Inventory Carrying Cost

Co = Inventory Ordering Cost

LT = Lead Time

TIC = Total Inventory Associated Cost

P = Purchase Cost

N = Number of orders or manufacturing runs per annum.

Having defined the notations used in inventory models the next step is to express the t otal inventory costs in terms of the variables and parameters defined. The inventory associated costs can then be represented by a linear equation.

$$TIC = \tfrac{1}{2} QCc + Co\, D/Q$$

= (Inventory holding cost) + (Order costs)

In order to derive the EOQ model, the TIC is differentiated and set to zero.

$$\frac{d}{dQ}(TIC) = \tfrac{1}{2} Cc + Cc(-Q^{-2})D$$

$$= \tfrac{1}{2} Cc - \frac{Co}{Q^2}$$

Setting $d/dQ(TIC) = 0$, we obtain

$$\tfrac{1}{2} Cc = \frac{CoD}{Q^2}$$

$$Cc Q^2 = 2 Co D$$

$$Q^2 = \frac{2 Co D}{Cc}$$

$$Q = \sqrt{\frac{2 Co D}{Cc}}$$

The classic EOQ model has thus been formulated. In the same way the cost of an optimal solution by this formula can bc easily derived by substituting Qx into the total incremental cost formula and solving for TIC.

$$TIC = \tfrac{1}{2} Q Cc + Co D/Q$$

$$TIC^x = \sqrt{2 Co Cc D}$$

The next parameter in the inventory model formulation to be determined is the optimum number of orders or manufacturing runs per year (N)

$$N^x = \frac{D}{Q^x}$$

or

$$T^x = \frac{Q^x}{D}$$

Finally, the re-order point (R) represents the level of inventory of inventory at which an order is placed for Q items. For the deterministic inventory system, the re-order points is easily determined as follows:-

$$R = L_T \times U_R$$

(Number of days) x (Utilisation per day)

Observing the optimal re-order point (R^x) is equal to the demand during the lead time: The number of days in the lead-time multiplied by the demand per day. The obvious implication of this relationship is that the inventory system assumes that the lead time is less than the time required to deplete the total order quantity. Otherwise the re-order quantity will be higher than the lot size.

The classic economic order quantity is defined directly by the cost per order, the carrying cost per unit, and the demand. With these input parameters, the EOQ model provides the direct derivation of the optimal order quantity which minimises the total incremental cost.

(2) Probabilistic Inventory models

The inventory model is of the probabilistic variety whenever one or more components of the problem must be described with probability distributions. This is so when either the demand or the lead time or both cannot be assumed to be known with certainty.

An important consideration in any probabilistic model is the possibility of stockouts. The stockouts can occur because of unexpected high demand during the lead time (or between review periods) or unexpected delays in receiving goods (i.e. longer than expected lead time). The danger of stockouts is not by maintaining safety or buffer stocks: Both stock out and buffer stock impose costs: consisting of lost profit and loss of customer good will.

The optimal level of safety stock is that which leads to the minimization of the sum of holding costs of safety stocks and stocks out costs. This means that estimates on the costs of being out of stock must be made and fed into the probabilistic inventory model".[39]

There are various ways of formulating and solving probabilistic inventory models but this is beyond the scope of this project.

(3) Use of Computers:

Once quantitative decision rules are developed, inventory management becomes a "natural area" for application of mechanised data processing. A computer can be used for reviewing the inventory status of each item, performing calculations quickly and accurately and taking action (such as providing a reorder notice) only when action is required. It can produce reports summarising the activity and current status of the inventory. It can also be useful for forecasting using the methods described above. It can prove a great aid in monitoring the current activity to determine when decision rules should be redefined. For example, re-computing reorder points when there is change in sales trends or adjusting buffer stock when there is change in the pattern of sales variation.

"The approach to setting up a computer based, inventory control system starts with three sets of decisions namely:

(1) The level of customer service required for each item.

(2) The rules to be used for determining order quantities.

(3) The total size of inventory which the business is currently able to support".[40]

"Computerised Inventory control systems can be conveniently divided into three main components:

(a) Inventory recording

(b) Inventory values

(c) Inventory counting".[41]

(a) Inventory recording - This can be broken-down into three components of raw materials, work in progress and finished goods. Each of this component records will be held on master files. These files will be updated by both transaction data and standing data. The main types of transaction data will be inventory movement. There will also be a need for adjustment to correct mispostings. Adjustments may also be necessary to input differences between book and actual stock revealed by inventory counting. Summaries and analyses of movements and adjustment will be produced. A listing of standing data amendments made will normally be produced.

(b) Inventory values - Normally, inventory balances and movements are held in quantities only but sometimes prices are also held in the form of standing data. This enable inventory values to be calculated regularly. The computer can be programmed to calculate and report periodically information relevant to the value of inventory. Depending on the system this may include details as to excess stock, obsolete stock and slow moving stock. Excess stock is usually calculated by comparing inventory on hand with past usage or future requirements. Obsolete stock is calculated by reference to past usage or by the setting of an indicator, for example in respect of a component for a finished product which is no longer in production. Slow-moving stock is calculated by reference to the date of the last movement. The scope of reports of this nature is governed by the range of information held on the file.

(c) Inventory counting - when inventory records are processed by computer, it is easier to ensure their reliability and thus continuous stock taking becomes more likely. "If continuous stock raking is carried out, one of the following three methods will normally be followed".[42]

(i) The stock is counted and compared with the most recent print-out of the balance on the file adjusted for outstanding issues and receipts. These adjustments can be made manually or by the computer. Differences are processed by the input of an adjustment. A manual record is kept of items to be counted.

(ii) Stock is counted, compared and adjustments processed as in (i). At the same time as the adjustment are processed, the date of the stock count is input. The computer records the date and produces a regular report of items which have not been counted for a specified period.

(iii) Stock is counted and the details of the physical balances are input. The computer calculates any differences between the physical and book inventor balance. The differences are often automatically processed and reported in some cases, only differences over a specified amount are reported.

The above components i.e. inventory recording, inventory values and inventory counting can be integrated to form a whole system.

Inventory control is but one part of the organisational system that coordinate planning, forecasting, production scheduling and related activities. A multitude of computer programs for inventory and production control systems are available in the market.

CHAPTER 3

THE HISTORICAL BACKGROUND OF ELECTRICITY METER COMPANY NIGERIA LIMITED, ZARIA.

3.0 Introduction:

The Electricity Meter Company Nigeria Limited (EMCON) is at present the only Electricity Meter manufacturing Company within the West African sub-region. The Company came into being following a proposal submitted to the Federal Government of Nigeria by Messrs Landis & Gyr Energy Management Corporation, Switzerland which is one of the world's leading firms in energy measurement, management and control. The government, after a careful evaluation, approved the proposal on September 10, 1976. Consequently, an agreement was signed between the Federal Government of Nigeria and Landis & Gyr (as Technical Partners) to set up a factory to manufacture Electricity Meters in Nigeria.

The Company (EMCON) was therefore incorporated on April 26, 1977 while Management, Engineering and Licensing Agreement with Landis & Gyr was approved on January 12, 1978. Shortly afterwards, it was decided that the project should be modified to include the manufacture of Miniature Circuit Breakers. Since the manufacturing processes of Circuit Breakers are in many ways similar to those adopted for the manufacture of Single Phase Meters, it was considered appropriate to integrate the two manufacturing processes into one integrated project thereby increasing efficiency and profitability.

$$CcQ^2 = 2CoD$$

$$Q^2 = \frac{2CoD}{Cc}$$

$$Q = \sqrt{\frac{2\,Co\,D}{Cc}}$$

The classic EOQ model has thus been formulated. In the same way the cost of an optimal solution by this formula can be easily derived by substituting Qx into the total incremental cost formula and solving for TIC.

$$TIC = \tfrac{1}{2}\,Q\,Cc + Co\,D/Q$$

$$TIC^x = \sqrt{2\,Co\,Cc\,D}$$

The next parameter in the inventory model formulation to be determined is the optimum number of orders or manufacturing runs per year (N)

$$N^x = \frac{D}{Q^x}$$

or

$$T^x = \frac{Q^x}{D}$$

Finally, the re-order point (R) represents the level of inventory of inventory at which an order is placed for Q items. For the deterministic inventory system, the re-order points is easily determined as follows:-

3.1 Project Implementation:

The implementation of the project was designed to give local staff the opportunity to participate fully in every aspect of the work - from construction of the buildings to installation, commissioning, operation and maintenance of the machinery.
The first building put up was the training centre where local staff were trained while the building of the factory was in progress, some of the Company's Engineers and Technicians were sent to Landis and Gyr's manufacturing plants in Switzerland and France for further training after the initial local training.

EMCON started test production in 1981 using parts supplied by the Technical Partners from their plants in Europe. Formal Commissioning of the factory was performed on September 1, 1982 by His Royal Highness, the Emir of Zazzau, Alhaji Shehu Idris.

3.2 Past Problems:

EMCON imports about 95% of its raw materials. When the project was conceived, it was expected that domestic steel and petro-chemical Industries would be on stream, at about the same time thereby providing EMCON with most of its inputs. Regretably, things turned out differently, only EMCON materialised as planned.

It was this unforseen problem that made it impossible for EMCON to operate satisfactorily under the import Licence Regime of 1983. The Company could not get import Licence and Foreign Exchange to bring in enough raw materials to sustain its operation at a profitable level. This and other minor problems necessitated the temporary closure of the Company for six (6) months in 1984.

Production resumed in July 1984 but it was at a low level and intermittent. Losses were incurred which made it impossible to raise additional funds to improve production level. In February 1988, the company was forced to close down.

3.3 Capital Restructuring:

The huge debts accumulated as a result of operating at a low capacity prevented the Company from operating economically. In 1988/89, it became necessary to re-consider carefully the financial and corporate structure as well as the future of this unique manufacturing facility, if it were to survive as a profitable venture.

The sharcholders were unanimous in their desire to save the company from collapse and consequently agreed to take necessary steps to put the company on a sound footing. The assets of he company were therefore revalued.
The shareholders agreed, in order to:

(a) Support the Federal Government Policy on Privatisation and Commercialisation.
(b) Increase NEPA's shareholding commensurate with its interest in EMCON.
(c) Maintain adequate commitment of the Technical Partners.

involve the consortium Banks (led by Afribank Plc) through direct participation in EMCON. The equity of EMCON was therefore re-structured as follows:

Share Holders	Initial Holding		Holding After Restructuring		Present Holding	
	%	N(M)	%	N(M)	%	N(M)
MOFI	60	2.7	7.7	2.7	-	-
NEPA	20	0.9	50.0	17.7	57.7	20.2
LANDIS & GYR	20	0.9	20.0	7.0	20	7.00
AFRIBANK	-	-	22.3	7.8	22.3	7.8

After the capital restructuring of the company, a new Board of Directors was constituted in 1990 with NEPA having 3 representatives, Afribank 2 representatives, MOFI 1 and Landis & Gyr 1 representative each respectively.
The ministry of Finance Incorporated (MOFI) sold its shares to NEPA in 1993 and has therefore no representative on the Board at present.

In addition to the manufacture of Single Phase Meters and Miniature Circuit Breakers, EMCON will soon start assembling Polyphase Meters having commissioned its polyphase assembly line on Tuesday, November 7, 1995. This is a new project that will save the country considerable foreign exchange.

EMCON also renders service to other industries for example, manufacture of plastic materials, metallic coating of parts (Surface treatment), manufacture of metallic parts/components.

3.4 Management/Department Heads:

The daily affairs of the Company is being run by a six-man management team and have the following departments:- General manager's Office, Production, Technical, Marketing, Accounting and Administrative/Personnel departments.

The office of the General Manager/Chief Executive has the Internal Audit, Maintenance and Purchasing Sections under it. The Production department has the Assembly section, Coil Winding section, Surface/Water Treatment Section, Plastic Press Shop, Tools Room, Parts Manufacture section, Production Planning and Control section and the Raw Materials and Auxiliary Materials stores under it.

The Marketing department has the Packing section under it, while the Accounts department has the Finance and Costing sections under it. Under the Technical department, we have the Calibrating/Check sections, Material Test Laboratory, Research and Development section and the Computer Section.

The Administration/Personnel is in charge of the Security, First Aid Clinic, and the cleaners in addition to the general administration of the Company. The Company's organisational diagram is in appendix 1.

3.4.1 Staff Strength:

The Company has a total of 170 staff made of 145 Junior, 19 Senior and 6 Management staff.

3.4.2 **Production Process:**

The flow chart of the production process is in appendix II. The raw materials which comprise of assorted chemicals, steel, copper, brass, aluminum and assorted plastics are first brought into Raw Materials Store where the qualities and quantities are checked.

From the raw material store, the imported piece parts are transferred to Pieces Parts Stores while the metals are sent to Metallic Parts Manufacture Section for various piece parts production. Similarly the plastic raw materials are sent to Plastic Press Shop to manufacture plastic piece parts while copper raw materials are sent to Coil Winding Section for the production of various coils.

The piece parts produced in Plastic Press Shop and the coils from Coil Winding Section are then sent to Piece Parts Store. The metallic piece parts from Metallic Parts Manufacture Section are sent to Surface Treatment Section for various types of corrosion prevention treatment before being sent to Piece Parts Store.

From the Piece Parts Store, both the locally manufactured parts and imported parts are sent to the two assembly lines for the production of Meters and Circuit Breakers. The products (Meters and Circuit Breakers) are then sent to Calibrating Sections for Calibration and Check before being sent to packing Section. From the Packing section, the products are stored in Finished Goods Stores before being sold to NEPA the sole customer of EMCON.

CHAPTER 4

DATA COLLECTION AND ANALYSIS

4.0 Introduction:

In carrying out this project, data were gathered through interviews, observations and questionnaires. Some of the facts gathered through interviews and direct observation are presented below:

4.1 Inventory Planning in EMCON:

EMCON keeps raw materials, piece parts, finished goods and spare parts inventories. The inventory planning and control of raw materials and piece parts is carried out by the Production Planning and Control Section of the Production Department, through the use of Operation Layout, Material Requisition, Material Receipts, Stock Control and Time cards (See appendix III for samples).
The finished goods inventory is kept by the Marketing Department while the Spare Parts inventory is kept by the Maintenance Unit of Technical Department.

4.1.1 Raw Materials Store:

The Raw Material Store of EMCON is the first port of call for production raw materials, auxiliary chemicals and imported piece parts. Here, all materials coming into the company are received and checked both for quality and quantity before being classified and stored. A material store consignment ledger is used for maintaining records of the receipts and issues of raw materials. A store keeper is in charge and keeps records of issues, receipts and balances in the Raw Materials Store. Quarterly and annual physical stock takings are embarked on to reconcile the recordings with physical stocks.

4.1.2 Piece Parts Store:

The Piece Parts Store (P.P.S.) just as the name implies is where all parts produced from Plastic Press Section, Metallic Parts Manufacturing Section, and Coil Winding Section as well as those parts imported are stored before being issued to the assembly lines. Piece parts stock card is used for maintaining records of the receipts and issues of raw materials. A Store supervisor assisted by a Storekeeper keeps record of issues, receipts and balances in the P.P.S.. Just like in the Raw Material Store, quarterly and annual physical stock taking are embarked on to reconcile the recordings with physical stock.

4.1.3 Finished Goods Inventory:

The finished goods of EMCON are single phase meters, three phase meters and mini-circuit breakers. Before the goods are sent to Finished Goods Store, the Check Section, records the ampage of the product as well as the quantity being sent. The recording is done in a big note book. A staff in the Packing Section takes delivery of the products into the section where they are packed and labeled. The store is under Marketing Department that deals directly with the customers - that is the NEPA Zones.

Weekly figures of the types and quantity of products available in the finished goods store are published by the Marketing department and physical stock taking exercise is carried out every quarter of the year.

4.1.4 Maintenance Spare Parts Store:

The Maintenance Unit of the Technical department maintains the store, where machinery spare parts are kept. In the store are series of racks that are partitioned into bins. For each rack in the store, a particular machine section number's parts

are stored. For each part in the bin card is opened recording issues and receipts for the part. The card also shows the minimum, maximum and re-order level of the part.

The spare parts are both locally obtained and imported, just like the raw materials, a lot of clerical procedure and documentation is involved in ordering for spare parts to ensure proper control. A storekeeper is in charge of the stores and just like other stores in the Company, quarterly and annual physical stock taking are carried out.

4.2 Data Analysis:

In addition to the interviews and observations, questionnaires were distributed to Production Planning and Control Officer (PPC), Technical Manager, Principal Maintenance Engineer, Marketing Manager and Admin./Personnel Manager. The questionnaires were restricted to the officers mentioned because it was believed that they would be able to answer the questions accurately with their experience and knowledge, (A copy of the questionnaire is in appendix IV).

A. General:

The respondents were asked what type of inventories by they carried and their responses were as shown in table 4.1 below:

Inventory Types:

Table 4.1

	Production Inventories	Maintenance & Operating Supplies Inventories	In process Inventories	Finished Goods Inventories	All of the Above
Production Dept.	X				
Technical Dept.			X		
Maintenance Unit		X			
Marketing Dept.				X	
Admin./Pers.Dept.		X			

Source: *The Questionnaire.*

This shows that EMCON maintains all the categories of inventories as a manufacturing Company. But each inventory type is under the control of a different department. Production department maintains the production inventories - ie. Raw materials and piece parts; Technical department keeps in-process inventories, Administration/Personnel department maintains the stationery inventories and Marketing department takes care of finished goods inventories.

B. Production Inventories:

The questions in this section were answered by the Production Planning and Control (PPC) Officer.

(i) The respondent was asked what specific inventories are used in the Company for production. He responded that the production inventories used by the Company are (a) raw materials - which comprises of steel, brass, copper, aluminum and various types of chemicals and (b) piece parts inventories.

(ii) Asked about the Company's sources of raw materials, the PPC Officer's response is as shown below in table 4.2.

Table 4.2 Sources of Raw Materials:

(a) Imports	
(b) Local Source	
(c) All of the Above	X

Source: *The Questionnaire*

This shows that the Company obtains its raw materials locally as well as through imports

(iii) The respondent was asked to state the percentage of raw materials imported annually. His response was that 80% of raw materials as well as 20% of piece parts are imported.

This shows that EMCON's reliance on imported raw materials is very high, since only 20% of them are sourced locally.

(iv) Asked on what provisions the company makes in ensuring constant supply of both imported and locally sourced raw materials. His response was that safety stocks are maintained so that the Company does not run out of stock unalerted.

(v) The respondent was asked on how often the company uses the raw materials procured. He responded as shown in table 4.3.

Table 4.3 Frequency of Raw Materials Usage:

(a) Very often	X
(b) Fairly often	
(c) Less often	
(d) Seldom	

Source: *The Questionnaire*

This means that the Company should have adequate stock of both imported and local raw materials to meet their daily production.

(vi) On what percentage of inventory investment constitutes production inventories, the respondent (Chief Accountant) gave a percentage of 70%.

This shows that production inventories take up a high portion of inventory investment of EMCON Ltd, Zaria.

C. Finished Goods Inventories:

This section was answered by the Marketing Manager:

(i) Asked about the main products of EMCON, the respondent gave the different types of products as (a) 5/25A Single Phase Meter,
(b) 25/100A Single Phase Meter; (c) 25/50A Polyphase Meter, (d) 50/100A Polyphase Meter (e) 15A Mini Circuit Breaker (MCB), (f) 30A MCB and (g) 60A MCB.

This shows that EMCON manufactures different types of meters and mini circuit breakers. This invariably means that the inventory of finished goods will be enormous which justifies the high percentage of inventory investment of production inventories.

(ii) On the extent of which the Company's products are differentiated, the reply was as indicated in table 4.4 below:

Table 4.4 Product Differentiated:

(a) Highly differentiated	X
(b) Moderately differentiated	
(c) Lowly differentiated	
(d) No differentiation	

Source: *The Questionnaire*

EMCON's products are highly differentiated from other manufacturers' products in terms of precision, functions and durability.

(iii) The respondent was asked to rate the quality of the products produced by EMCON and his response is shown in table 4.5.

Table 4.5 Product Quality:

(a) High	X
(b) Medium	
(c) Low	

Source: *The Questionnaire*

The quality of the products of the Company is highly rated by the respondent as well as NEPA Meter Test Station staff. This probably is due to the high quality checks carried out in the piece parts manufacturing sections as well as Assembly lines.

(iv) On how the respondent rates the distribution and delivery system of the Company, his response is as indicated in Table 4.6

Table 4.6 Distribution and Delivery System

(a) Excellent	
(b) Very Good	x
(c) Good	
(d) Fair	
(e) Poor	

Source: *The Questionnaire*

The distribution and delivery system of EMCON is rated very good. NEPA being the sole customer of the Company collects their goods from the factory once they are ready with minimum delay. This means that the Company does not have to keep large stock of finished goods.

(v) The respondent was asked to estimate the demand rate of the Company's finished products and his answered in tabulated below:

Table 4.7 Demand Rate of Finished Products:

(a) High	
(b) Medium	X
(c) Low	

Source: *The Questionnaire*

The demand rate is neither high or low. This probably means that on the average, there could be favourable times when the demand rate will rise leading to low stock in the packing section or unfavourable periods when demand rate will decline leading to large stock in finished goods store.

(vi) On the percentage of the inventory investment that constitute the finished products, the chief Accountant gave a figure of 10%.

This shows that not much is invested in keeping inventories of finished goods. This probably shows an indication of cost reduction in the management of finished goods inventories.

D. In-process Inventories and Maintenance/Operating Supplies Inventories:

The Technical Manager and the Principal Maintenance Engineer completed this portion.

(i) Asked on how enormous the in-process inventories is, the response is that it is about 1% of total production inventory.
From this response it shows that in process inventories maintained are not significant.

(ii) The respondent was asked on the possible causes of in-process inventories in the Company and the response is as indicated in table 4.8

4.8 Causes of In-process Inventories:

(a) Length of production period	
(b) Breakdown in machine component	
(c) Resultant delay (lack of Order)	
(d) Idle time	
(e) All of the above	X

Source: *The Questionnaire*

This mean that in-process inventories arise as a result of the length of production, machines breakdown, lack of customer order, and so on.

(iii) On what stock constitute the maintenance repairs and operating supplies inventories in the Company the Principal Maintenance Engineer's response is as follows: Spare parts, office/household items and overhaul spares.

(iv) Asked about what percentage of inventory investment is allocated to maintenance, repair and operating supplies inventories, the response was that about 8%. This is because spare parts are essential to production machineries. Any breakdown in any machine component requires replacement or repairs. Thus inventories of these parts are essential to meet production target.

4.3 Inventory Planning

(a) When asked if the company embarks on any form of forecasting of their inventory requirements, all the respondents answered in the affirmative.
This means that there is a general recognition by the company of the importance of planning for inventory requirements. This is because through forecasting future needs of customers, their preferences can be predicted to aid the company in planning now what to do in future.

(b) The respondent were asked what form of forecasting they engage in and the responses are indicated in table 4.9

Table 4.9 Forms of Forecasting:

	Short Time	Long Time	Both	None
PPC Officer			X	
Technical Manager			X	
Marketing Manager			X	
Prin.Maint.Engineer			X	
Admin./Personnel Manager			X	

Source: The Questionnaire

All the respondents indicated that the Company embarks on both short term and long term forecasting. This shows that the Company tries to satisfy the immediate needs as well as the long term needs of the Company.

(c) When asked what type of scientific forecasting techniques used by the various respondents, the answers were as shown in table 4.10

Table 4.10 Type of Forecasting:

	Exponential Smoothing	Moving Average	Box Jenkins	None of the above
Technical Manager				X
PPC Officer				X
Principal Maint.Engineer				X
Marketing Manager				X
Admin./Pers.Manager				X

Source: *The Questionnaire*

This shows that the Company does not use any of the Scientific forecasting techniques. This could be either because they are not aware of these methods or they forecast based on historical experiences or subjective estimates.

(d) When asked if they have a budget for inventory investment, all the respondents answered in the affirmative.

This shows that the Company recognises the importance of inventory control and the need to regulate it through the establishment of budgets, as excessive inventory may result in liquidity problem for any organisation. This inventory budgets are usually tied to production and sales budgets in such a way as to strike a balance among them.

4.4 Inventory Control:

(a) The respondents were asked if they have an inventory control unit and they answered in affirmative. This shows the company knows the significance of inventory control and this maintains a unit for it. Thus for the respective stores one form of inventory control unit exists.

(b) When asked where inventory control actions originate in the organisation, the respondents answered as shown in table 4.11

Table 4.11 Origination of Inventory Control Action:

	Accounts Dept	Prod. Dept	Admin Dept.	Techn Dept.	GM's Office	Mktg Dept.
PPC Officer	x	x				
Techn.Manager	x			x		
Mktg. Manager	x					x
Prin.Maint.Engr	x				x	
Admin./Pers.Mgr	x					

Source: *The Questionnaire*

This means that the various departments control the individual inventory units while the Account department is involved fully at all levels of the Company inventory control.

(c) Asked on the system of inventory control they operate, the respondents answered as shown in table 4.12.

Table 4.12 System of Inventory Control:

	Fixed Order System	Cyclical Order System	MRP	Combination of the above	None of the above
Mktg. Manager		x			
Techn.Manager					x
Admin./Pers. Mgr		x			
Prin.Maint.Engr	x				
PPC Officer				x	

Source: *The Questionnaire*

This shows that the different departments operated different inventory systems probably due to the fact that the inventory items differ and that factors such as tradition, the value of or importance of the item, the production process, the types of business, usage rate, determines the type of system that should be adopted to control stocks of a particular item.

(d) The respondents were asked to rate the effectiveness of the inventory control system used in the Company and their responses are as indicated in table 4.13.

Table 4.13 Inventory control System Effectiveness:

	Very effective	Fairly effective	Just effective	Not effective
PPC Officer		x		
Marketing Manager		x		
Technical Manager		x		
Prin.Maint. Engineer		x		
Admin./Pers. Manager		x		

Source: *The Questionnaire*

The system employed are judged fairly effective by the respondents. These shows that there is room for improvement.

(e) Costs Associated with Inventory:

(i) The respondents were asked on what costs are associated with carrying or holding inventory in EMCON. Their responses are as shown in table 4.14

Table 4.14 Carrying Costs:

	Storage	Obsolence	Insurance	Stock Checking	Oppor-tunity	All of the above
PPC Officer						x
Mktg. Manager						x
Techn. Manager						x
Prin.Maint. Engr.						X
Admin./Pers. Mgr.						x

Source: *The Questionnaire*

This shows the carrying costs include storage cost, obsolence/deterioration cost, insurance and taxes, stock checking, recording and accounting costs, cost of money tied up in the inventory. An effective inventory control should be able to minimise these costs.

(ii) On the ordering costs associated with inventory, the respondents indicated that ordering cost combined transportation, clerical and administrative costs and import duties. These are costs normally associated with inventory. However, a good inventory control system aims at such cost reductions.

(iii) Asked if the Company keeps safety stock, the respondents replied in the affirmative. The Company does keep safety stock to guard against stock out situation.

(f) The respondents were asked what tools they employ to maintain effective inventory control, and their responses are as shown in table 4.15

Table 4.15 Methods of Inventory Control:

	Inventory Records	Inventory Models	Computers
PPC Officer	x		x
Marketing Manager	x		x
Technical Manager	x		
Admin.Pers. Manager	x		
Prin,Maint. Engineer	x		

Source: *The Questionnaire*

The Company makes use of inventory records and computers for maintaining effective inventory records. No inventory models are used but probably some of the inventory models are incorporated into the programme of the computer being used by the Company. The Company is newly applying the use of computer in the control of inventories hence the use of both inventory records and computer in some places.

(g) Asked on what inventory records or cards are maintained by the stores for stock recording, the responses are as indicated in table 4.16

Table 4.16 Inventory Records:

	Bin Cards	Stock Cards	Control Cards	Store Ledger	All of the above
PPC Officer					x
Marketing Manager				x	
Technical Manager				x	
Prin.Maint. Engineer		x		x	
Admin./Pers Manager				x	

Source: *The Questionnaire*

The response shows that the Production department maintains all the manual methods of inventory control system while others maintain store ledger.

(h) The respondents were asked to state in days, weeks or months, the lead-time of inventory kept in the Company, it was reported that the average lead-time for imported items is 6 month while that of locally purchased items is about 2 weeks.

(i) Asked on what the re-order quantities are, the PPC Officer said it is based on a predetermined and specified programme.

This shows that the Company does not use the sophisticated or statistical inventory models in determining the re-order quantities.

(j) The respondents were asked how the quantity to be ordered at any time is determined. The answered as shown in table 4.17

Table 4.17 Order Quantity Determination:

	Using Min. stock level	Re-order stock level	Economic Order Qty..	None of the above
PPC Officer	x			
Technical Manager				x
Prin.Maint. Engineer	x			

Source: *The Questionnaire*

This shows that the Company relies on the use of stock level minimum, maximum and re-order level to determine the quantity to be ordered at any given time. The EOQ concept is not in use. This further confirms the fact that the Company does not use statistical inventory models in inventory control.

(k) The respondents were asked when stock taking is carried out and they all answered periodically. Stock taking are carried out quarterly.

(l) Asked if the company uses the ABC - Classification analysis for classifying stock. The answers was No. This question is more relevant to the spare parts because different parts both of high and low value are carried. From the response, the spare parts need classification in terms of value for effective control that could be aimed at cost reduction consideration.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion:

To say that the Nigerian manufacturing sector, and indeed the economy as a whole is in crisis is a fact which every business organistation is acutely aware of. The inflationary growth, the continuous fall in the value of Naira, the increasingly difficulty in the purchase of foreign exchange and the frequently factory short-downs and lay-offs have affected productivity in the manufacturing sector.

In view of these economic problems, industrialists must seek and rigorously pursue ways of increasing productivity and cost reductions techniques in order to survive the gloom. It is in this light that inventory management and control in manufacturing firms can act as effective instrument.

In this study, the importance and functions of inventories in any manufacturing firms has been emphasised. Some theoretical principles towards inventory management control have been discussed to give a general background towards maintaining inventories costs effectively. EMCON Zaria, the only manufacturer of Electricity Meters in West African sub-region, was studied with the hope of finding out the extent to which the theoretical framework is implemented and has practically helped to solve inventory problems of the oraganisation.

From the data analysis and research findings, it is evident that in planning for inventories, EMCON relies mainly on historical tend of events in economy, market conditions, customer preferences before coming out with a decision on how much capital to invest on inventories, what inventories to keep, when and how much of a particular type of inventories to order. The analysis reveals that the company barely embarks on the application of methods of forecasting for inventory control as discussed under literature review in chapter 2. This may be due to lack of awareness of these methods or the general believe that these theories only work in developed economics where the business environments is conducive for their implementation.

The analysis revealed that the company embarks on short term and long term forecasting which help them prepare their departmental action plan, for every year. From these plans, each department prepares their monthly action programmes which are communicated to the other departments so that the overall company plan can be achieved.

From the data analysis, concerning inventory control, it is deduced that departments carrying one inventory or another make use of one or more of the inventory methods discussed in the literature. Similarly, the control systems are also adopted to suit the type of inventories carried taking into cognisance such factors as usage patterns, item characteristic, type of production process, etc.

However, in the area of the use of inventory models, most of the departments were not strong on the fact, whether they apply any of the statistical methods/techniques of inventory control. The answer to the question on how the quantity to be ordered at any time is determined revealed that the managers do not even use the EOQ model in computing the most economic quantity to order. They rely on the use of minimum stock level, reorder stock level and then assume lead time based on historical consumption pattern for that item before calculating the quantity to order. The lack of the use of EOQ model could be generating same costs which could have been avoided by the company, if all the carrying costs and ordering costs be incurred by the company are used in calculating the quantity to be ordered. This might be the reason why the company managers rated the inventory control system in the company's respective stores as fairly effective since avoidable costs are incurred.

Even though the analysis revealed that some departments make use of computer to control their inventories from interviews and observation, it is discovered that the company have only acquired some computers and none of its departments is fully Computerised. When the departments are fully Computerised most of the manual methods will be dropped.

Certain problems were identified in the course of the study: (a) The difficulty in procuring foreign exchange for the importation of raw materials have led to frequent stockouts of some piece parts; and this is an inventory problem. This has its penalty costs, viz: costs resulting from loss of customers' goodwill and potential loss in profit due to loss of sales.

(b) Most managers are aware of the existence of inventory control models and the power of their analysis, but that they have very little faith and confidence in their applicability in the real life problems of the Nigerian economy which they have to deal with.

(c) There are a number of raw materials that are imported and the period between placing of orders and receipts of the consignments varies and is uncertain. (See the 1995 Delivery Chart in appendix V)

5.2 Recommendations:

The cost of inventory control should not be overlooked by the company. Human and mechanical effort cost money. Different control systems have different costs and produce different results. These considerations should be a factor in determining which system is used. The company should therefore examine the inventory control system to discover the major areas that will benefit from the processing power of the computers and then fully computerise this areas since for a given application, programming and operating costs may be excessive in the sense that manual methods will prove to be economical.

The use of some inventory models should be adopted in order to minimise carrying and ordering costs. The lack of awareness of using the models of solving inventory problems could be solved by seeking the assistance of young operations Research Expert, or send some of the departmental heads in charge of the stores for training in operations research so that possible areas that require the use of inventory models will easily be identified and implemented.

The foreign exchange problem faced by EMCON in procuring the required raw materials could be minimised by intensifying efforts in sourcing some of its raw materials like chemical locally.

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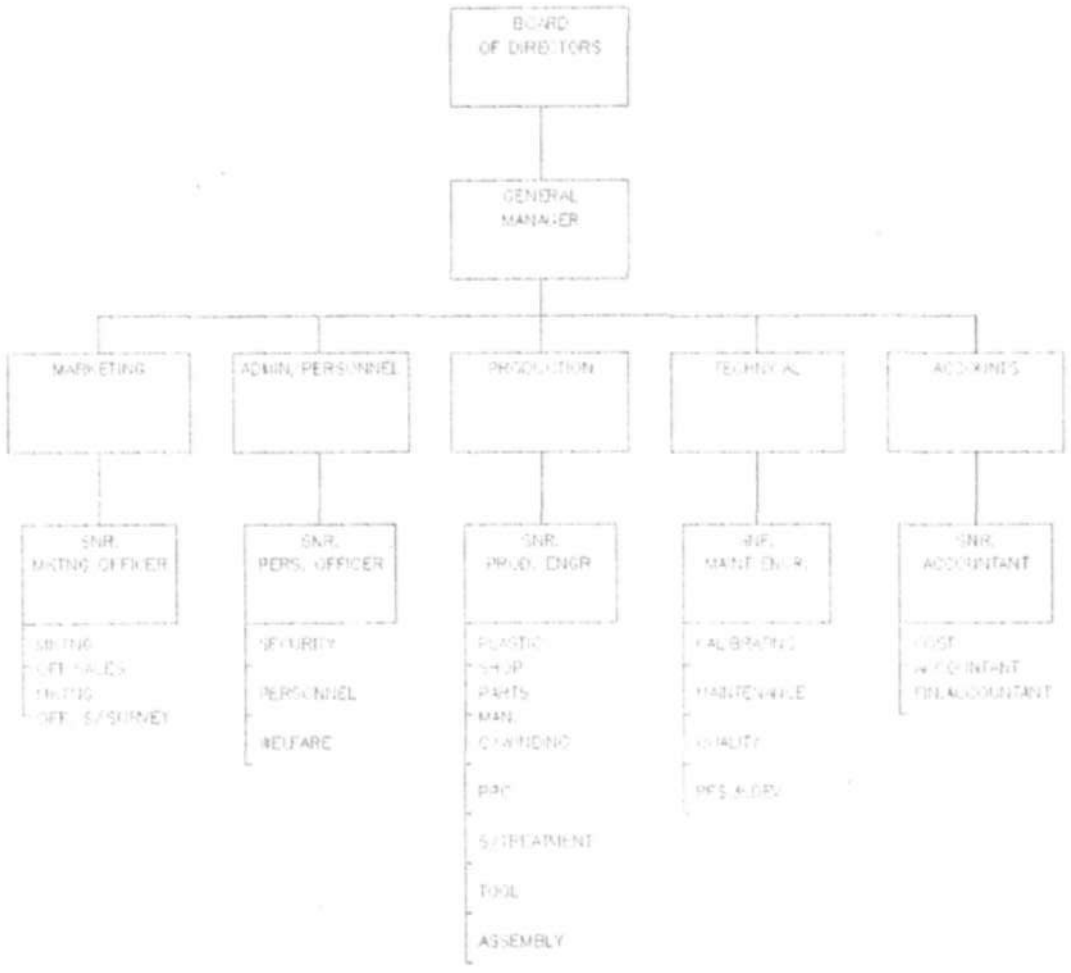
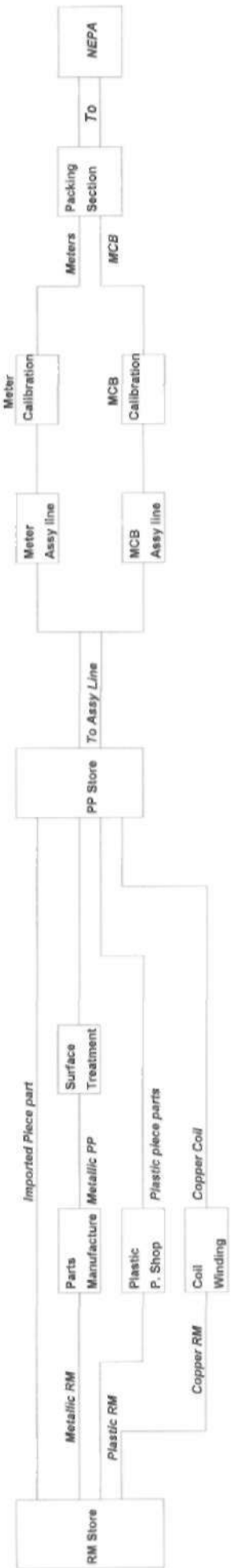
Appendix 1.

EMCON ORGANISATIONAL CHART

MAIN DEPARTMENTS AND SECTIONS




NEPA
To
Packing Section
Meters
MCB
Meter Calibration
MCB Calibration
Meter Assy line
MCB Assy line
To Assy Line
PP Store
Surface Treatment
Imported Piece part
Metallic PP
Parts Manufacture
Metallic RM
Plastic P. Shop
Plastic piece parts
Plastic RM
Copper Coil
Coil Winding
Copper RM
RM Store

		Quantity	Order-No
Denomination		Drawing-No Stock-	

EMCON OPERATION LAY-OUT

Itinerary	
Departments	
Date required	
Order finished	

	Stores	Quantity	Unit	Denomination of material / Dimension	Stock-No	To Dept	Date req
0	Op.	Cost centre	Cost class	Description of operation	Machine / Tool / Fixture	Prep T	T allow'ce
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							

	Op.	Auxiliary material	Stock-No	Qty 'M	Op	Auxiliary material	Stock-No	Qty 'M
23								
24								
25								

Prod. planning	Order issued	Qual. control	Stores	Prod. control	Cost accounting	Sheet
Date Sgnd	Date Sgnd	Date Sgnd	Date Sgnd	Date Sgnd	Date Sgnd	

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DELIVERY- AND QUALITY CONTROL

PARTIAL DELIVERIES

Quantity	processed up to Op.	Date	Receiving Dept.	Visa

QUALITY CONTROL

Operation	Operator	Rejected parts		Accepted parts	Inspector
		Material	Processing		

Deliveries for compensation (Manufacture- or assembly orders)

Dat.	Quantity	Voucher	Vis.	Dept.

Quantity control / Parts store

Date	Quantity	Vis.

Production control — PC
Industrial accounting — IA
Record office — RO

Denomination	Date	Visa
PC		
IA		
RO		

Remarks

		Quantity	Order No.
Denomination			Drawing - No. Stock-

Op	Cost centre	Cost class	Description of operation	Machine/Tool/Fixture	Prep T.	T. allow %

No	Name	Qty to be paid	Supplem./deduct	Total time allow	Actual time	Eff. ratio	Wage Periods

Manufacturing Dept	Quality Control	Production control	Wage office	Cost accounting
Date Sgnd	Date Sgnd	Date Sgnd	Date Sgnd	Date Sgnd

EMCON TIME CARD

		Quantity	Order-no.
Denomination:			Drawing No- Stock-

From	Qty.	Unit	Denomination of material/Dimension	Stock – no	To Dept.	Date req.

Qty. to Issue	Qty. Issued	Price per % Units		Total price

Stock planning	Store	Received:	Stock control	Cost accounting
Date: Sgnd:	Date: Sgnd:	Date: Sgnd:	Date: Sgnd:	Date: Sgnd:

EMCON MATERIAL REQUISITION CARD

		Quantity	Order-No.
Denomination			Drawing- No. Stock-

Op.	Cost centre	Cost class	Description of operation	Machine / Tool / Fixture	Prep. T.	T. allow %o

Qty. Delivered	Quantity passed	Quantity received	Outstanding	Price per %

Department	Quality control	Stores	Stock control	Cost accounting
Date Sgnd	Date Sgnd	Date Sgnd	Date Sgnd	Date Sgnd

EMCON MATERIAL RECEIPT CARD

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	Stock-No.:

EMCON Stock Control Card for: _____ Unit: _____ Dimension: Drawing-No.: _____

Place of Storage			L	Stock Movements					Stock Movements				
Store	Rack	Partition		Date	Order-No.	Stock Entry	Stock Issue	Actual Stock	Date	Order-No.	Stock Entry	Stock Issue	Actual Stock
			1										
Re-Ord.Level			2										
Stock Price			3										
Valid From	Price per %		4										
			5										
			6										
			7										
			8										
			9										
			10										
			11										
			12										
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			23										
			24										
			25										

Questionnaire For A Project

I am an M B A student of Ahmadu Bello University, Zaria and I am carrying out a study on " Inventory Management in Manufacturing Industry: A case study of EMCON Ltd., Zaria".

This questionnaire is designed to collect necessary data from you for us in the study. Any information released to me shall be treated as confidential and shall be used for accademic purpose only.

I shall therefore appreciate your assistance in answering the following questions.

Kindly tick where appropriate and fill in the the blank spaces. Incase of the space provided is not adequate, please you are free to use additional materials to elaborate.

A. General Questions:

1. Personal Particulars:

Name: .....

Designation: .....

Principal Function: .....

B. Inventories:

2. What form of inventories do you normally handle?

(i) Production Inventories ☐

(ii) Maintenance, Repair, Operating (MRO) inventories ☐

(iii) Finished - Goods Inventories ☐

(iv) In-process Inventories ☐

(v) Others Specify ☐

3. What specific inventories are used in the Company for production?

.....

.....

.....

4. What are the Company's sources of raw materials?

   (i) Imports ☐

   (ii) Local Source ☐

   (iii) All of the above ☐

5. If the Company imports (some of its) raw materials, please state the ones imported, the name of the country, and what percentage of the annual requirement is imported

   .....

   .....

   .....

6. What provisions are made by the Company to ensure constant supply of both imported and local raw materials? .....

   .....

   .....

7. How often does the Company make use of these raw materials?

   (i) Very often ☐

   (ii) Fairly often ☐

   (iii) Less often ☐

   (iv) Seldom ☐

8. What percentage of inventory investment constitute production inventories.

   (i) 10% - 25% ☐

   (ii) 25% - 39% ☐

   (iii) 40% - 54% ☐

   (iv) 55% - 70% ☐

   (v) If exact percentage is known, please indicate .....%

C. Finished Goods Inventories

9. What are main products produced by your company?: .....

.....

.....

10. To what extent are your products differentiated?

(a) Highly differentiated ☐

(b) Moderately differentiated ☐

(c) Lowly differentiated ☐

(e) No differentiated ☐

11. How do you rate the quality of the products?

(a) High ☐ (b) Medium ☐ (c) Low

12. How do you rate the distribution and delivery system of your company?

(a) Excellent ☐

(b) Very Good ☐

(c) Good ☐

(d) Fair ☐

(e) Poor ☐

13. What is the demand rate of the Company's finished products?

(a) High ☐ (b) Medium ☐ (c) Low

14. What percentage of the inventory investment of the Company constitute the finished products?

(i) 10% - 25% ☐

(ii) 25% - 40% ☐

(iii) 40% - 55% ☐

(v) If exact percentage is known, please indicate .....%

D. In-process Inventories and Maintenance/Operating Supplies Inventories:

15. *What are the possible causes of in-process inventories in your company?*

(i) Length of the production period ☐

(ii) Break down in machine component ☐

(iii) Resultant delay ☐

(iv) Idle time ☐

(v) All of the above ☐

16. What stock (e.g. lubricating oil, soap, machine spare parts), constitute the Maintenance, Repairs and Operating Supplies inventories of your Company?

.....

.....

.....

17. What is percentage of the inventory is allocated to MRO supplies?

(i) 10% - 25% ☐

(ii) 25% - 40% ☐

(iii) 40% - 55% ☐

(iv) If exact percentage is known, please indicate .....%

E. Inventory Planning:

18. Does your company embark on any form of forecasting before stock/producing to stock?

(i) Yes ☐ (ii) No ☐

19. If the answer to 18 above is Yes, what form of forecasting is used?

(i) Short term forecasting

(ii) Long term forecasting

(iii) Both (i) and (II)

(iv) None of the above

20. What type of forecasting is employed by the company?

(i) Exponential smoothing ☐

(ii) Moving average ☐

(iii) Box Jenkins ☐

(iv) None of the above ☐

21. Does your company engage in financial planning (budgeting) for inventory investment?

(i) Yes ☐ (ii) No ☐

Inventory Control:

22. Do you have an inventory control unit?

(i) Yes ☐ (ii) No ☐

23. Where do inventory control actions originate?

(i) Production department ☐

(ii) Purchasing department ☐

(iii) Marketing department ☐

(iv) If any other, please indicate.....

24. Which system of inventory control do you operate?

(i) Fixed Order System ☐

(ii) Cyclical Ordering System ☐

(iii) Materials Requirement Planning ☐

(iv) None of the above ☐

25. How effective is the system employed in your company in attaining inventory control?

(i) Very effective ☐

(ii) Fairly effective ☐

(iii) Just effective ☐

(iv) Not effective ☐

Costs Associated with Inventory

26. What are the costs associated with carrying (holding) inventory in your company?

(i) Storage cost ☐

(ii) Obsolescence/ Deteroriation cost ☐

(iii) Insurance and taxes ☐

(iv) Stock checking, re-ordering and Accounting cost ☐

(v) Cost of money tied up in inventory ☐

(vi) All of the above ☐

27. If there are more carrying costs not mentioned in 23 above, please list them:

.....

.....

.....

28. What are the ordering costs associated with inventory in your company?

(i) Transportation

(ii) Clerical and administrative cost

(iii) Import duties

(iv) All of the above

29. State other ordering costs (if any) that are not included in 28 above.

(i) .....

(ii) .....

(iii) .....

30. Does the company keep safety stock?

(i) Yes ☐ (ii) No ☐

31. What tools are used by the company for maintaining effective inventory control?

(i) Inventory records ☐

(ii) Inventory models ☐

(iii) Use of compuers ☐

(iv) All of the above ☐

(v) None of the above ☐

32. What inventory records or cards are maintained by the stores for stock recording?

(i) Bin cards ☐

(ii) Stock control cards ☐

(iii) Stores ledger cards ☐

(iv) All of the above ☐

33. What types of inventory model is used by your company?

(i) Deterministic model

(ii) Probablistic model

(iii) None of the above

(iv) If any other, please state.....

34. What is the lead time of Inventory in your company? (Please state in day, weeks or months)

.....

.....

35. What are the re-order quantities of your stock? (Please state in Units, Weight or Volume as applicable)

.....

.....

35. How is quantity to be ordered at any time determined?

(i) Using minimum stock level ☐

(ii) Re-order level ☐

(iii) Econmic Order Quantity ☐

(iv) None of the above ☐

36. When is stock taking done?

(i) Periodic ☐

(ii) Perpectual ☐

(iii) Both ☐

37. Does the company use the ABC Classification analysis for classifying its stock?

(i) Yes ☐ (ii) No ☐

EMCON LTD, ZARIA.
1995 DELIVERIES

AS AT 31/12/95

S/NO	PFI NO/DATE	ITEM DESCRIPTION	QTY	AMOUNT SFR	LC NO/DATE	ARRIVAL (PORT)	ARRIVAL (ZARIA)	G R A NO./ DATE	NUMBER OF DAYS TAKEN		
									LC-Port	Port-Zaria	LC-Zaria
1	385/03008837 (18/2/94)	CL 5/25A	5000 sets	148,950	NEWAFR/KD026/94 28/6/94	Lagos 19/10/94	02/01/95	103791-5(17/1/95)	112	119	231
2	385/03007304 (18/2/94)	CL 25/100A	5000 sets	148,950	L/00229/94 17/10/94	Lagos 4/1/95	500 on 15/02/95	103786-90(29/3/95)	79	42	121
							500 on 24/03/95	103798-402(4/4/95)	79	79	158
3	385/03007305 (18/2/94)	CL 25/100A	5000 sets	148,950	L/00229/94 17/10/94	Lagos 4/1/95	500 on 15/02/95	103786-90(29/3/95)	79	42	121
							500 on 24/03/95	103798-402(4/4/95)	79	79	158
4	385/03008928 (15/3/94)	Raw Materials (Steel 3x120 mm)	15000 kg	30,155	L/00265/94 10/11/94	Lagos 13/2/95	03/07/95	103432 (25/8/95)	95	140	235
5	385/03008929 (15/3/94)	Raw Materials (Chemicals)		21,288	L/00248/94 28/10/94	Lagos 17/3/95	01/09/95	103436 (6/9/95)	142	168	310
6	385/03008980 (21/3/94)	KBB 80A	5000 sets	131,400	L/00255/94 28/10/94	Lagos 4/1/95	24/03/95	103401-10(18/4/95)	88	78	147
7	385/03007315 (27/4/94)	ML 50/100A	1000 sets	178,800	L/00229/94 17/10/94	Lagos 17/3/95	500 on 10/7/95	103413-4 (10/7/95)	151	115	266
							500 on 14/6/95	103447-8 (24/7/95)	151	150	301
8	385/03007316 (25/5/94)	ML 50/100A	1000 sets	178,800	L/00272/94 21/11/94	Lagos 9/4/95	500 on 10/7/95	103415-8 (19/7/95)	139	92	231
							500 on 15/02/95	103444- 8(24/3/95)	139	53	192
9	385/03007599 (25/5/94)	ML 50/100A	1000 sets	178,800	L/00310/94 4/1/95	Lagos 15/4/95	14/08/95	103495-50(14/8/95)	101	121	222
10	385/03007930 (28/6/94)	ML Assy Line Tools & Fixtures		280,000	L/00247/94 28/10/94	Lagos 3/7/95	25/07/95	103429-31(25/8/95)	100	172	272
11	385/03008048 (15/7/94)	Raw Materials (Steel & Copper)	17500 kg	57,889	L/00245/94 28/10/94	Lagos 17/3/95	10/07/95	103425 (26/95)	142	115	257
12	385/03008097 (15/7/94)	Raw Materials (Brass)	5000 kg	50,100	L/00245/94 28/10/94	Lagos 17/3/95	10/07/95	103427 (9/8/95)	142	115	257
13	385/03008100 (15/7/94)	Raw Materials (Brass)	5000 kg	50,100	L/00245/94 28/10/94	Lagos 17/3/95	10/07/95	103427 (9/8/95)	142	115	257
14	385/03007972 (31/7/94)	ML 25/50A	400 sets	66,000	NEWAFR/KD170/94 10/2/95	Lagos 27/4/95	14/08/95	103901-2(14/8/95)	76	109	185
15	385/03008231 (2/8/94)	Raw Materials (Phenolic Resin)	16 Tons	51,920	NEWAFR/KD187/94 14/11/94	Lagos 15/3/95	12/08/95	103411 (13/8/95)	121	89	210
16	385/03008255 (4/8/94)	Raw Materials (Electric Steels)	14000 kg	44,578	L/00248/94 28/10/94	Lagos 28/4/95	28/08/95	103812 (17/10/95)	184	122	306
17	385/03008256 (14/8/94)	Raw Materials		21,218	L/00182/94 9/9/94	Lagos 4/1/95	24/03/95	103795-8 (24/3/95)	117	79	196
18	385/03008620 (12/08/94)	Raw Materials (Brass, Cu, Al, e.t.c)		96013	L/00035/95 17/3/95	Lagos 5/7/95	20/08/95	103910-11 (16/10/95)	110	77	306
19	385/03008176 (25/10/94)	Raw Materials (Brass, Al, Chem.)		45,787	L/00265/94 10/11/94	Kano 28/3/95	24/07/95	103797 (4/8/95)	135	7	145
						Lagos 15/4/95	10/07/95	103425 (26/95)	156	86	242
20	385/03009189 (25/10/94)	CL 25/100A	5000 sets	140,000	L/00268/94 10/11/94	Lagos 3/4/95	10/07/95	103417-23(10/7/95)	144	98	242
21	385/03008192 (25/10/94)	CL 25/100A	5000 sets	140,000	L/00268/94 10/11/94	Lagos 3/4/95	10/07/95	103417-23(10/7/95)	144	98	242
22	385/03008302 (18/11/94)	ML 50/100A (CKD)	500 sets	59,170	L/00038/95 17/3/95	Lagos 23/5/95	07/08/95	103437-42, 44 (9/8/95)	67	76	143
23	385/03008983 (21/11/94)	KBB 30A	4000 sets	93,210	L/00255/94 28/10/94	Lagos 4/1/95	24/03/95	103401-10(18/4/95)	88	78	147
24	385/03008634 (13/12/94)	Clocks	50 pcs	1,875	EMCON ACCT IN ZUG	-	18/03/95	103412-9(16/3/95)	-	-	-
25	385/03008640 (13/12/94)	ML Assy Line Tools & Fixtures		190,077	L/00242/94 28/10/94	Lagos 27/4/95	14/07/95	103434-5 (29/8/95)	193	78	261
26	385/03008682 (14/12/94)	Raw Materials (Cemo Org Steel, Brass)	8000 kg	87,368	L/00035/95 17/3/95	Lagos 5/7/95	20/08/95	103909 (13/10/95)	110	77	187
27	385/03008683 (14/12/94)	Raw Materials (Cemo Org Steel, Brass)	14100 kg	32,793	L/00034/95 17/3/95	Lagos 12/5/95	30/10/95	103924-8 (6/12/95)	179	48	227
28	385/03020179 (8/2/95)	Tool Steel		3,118	L/00045/95 23/3/95	-	14/09/95	103904 (29/8/95)	-	-	197
29	385/03020535 (14/3/95)	Pressure Spring		8,080	L/00045/95 23/3/95	-	14/09/95	103905 (29/8/95)	-	-	181
30	385/03020503 (13/3/95)	CL 25/100A	5000 sets	143,600	L/00101/95 21/7/95	Lagos 12/9/95	03/11/95	103927-9 (11/12/95)	105	52	157
31	385/03020550 (13/3/95)	Stamping Tool for ML Faceplate	1	17,820	NEWAFR/KD211/94 31/3/95	-	14/09/95	103908 (6/10/95)	-	-	187
32	385/00213881 (18/3/95)	Hand Tools		2,005	EMCON ACCT IN ZUG	Hand Carried	21/03/95	103794 (28/3/95)	-	-	-
33	MTE - 3376 (27/1/95)	Meter Testing and Calibrating Equip.	4 sets	98,437	L/0 104/95 21/7/95	Kano 19/9/95	22/11/95	103922 (29/11/95)	124	95	219
34	385/03020828 (4/5/95)	Repaired Frame Punching Tool	1	15,530	L/0 104/95 21/7/95	Kano 19/9/95	22/11/95	103923 (1/12/95)	124	95	219
35	385/03020979 (10/5/95)	KBB 80A	5000 sets	132,450	L/00103/95 21/7/95	Lagos 12/9/95	03/11/95	103915-8 (1/12/95)	105	52	157
36	385/03020989 (11/5/95)	Swbec Filtration pump	1	4,060	L/00063/95 24/5/95	-	14/08/95	103908-7 (3/10/95)	-	-	113
37	385/03020658 (13/7/95)	CL 25/100A	500 sets	15,300	L/00103/95 21/7/95	-	-	ROYALTY	-	-	-
38	385/032002181 (21/8/95)	Set of letters/numbers size 11/2	1 set	642	EMCON ACCT IN ZUG	-	-	1039382 (11/12/95)	-	-	-