TUDY AND COMPUTERISATION OF PURCHASE STORES AND INVENTORY MANAGEMENT SYSTEM IN U & V AUTOMOBILE SERVICES (P) LTD.

esis submitted in partial fulfilment of the requirements for the award of the degree of

MASTER OF ENGINEERING IN MECHANICAL ENGINEERING

(INDUSTRIAL ENGINEERING)

of BHARATHIAR UNIVERSITY

By

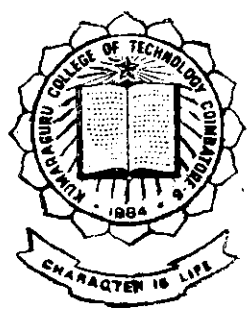
P. V. SABARI

(Reg. No. 9837H0005)

Under the Guidance of

Prof. K. KANDASWAMY, B E., M.Sc (Engg)

Assistant Prof., Department of Mechanical Engineering



DEPARTMENT OF MECHANICAL ENGINEERING

KUMARAGURU COLLEGE OF TECHNOLOGY

(Affiliated to Bharathiar University)

COIMBATORE - 641 006

CERTIFICATE

Department of Mechanical Engineering

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The thesis work done by

Mr. P.V. SABARI

(Reg.No. 9837H0005)

at

KUMARAGURU COLLEGE OF TECHNOLOGY
COIMBATORE – 641 006.

During the year – 1998 – 99

K. Kandaswamy

.....

Guide
Mr.K.KANDASWAMY
Professor,
Mechanical Engineering Dept,
K.C.T., Coimbatore.

.....

Head of the Department
Dr. MOHANAKRISHNAN

Place : Coimbatore –6
Date :

Submitted for viva-voce examination held at

Kumaraguru College of Technology on 7-1-2000

K. L

CERTIFICATE

This is to certify that this thesis work entitled " **STUDY AND COMPUTERIZATION OF PURCHASE STORES AND INVENTORY MANAGEMENT SYSTEM IN U & V AUTOMOBILE SERVICES (P) LTD.,"** being submitted by **P. V. SABARI.,** (Reg.No. 9837H0005) for the award of degree of **MASTER OF ENGINEERING IN MECHANICAL ENGINEERING (INDUSTRIAL ENGINEERING),** is a bonafide work carried under my guidance. The results embodied in this thesis have not been submitted to any other university or institute for the award of any Degree of Diploma.

.....

Prof. K. KANDASWAMY,

Dept. of Mechanical Engineering
Kumaraguru College of Engineering
Coimbatore.

FIRST INDIAN GARAGE TO GET ISO 9002

U&V Automobile Services Pvt Ltd

CERTIFICATE

This is to certify that Mr P.V.SABARI a full time M.E Industrial Engineering student of Kumaraguru College of Technology has successfully completed his Project work in our concern. After making a brief study of our present Inventory and Stores Management System, he has suggested a New Inventory System for our Stores Management and has also provided a Software for the same. The New System has many Advanced Features and it enhances the Operative efficiency considerably and also takes care of Future Expansion requirements.

We wish him all success.

for U & V Automobile Services Pvt. Ltd.,

C. MURALI
MANAGING DIRECTOR

Place : Coimbatore
Date : 10.12.99

Industrial Estate, Bharathi Colony, Peelamedu, Coimbatore - 641 004.

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P.V.SABARI

SYNOPSIS

U&V Automobile services Pvt. LTD is one among the authorized service dealersin Coimbatore servicing TATA company passenger cars .To perform their functions effectively the service station is in need of spare parts for its various models in right quantity and at right time. This project work has been undertaken with the objective to study and analyze the existing inventory management system and to develop inventory management software to maintain an optimal level of inventory in order to prevent stock outs.

Each spare part used has its own route starting from procurement up to its fitment and trials. This means that the spare parts have to be recognized by all the persons involved with it. For this purpose TATA has developed a set of unique 12 digit coding system and the U & V Automobiles has also a set of in-house developed codes equivalent to them.

The inventory classification done takes into account the different consumption need of the spare parts and also helps in building up an inventory system. This inventory system establishes the replenishment procedure for all the category of spares. These classifications and the inventory management schemes have been done with the help of a data storage and retrieval capacity of a computer. ORACLE 7.03 has been

used to store the data in the form of tables. The front-end menu driven program has been built using VISUAL BASIC 6.0.

The stores in-charge is responsible for registering the daily transactions like the spare parts issues, placing of purchase orders and receiving of the incoming goods. Apart from this he will register any item that is needed for a new model as a new record in the master menu. This front end acts as an interface between the user in the stores and the database updates the fields by getting the entries from the user through suitable forms designed for the purpose. Thus the user is never allowed to access the database directly. This proposed system and the software is expected to reduce the inventory costs considerably.

CONTENTS

ANNEXURE

1.1 Materials management:

Materials management is a recent addition to the growing glossary on management. It is the aspect of industrial management, which is concerned with the activities involved in the acquisition and storage of all materials directly and indirectly employed in the production of finished products. These activities include materials planning and programming, purchasing, inventory control, receiving, warehousing, transportation, materials handling, disposal of scrap and surplus etc. Materials are one resource available to the manager and it's the management tasks to make an optimum use of materials.

There is no doubt that scientific spare parts management will go a long way to release vital and much needed capital which can then be put to essential economic use. But many material mangers have found that the management of spare parts is a different ball game than that of managing production consumables. The same policy is adopted for both results in shelves overflowing with unwanted spares and the works department suffering for the want of critical spares. Each and every aspect of spare part management is different from production consumable management, hence entailing a completely different approach to the spare parts.

1.2 About the project:

This study and computerization of inventory management system deals with the study and analysis of existing system of inventory management. After that the inventory management techniques are introduced with a view to optimize the investment in inventory. This system comprises of maintaining an optimum level of inventory and designing an efficient purchase order pattern.

The study and analysis of the existing system of purchase procedure, stores and inventory management gives a clear cut idea about what to order, when to order, how much to order and whom to order. By using the inventory classification techniques like the ABC, HML, FSN, VED analysis the control limits required for different classes of items have been determined and the purchase policies are formed.

Moving average technique is used to find out the projected demand for different spare parts. The fixed quantity ordering system, fixed period reordering systems are used to find out the various factors like reorder level, safety stock etc. and finally the software is built for the system.

The study is mainly focused on spare parts of five different models of TATA vehicles namely:

- TATA SIERRA
- TATA ESTATE
- TATA SUMO
- TATA SAFARI

COMPANY PROFILE

M/S U & V Automobile services (P) Ltd was established on 24/12/99. The objective of the company is to service TATA range of passenger Cars like TATA Mobile, TATA Sumo, TATA Sierra, etc.

The company was principally promoted by Mr C.Murali a mechanical engineer with a vast experience in the field of marketing. He is supported by two of the directors with about seven years in production and systems management.

The company was well received by the market because of first of its kind benefits being offered to customers. The unit was well advertised. Encouraged by the market response it was decided to focus on obtaining ISO 9002 Certification to be in line with International Quality Standards. The Certificate of ISO 9002 was obtaincd within 13 months of establishing the unit and incidentally this is the first unit in India to obtain this certificate as a Garage.

Fully computerized operations with expert Operation system, Monitoring and Analysis, the unit has achieved 98.7 % Reliability in its service and this has been the first Quality Objective of the Company.

The company is authorized by TELCO and has also set up a separate unit for servicing Maruti range of cars. The unit will be the first to offer a unique three-digit number, which can be, accessed through mobile phone anywhere from Tamil Nadu. Unit is already operational 24 hrs and 365 days and is looking for establishing franchisees throughout

high way so that every vehicle on the high way can get Breakdown assistance within the shortest possible time. There are plans to extend this type of service to all brands of vehicles.

3.1 Objectives:

1. To study the existing system of purchase, inventory management, storage, issue and accounting of spares with a view to improve them.
2. To classify the items inventory, consumption value wise in order to design a scientific system for spare parts procurement depending on the requirement.
3. To maintain a suitable as well as an optimum level of inventory in order to prevent stock outs and minimize inventory costs.
4. To prevent over consumption of spare parts, avoiding the usage of Shelf life items after the expiry period and minimizes the human labor hours.
5. To develop a software for the management of purchase and inventory maintenance.

4.1.Existing system:

4.1.1 Planning:

As this project is done in a service industry there are no production schedules available like a production industry to work out the consolidated material requirement. The stores in-charge maintains a maximum level of inventory of the fast moving items and minimum level of inventory of slow moving items, taking into consideration the availability of the spare parts. He also maintains a buffer stock for the fast moving items depending upon the requirement of the items and depending on the reliability of the vendor to supply them in time.

4.1.2. Purchase:

The purchase department and the stores in-charge jointly release the purchase orders to the different vendors after realizing the material requirement for the stores. All the formalities in procurement of spare parts like competitive rate, quality, delivery time, payment terms & credit terms are exercised by the purchase department before release of the of the purchase order to the vendors. The purchase dept looks after the follow up for the supply of the spare parts by the vendors when required.

4.1.3. Receipt of materials:

There is no separate department for the receipt of materials. The materials are directly received into the stores accompanied with the copy of the purchase invoice form. The stores in-charge verifies the purchase invoice with the purchase order released to verify the order fulfillment.

The items are inspected by the stores in charge himself before putting the purchase entry in the purchase ledger. In case of any rejections, the stores in charge prepares a delivery note for the rejected items that are to be sent back to the vendor and returns the material immediately or stores the material separately. After the purchase entry is over the items are stocked in their places.

After the inspection of the items supplied the stores in-charge sends the bill with the copy of the purchase order to the accounts department for the payment to the vendor for his supplies.

4.1.4. Arrangement of stores:

The storekeeper properly stacks the items received. Vertical stacking of materials restored to, so that the floor spaces requirement is minimized. There are separate racks for each type of items like lubricant oils, rubber items, electrical items and fasteners.

All the fast moving items are stacked near the aisle for easy issue. The slow moving items are stacked next and the non-moving items are stored at the farther end. Heavy materials are stacked at the bottom and the liquid items like the lubricant oils barrel are stored in the floor.

4.1.5. Maintenance of the stores:

A stores ledger is maintained for recording the purchase and issue activities. The stores ledger contains the date, name of the item, receipts, issues and balance in hand for use. As and when the materials are received into the stores or issued to the shop floor, the entries are made

in the ledger. Whenever the inspected items after receipt are to be stacked, they are entered in the stores ledger with the purchase invoice number or bill number as authority for the receipt of the items.

4.1.6. Issues and returns:

The stores in-charge issues the items required for the replacement in the vehicles serviced on receipt of the oral requisition from the shop floor manager along with the job card. Immediately after the issue of the items the issue is entered in the stores ledger with the mode of issue either for warranty replacement or cost free replacement due to the shop floor breakage of the item previously issued or for replacement against cost.

In case of the return of the issued items the returns are entered in the stores ledger and the broken out items are separately stored in a scrap store for disposal. The items, which were returned due to manufacturing defect, are stored separately for replacement from the vendor.

4.1.7. Monthly stock list:

The storekeeper maintains a monthly stock list at each month.

4.1.8. General:

Only the stores in-charge, the store assistant are the authorized persons who can enter the store. These persons do stacking of items in the racks and the removal of the items only. The stores in-charge has the complete authority for all activities of the stores.

4.2.Problem definition:

U & V Automobiles follows the conventional method of procuring and storing the spare parts. As going through their previous months records it was found that the number of vehicles coming for service varied each month. The spare parts required also varied depending on the service needed by these vehicles. For achieving the company's goal of on road reliability of the vehicles serviced by them this inventory classification and the software will be a helping hand. The problems found in the present system of purchase stores and inventory management is as follows:

4.2.1. Stock outs:

In many situations the stock outs lead to higher inventory costs due to rush purchase done during the non-availability of the spare parts in the stores on requirement. In the present system the items leading to stock out are the fast moving items like lubricants, rubber bush items, gaskets, filters, electrical items and fasteners.

4.2.2. Over consumption:

Over consumption is one of the major problems that could not be monitored and controlled in the present system leading to the management dissatisfaction and suspicion on the shop floor activities. Sometimes the spares and lubricant oils are consumed more than the requirement for a vehicle. The items that are consumed more than the

requirement are the engine spares, lubricant oils, suspension system spare parts and fasteners.

4.2.3. Shelf life:

Usage of items that have fixed shelf life after the date from when they are not fit for use which leads to failure of the item before its specified life. Generally the problem of shelf life is with the rubber items namely the suspension bush kits, engine, gearbox beds, and radiator and vacuum hoses.

4.2.4. Wastage of labor hours:

Manual labor hours are wasted in inventory control for every day stock verification, monitoring the consumption and estimating the requirements of the different spare parts for placing the purchase orders to the vendors considering the prices and supply of the items to prevent stock outs.

4.2.5. Improper locations and mixing:

The issue of spares becomes more difficult and time consuming when the location of spares is not proper and are mixed up. The daily stock verification process also becomes more laborious because the same item is stocked in different locations and bins leading to confusion.

4.2.6. Increased inventory and purchase costs:

Due to the manual inventory planning and control i.e. estimating the requirements of the spare parts without forecasting leads to the release of more number of purchase orders and rush purchases

increasing the inventory and purchase costs. The other case of higher inventory cost is the cost built up due to maintaining higher level of inventories more than the requirement.

5.1.Introduction to Stock control:

Stock and inventory as it is usually called means the systematic regulation of the quantity and variety of things to be held in stock. It deals with the policies and procedures adopted which match supply and demand effectively and economically. As a function adopted under the wide gamut of materials management it strands sandwiched between the purchasing and the users functions, i.e. when the purchase man desires that all items to be bought in bulk to take advantage of the discounts offered by the seller, the user demands that the items be bought in minimum amounts as and when they are required, the stock controller disagreeing with the both.

How it is seen

The term stock control is used in different senses by different people – as are many of the terms used in connection with it, such as max-min. Accountants sometimes regard stock control as a branch of book keeping and it is true that most organizations have large number amounts of money tied up in stocks, which appear as assets on the balance sheets. Mathematicians tend to regard stock control as a branch of mathematics and statisticians see it as special fields of mathematical forecasting. Operations research men have toiled mightily on the stock control, producing some remarkably abstruse pieces of theory. Computer experts enthuse as " tell us what's the figure and facts you would like to have", they say, causing their admirable machines to discharge piles of

printouts. And there exists many thousands of practical stores man who operate stock control as a traditional practice like folk dancing.

[1.Pg18.ch1]

5.1.1.The stock Controller:

Stocks are held to serve the business. The person who has the following fundamental conflict in mind always " The better the service, the more is the costs" is the stock controller. It is precisely by giving a good service, by having whatever is required available whenever it is wanted, that the stock controller reduces the overall operating costs of the organization and thus makes him contribute to the profits.

The Position of the Stock Controller:

The over laps between the stock controller and other functions often leads to stock control people being include in either the purchase department or the production control department. The manufactured parts and the purchased parts, which do go into, stock constitutes the total stock. The fundamental questions in stock control What to order, When to order, How much to order- must overlap similar questions in the sense that fundamental to the success of operation are sound procedures which provide regular answers on a regular basis. The stock control question — 'how much to order' is the same as the purchasing the question – 'How much to order', or the production planning question –'How much to make'. Stock control is connected with shortage control and stock turn rate. Purchasing also has its angle; price volume

relationships and commercially practicable order sizes. Production have problems in capacity utilization and setup costs which affect order sizes have problems in capacity utilization and setup costs which affect order sizes. All these considerations have to be taken into account to make optimum decisions. This is one of the reasons for the gradual growth of what are called 'materials management " type organization structures. Finished products held for immediate sale introduce directly a third set of considerations which in any case indirectly underlie those already mentioned – What will sell and in what quantities he sale or marketing department must then have a major sale in stock control.

Hence nowadays a physical distribution manger is often put in charge of the broad range of activates concerned with supplying, storing handling and moving the product from the end of the production line to the customer – which are considered as a rclated group of functions to be managed integrally. *[1.Pg37.ch2]*

5.1.3.Performance standards – shortages and the service level:

Measuring satisfactory performance in the stock control is far from easy. It is easy to state the objectives of stock control in slogan form: the most service at least cost. But it is difficult to express these objectives in the form of specific targets and quantitative standards for the service desired and the cost allowed.

Service for instance has number for aspects. Users will assess the service given by stores by such criteria as short queues, simple

procedures, a cheerful reception, a helpful and commonsense attitude and no shortages. The part for which the stock controller is responsible is confined to stock outs and shortages: how often is some thing, which ought to be in stock, is not in stock. Zero stock outs are the simplest service target. It looks good until it is costed out. The store, which never runs out of anything, has too much stock. The common most performance measure is probably6 just to list each month, the items which ran out of stock, perhaps also with details of the extent of the shortage. Whether or not the length of the list if acceptable is then a matter for management judgment.

[1.Pg87.ch6]

5.2. Why inventory control:

5.2.1. Stocks and Profitability:

As already mentioned, stocks held are seen as assets in the balance sheet of the company. Hence the lower the stock held higher the return on investment.

$$\text{Return on investment (ROI)} = \frac{\text{Earnings}}{\text{Sales revenue}} \times \frac{\text{Sales revenue}}{\text{Capital EMP}}$$

When the stock is less, the capital employed is less and hence the ROI is more. Another factor, which is a measure of probability, is the stock turn rate. It is a quick guide to the mileage obtained from the money tied up in the stock. If the manual accounts show stocks worth Rs 58000 at the beginning of the year and Rs 82000 at the end of the year, the average stock value over the year appears to be Rs 60000. If the sales amounts to say Rs24000 then, it can be seen that the stock has turnover four times a year. This stock turnover rate of four means on the average the entire stock has been replaced four times a year.

5.2.2. The wide variety and complexity of requirements of the modern industry also necessities conscious management. Larger the range, greater the number of problems, investments, procurement handling and accounting, shortages and stock outs, deterioration and obsolesce. Once the reason for poor stock turn rates is that items, which turn over at all,

inflate stock balances. Even a well-managed store contains special policy stocks and insurance of various stocks of various kinds. A continued effort is needed both to clear out unwanted stocks and to bring in wanted stocks, as requirements change and evolve.

5.2.3. In case of spare parts, the urgency of the requirement of the spare and amount of customer dissatisfaction during the case of urgency necessitates a well-planned spare parts stock control system. The cost that may be incurred in the proper management of spares is very small when compared with the cost incurred due to the non-availability of the spares. The service level for these spares has to be obviously more than that for production consumables.

5.2.4. In today's industrial economy, greater pressure is on the finance department to maintain liquidity. The company has to be alert about its capital turnover. The best way to attain this is inventory control.

These are the major factors necessitating the control of the stock. Apart from this there may be so many small factors, which shall come under the four mentioned factors above. *[cp 2..Pg15.ch1,3.Pg34. ch2]*

5.3. Inventory models and practices:

As soon as the steps are taken to maintain the right range of things, the stock controller will face another major problem, how much stock to hold of the items stocked. This calls for a balancing act. These two acts namely, controlling the range and fixing the optimum level of category take the stock turnover levels to higher values.

Big stock keeps the operational people happy. Sales department likes a situation where anything they sell is available off the shelves because makes customers come back former. Production likes a situation where materials for whatever to be manufactured are available from stock. Purchasing prefers a few large orders to lots of small orders, because it makes less paper work and enables them to get at lower prices; but large orders mean big stocks leaving a lot to be said for large stocks. Unfortunately big stocks are expensive. The biggest expense is the financing of the stocks. Forms, which finance stocks on bank overdrafts, find their bank managers backing up the squeeze on stock levels. It is wasteful to carry stocks worth RS 100000 if similar results can be achieved with a stock worth RS 50000.The financial costs is not the only one, big stocks require big stores to accommodate them, more staff to handle them, lots of office work to keep track of them. Deterioration and obsolesce due to changing requirements of the company can conflict can inflict losses on the company.

Balancing the financial and other advantages of low stocks against the operational convenience of high stocks is not an abstract problem. It is something intact is done, whether intentionally or not, whenever an order quantity is decided. Another balancing act is required to prevent the shortages. Big stocks should mean, if they are right stocks, that not many shortages are experienced. But preventing shortages by carrying plenty in stock is like any form of insurance; the more you pay, the more you have available for other purposes. Balancing the cost of shortages against the cost of preventing the shortages affects the level of stocks at which more supplies are ordered: the when to order decision. These problems are the fundamental problems in stock control.

1. WHAT TO ORDER?
2. WHEN TO ORDER ?
3. HOW MUCH TO ORDER ?

5.3.1. Arriving at the model of the system:

The starting point of planning for any stock controlling system lies in forecasting the sales for the future by various techniques available. This will give the company an idea of what amount is to be produced to meet the demand. Then the production capacity decides how much can be produced actually. The bill of materials got from the production drawings and the batch size gives the material requirement. But since the production rate varies owing to many reasons, the material requirement too varies. Production schedule has to be drawn up for this

reason. The BOM balanced with the production schedule along with the factors like the lead-time for the component, outstanding quantity etc. Decide what materials are required, when and what quantities.

[4.Pg37-40.ch3]

5.3.2. Fixing the order quantities:

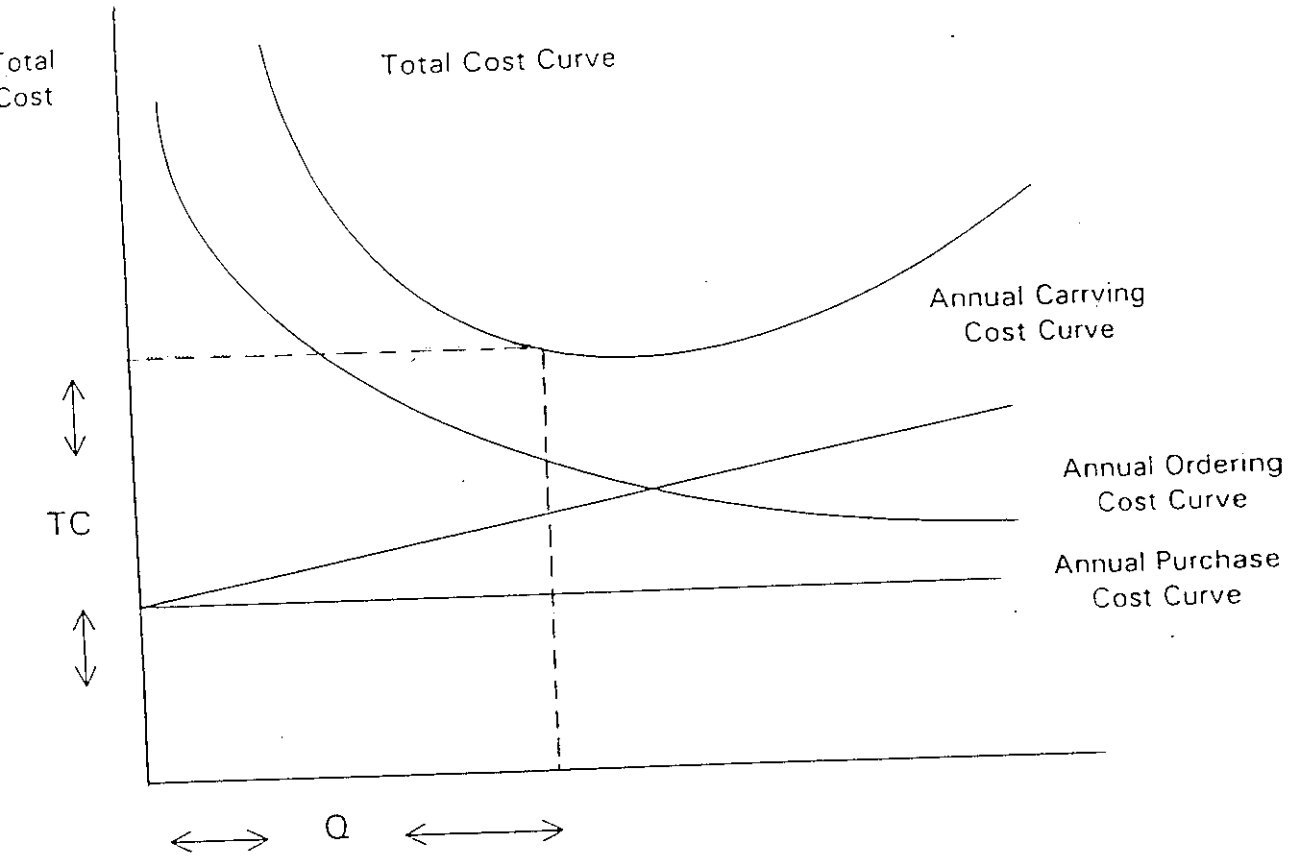
The fundamental question "How much to order" can be answered in two ways:

1. Enough to bring stock up to an order-up-to-level
2. A quantity (A)

For a stable demand the question "what quantity to order" is an another form of "how often to order" .For fixing the order quantities the consumption analysis is first done and the A, B & C categories are arrived at based on a Pareto analysis of previous consumption values got from the records. The category items are those unit prices are high or are used at high rate. Hence the stock held should be minimum for them. For the B&C category items, the stock held can be more. Hence the following systems of reordering and maintenance are followed for the categories:

Continuous system or fixed quantity ordering system:

Here as and when the stock level of any item equals the reorder level or goes below it an order is triggered for the item. Hence this is a daily duty for the stores man to place the indent for those items, which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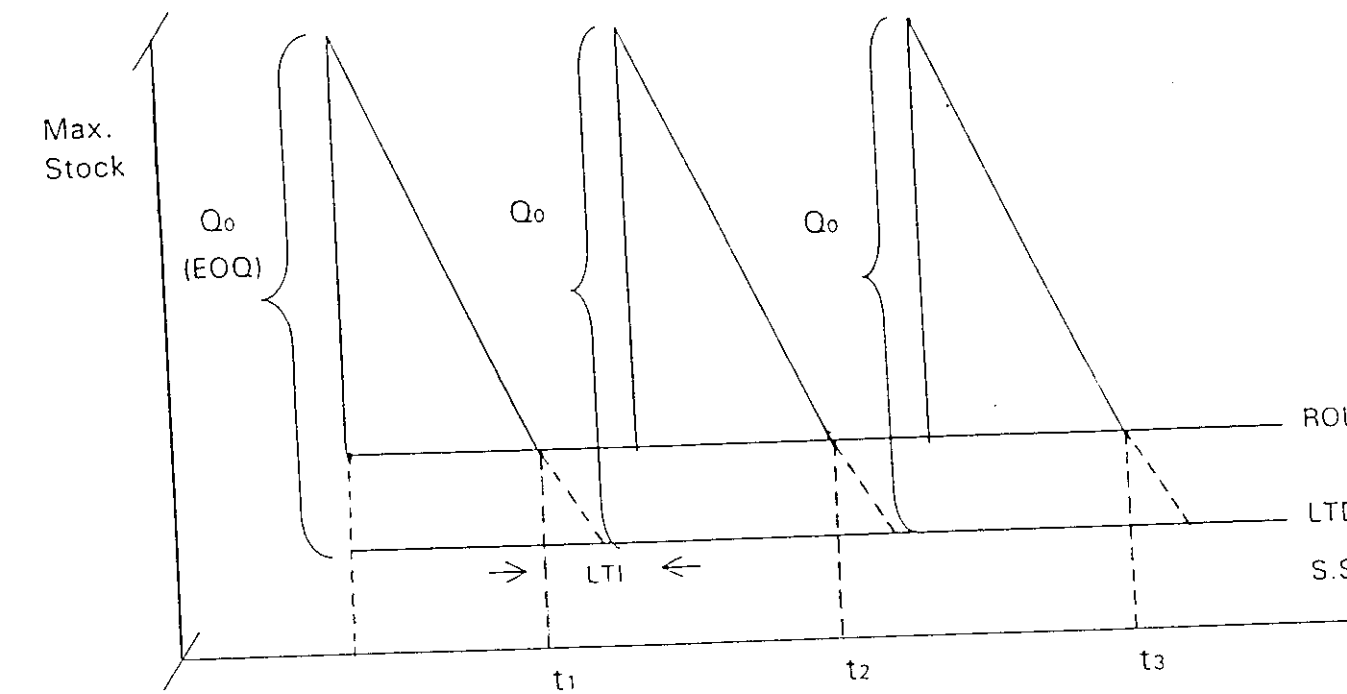
Max. Stock
Q₀ (EOQ)
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ROL
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have been placed under this category and whose stock level is less than the reorder level.

This is applied to A class item alone. Here the EOQ is arrived at by optimizing the total cost involved in the inventory i.e. carrying cost + ordering cost. The carrying cost which is compromised of holding cost and the purchasing cost goes on increasing with the quantity ordered and the ordering cost goes on decreasing with the order quantity. The sum of these two costs reaches a minimum at an order quantity called the **Economic Order Quantity.** Shown in Figure 1 refer page no.24a.

It is given by E.O.Q = SQRT (2 x A x S / C x I)

Where

O = Ordering cost

A = Annual demand

H = holding cost

I = Rate of interest charged for the money Invested in stock

C = Price of the item.

There are many types of models, which adhere to this continuous system of reordering. They differ from each other in the modes of replenishment i.e. immediate replenishment or a gradual replenishment as the consumption is going on etc. These minor variations bring about a difference in the maximum quantity in stock, the economic ordering quantity. But all of them fall under this continuous system and the

policy is to establish an ROL which when reached for each and every item triggers the reorder. This time between the reorders for an item is a variable here, but the ordering quantity is a constant.

Periodic review system:

The B&C category items are ordered on a periodic basis i.e. their levels are checked at a particular date and those items of the group for which the stock level is below the minimum level are reordered such that their stock level comes up to the maximum level. The maximum level is fixed based on the period of review.

For example B class items: 3 months of stock are reordered for a period of review of three months. (For those items of the group where stock level < minimum level) for C class items, the reorder quantity will be more since the period of review is longer. These are the two mainly employed methods, which combine the ideas of consumption analysis and economic ordering quantities. Shown in Figure 2 refer page no.24a.

[2.Pg49-52.ch4]

5.3.3. Fixing the reorder level:

The reorder level is made of two quantities: they are the safety stock and the lead-time stock. The safety stock is used to take into account the variations in the lead-time and the variations of the consumption in the lead-time. Statistical methods are available to determine levels of the safety stock for varying degrees of assurance against then stock out. The basic data required is the average

consumption during the lead-time. The distribution during the lead times analyzed. Based on the actual distribution, safety stocks could be estimated using the statistical tools. However, this consumption pattern generally can be approximated to one of the two standard distributions namely the normal distribution and the Poisson distribution.

For normal distribution:

Safety stock = K* SQRT [(X-X)/N-1]

Where

X = consumption of spares in the lead time during a Period (number)

X = average consumption of spares in the lead time for that period.

N = number of periods considered

K = the value of K varies with the degree of assurance (or) risk desired for the item

For Poisson distribution:

The second type of distribution is more common for variation in consumption pattern.

Here the safety stock is determined as

S.S = SQRT (average consumption in lead-time)

The lead-time stock is found out by:

L.T.S = consumption rate X lead-time

Hence the reorder level is = safety stock + lead time stock

5.3.4.Periodic review system:

As the above case the reorder level is made up of the safety stock and the lead-time stock. But here the safety stock is determined by taking into account the period of review and not on the basis of any statistical calculations. The longer the review period, higher the safety stock hence the C category items have higher safety stock and longer review periods. Various other methods are also employed, but have the basis as fixing a reorder level and adopting some systems of maintaining it. A brief mention of those methods is done here.

Imprest stock control:

This method is adopted for the items having the least consumption value (C value items). A maximum level for the items is fixed, periodic inspections are done and the bins are immediately replenished to their maximum levels.

Open access bins:

This is adopted in case of offline requirements like nuts and bolts required in an assembly line. Open bins are kept near the production lines and the replenishment from the stores to these bins takes place on the lines of Imprset system. The quantity replenished is assumed to be equal to the volume issued in topping up the open access lines by Imprest. If stock outs occur, this shall be reflected in the overall record. Inquiries can be made into the reason for irregularities—excess

consumption might have been due to a change in demand about which the stores might have not been informed.

Two bin system:

This is basically a visual method of stock control. There are different levels of stock. Material is used from only one of the bins until that particular bin gets empty signaling the time for replenishment. At this time the second bin is put into use acting as a reserve stock level indicated in the petrol gauge of a scooter. *[2.Pg58-62.ch4]*

5.4. Spare parts management:

The present day reality of spare parts management is stock out of items in the midst of high stock levels. In eight to ten companies, one finds the shelves of engineering stores flowing with the spare parts, while the users are complaining about the non-availability of items they need. This is strange but true. To an extent it is caused by the inventory system used by the company.

For some materials managers, spare parts management means only maximum- minimum control limits and the classification of spares by ABC method. They try to follow such control systems blindly and end up with huge inventory levels. As already mentioned materials manager should understand that the management of spare parts inventory is essentially different from managing direct materials are not suitable in managing spare parts.

The various factors involved in the spare parts management and the various implications arising from the huge inventory of spare parts are:

5.4.1. Large numbers and excessive range:

Unlike raw materials the number of spare parts in the stores is usually very high comparatively. For example a manufacturing company may purchase only 500 different types of raw materials for manufacturing their products but an automobile service industry needs [illegible] items in stock to fulfill their goal of satisfying their

customers by duly servicing their vehicles. In India as in other developing countries it is most common that the same models of vehicles introduced with slight modification in their systems and specifications every time and several new models introduced leading to the excessive range and number of spares.

5.4.2. Improper identification:

Arising from excessive numbers, another major problem that exists is the absence of proper identification of spares. Some scientific method of identification of the thousands of spares is to be arrived. Hence a clear and logical coding system is needed which is understood by all the persons who deal with the spares. Generally in an automobile service industry the coding system is formulated by the manufacturer himself for the different models he is manufacturing. The only thing to be done is to follow the coding system effectively for identification of the spare parts.

5.4.3. Uncertainty of requirements:

Unlike raw materials and consumables, there is a considerable degree of uncertainty with reference to the requirement of spare parts. In fact, the failure of certain spares is almost totally unpredictable. This vagary in the life of these spares results from a variety of reasons ranging from incorrect use and improper maintenance of the vehicles

5.4.4. Absence of reliable data:

Most automobile service industries in India do not have any correct data in regard to past consumption of spares. The only data provider is

the issue documents from the stores even which is destroyed after a period. Sophisticated techniques available to enable purchase and stocking decisions to be taken for spares can be applied only if the past data is available. These techniques make sure of the accurate past consumption data and the experience of the stores person to fix up the effective inventory control system.

5.4.5.Stock out cost:

The stock out cost in the case of non availability of spare is usually very high taking the form of higher downtime of the vehicles, leading to rush purchases at higher costs and intangible costs in the form of customer dissatisfaction loss of goodwill of the customers.

5.4.6. Spurious spares:

For all the Indian vehicles on road spares are easily available from the market in quite a large number of cases. One unfortunate aspect of this is the spurious makes being marketed. Purchase and use of these spares results in the damage to the machine. Leading to customer dissatisfaction due to the higher repair cost of their vehicles.

5.4.7. Procurement problems:

There are many problems regarding procurement. The first one is the proper identification of the spares involved. Generally if the part codlings supplied by the manufacturer is used effectively then the problem of identification is solved. The second problem is the reliability of the source of supply they are the distributors and the dealers of the

manufacturers. Quite of the manufacturers may not be manufacturing the spares for their previous models which for him is an expensive proposition in marketing resulting in poor service levels. Added to this many manufacturers adopt batch production of their spares and to keep storage costs low, the batch size is kept as low as possible.

5.4.8. Shelf life:

Shelf life is another problem that is threatening storage of spares. Some spares cannot be stored in normal climatic conditions and used after a certain period of time for example rubber items they are easily influenced by the climatic conditions and on using them leads to non fulfillment of the purpose for which they are used.

5.4.9. Difficulty in establishing service levels:

The common service levels incase of raw materials viz. the number of times an item gas gone out of stock, the quantity backordered etc cannot be applied to the spares owing to the already cited reason that the variety of spares is so high that it would not be possible to maintain a record of these measures.

From the above the following points may be considered as features that are peculiar to spares:

1. The requirement is very large.
2. There is a considerable degree of uncertainty with regard to their requirements.

3. Due to the large variety of spares, identification becomes a problem necessitating a clear system of codification.

4. In most companies decision making regarding the spares is routinised and it is generally the stores in charge who prepare the purchase order for purchases.

5. A small range of items account for a large percentage of requirements.

6. No proper information storage about the usage of spares with the result that forecasting cannot be done

7. A large number of spares might be very critical or vital from the operational point of view and hence the tendency to hoard though the requirement may not be there leads to high inventory in spares.

[3.Pg23-32.ch3]

6.1. Method of data collection:

The data and details about the consumption of various spare parts, lubricant oils, and consumables were obtained mostly from sources like the issue documents, stock statements, purchase orders, daily consumption records and invoices during the previous months in the company.

6.2. Analysis and interpretations:

For analyzing and interpreting the data, the following inventory management techniques are used:

6.2.1. ABC Analysis:

For this analysis the annual consumption value of each item is found out in rupees from the consumption records of issues from stores. After this the cumulative consumption value arranged in descending orders are added up and percentage consumption value is found out. The items whose percentage consumption value comes under 70% are classified as an items (i.e. 70% of total consumption value), 90% are classified as B category items (20% of total consumption value) and remaining as C Items (i.e. 10% of the total consumption value).

6.2.2. FSN Analysis:

All the items are not required at the same frequency. Some are required regularly, some occasionally and some very rarely. This analysis divides items into three categories in the descending order of their

consumed over a short span of time. 'S' represents the Slow moving items stocks, which are consumed within a few months. 'N' represents the Non-moving items stocks, which are consumed within a year or more.

6.2.3. HML Analysis:

This analysis is similar to ABC analysis but here the criteria are price instead of usage value. The items in the analysis are classified into three groups i.e. High, Low, and Medium. The analysis helps to keep control over consumption as per the price and helps to access the storage and security requirements. It helps to outline the buying policies.

6.2.4. VED Analysis:

This analysis represents classification of items based on criticality. The analysis classifies the items into three groups called Vital, Essential and Desirable. Vital items are those items the unavailability of which will stop the production. Essential items are those items whose stock out costs is very high. Desirable items will not cause any immediate production stoppages and their stocks out costs are nominal.

This analysis is mainly carried out to identify the critical items. An item, which may belong to the C category, may be critical from the operational point of view. The service level for each item may be determined and the inventory can be planned accordingly.

6.3. Demand forecasting:

The demand forecasting is done getting the consumption data of the previous days, year depending on the type of the ordering system. As the consumption of the spare part items is more fluctuating the moving average technique is used.

6.4. Framing of purchase policies and fixing of ordering systems:

The purchase policies are framed based on two major factors. The first factor is consumption rate of the items and the second is the item value. After the purchase policies are formed the ordering systems are defined either the fixed quantity ordering system (EOQ) or the fixed period ordering System i.e. the periodic review ordering system.

6.4.1. Fixed quantity ordering system (EOQ):

This type of ordering system is used for slow moving medium and low value items. The maximum level is fixed by adding the safety stock and lead-time stock with the economic order quantity. The safety stock level is the safety minimum level, which is fixed depending on the reliability of the vendor. The reorder level is level at which the order for the purchase of the item is to be placed. It is fixed depending on the vendor lead-time and the consumption during the lead-time. The formula for calculating the EOQ is given below. The annual demand is forecasted from the previous year consumption.

It is given by E.O.Q = SQRT (2 x A x S / C x I)

Where O = Ordering cost

A = Annual demand

H = holding cost

I = Rate of interest charged for the money invested in stock.

C = Price of the item.

6.4.2. Fixed period ordering system:

The fast moving items are ordered on a periodic basis i.e. their levels are checked at a particular date and those items of the group for which the stock level is below the minimum level are reordered such that their stock level comes up to the maximum level. The maximum level is fixed based on the quantity forecasted of the previous 21 days consumption. The minimum level is the safety stock level, which is fixed, based on the consumption rate during the review period.

6.4.3. JIT purchase:

This type of ordering and purchase system is adopted for slow moving and non-moving high value items. Stocking of these occasionally needed items increases the inventory costs as well as the security problems arising because of the high value items.

6.4.4.Minimum stock and ordering system:

This type of stocking and ordering system is adopted for non-moving low and medium value items. For such items the minimum stock

that is required is maintained and on consumption of the stock an order is placed for purchase of the item.

6.5.Software formulation and implementation:

The software is formulated using the interpretations from the analysis and the ordering systems fixed for different items. The back end of the software is formed using Oracle 7.0.3 production version. The database is formed as tables with the required data fields for inserting, updating and retrieval of data's on requirement. The front-end user-friendly screen design and the programming are done using Visual Basic version 6.0. The screen designs are done according to the requirement of the user and the programming is done so that the data entered as well as the data manipulated are updated in the database. The user is never allowed to access the back end directly and enter the data's; only he is allowed to access the database from the front-end entry and retrieval of data.

7.1.Classification of items based on based on consumption value (ABC):

Applying the ABC classification to the whole lot of the spares and fixing their levels for their maintenance would be far from an engineering approach to the problem of spare parts inventory management. As already mentioned, the peculiarity of the spare parts which sets them apart from production consumables management there are thousands of items each having different requirement related to the type service required by the incoming vehicles.

The classification of the spare parts done on the basis of its consumption value.

Analysis:

Procedure for making ABC analysis

1. Calculate the total inventory value for each item held in inventory by multiplying the number of units used in a year by its unit price.
2. Tabulate these items in the descending order of their values placing the item having the highest total value and so on.
3. Prepare a table showing item no, unit cost, annual units consumed and the annual rupee value of the units used.
4. Compute the running total item by item and also for the rupee value of consumption.

5. Compute the cumulative percentage for the item count and the cumulative usage value.

6. Plotting a graph between the cumulative percentage units and cumulative percentage value calculated does the percentage fixation for the classification of the items.

7. Classify the items as per the norms for the ABC items.

The procedures above described are followed for the making the analysis and the quantified results are as follows

Quantification:

Total number of items taken for analysis = 1307 Items

S.NO	Class	No of items	% Of usage value	% Of items
1.	A	209	67%	16%
2.	B	365	21%	28%
3.	C	731	12%	56%

A pie chart representing the above interpretations is shown in Figure 3

Refer Page no 41

Pie chart representing ABC classification of items:

Comparison according to % of items

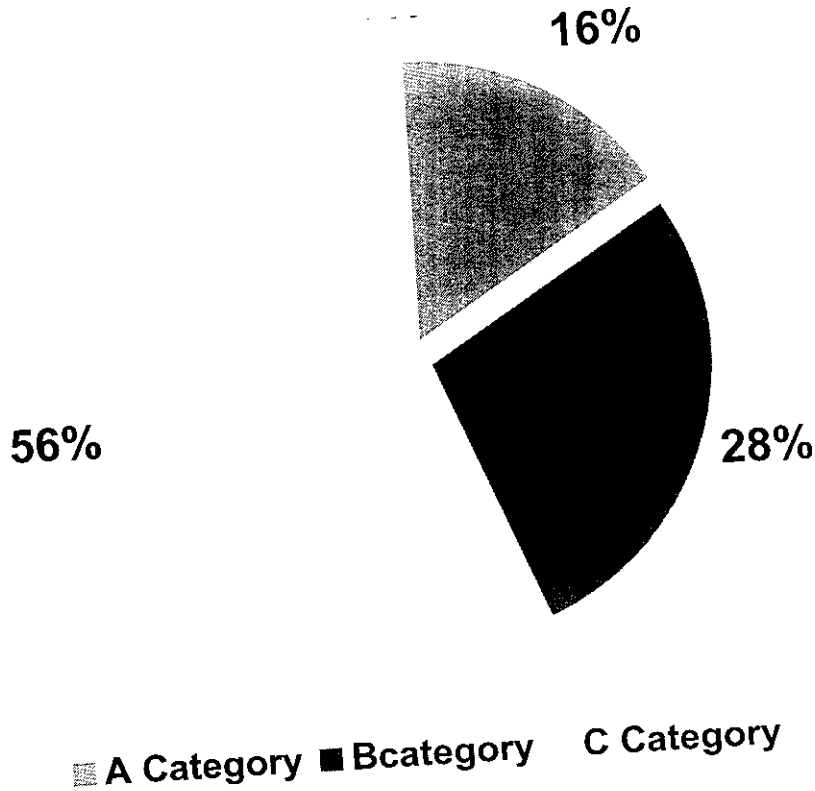


Figure 3

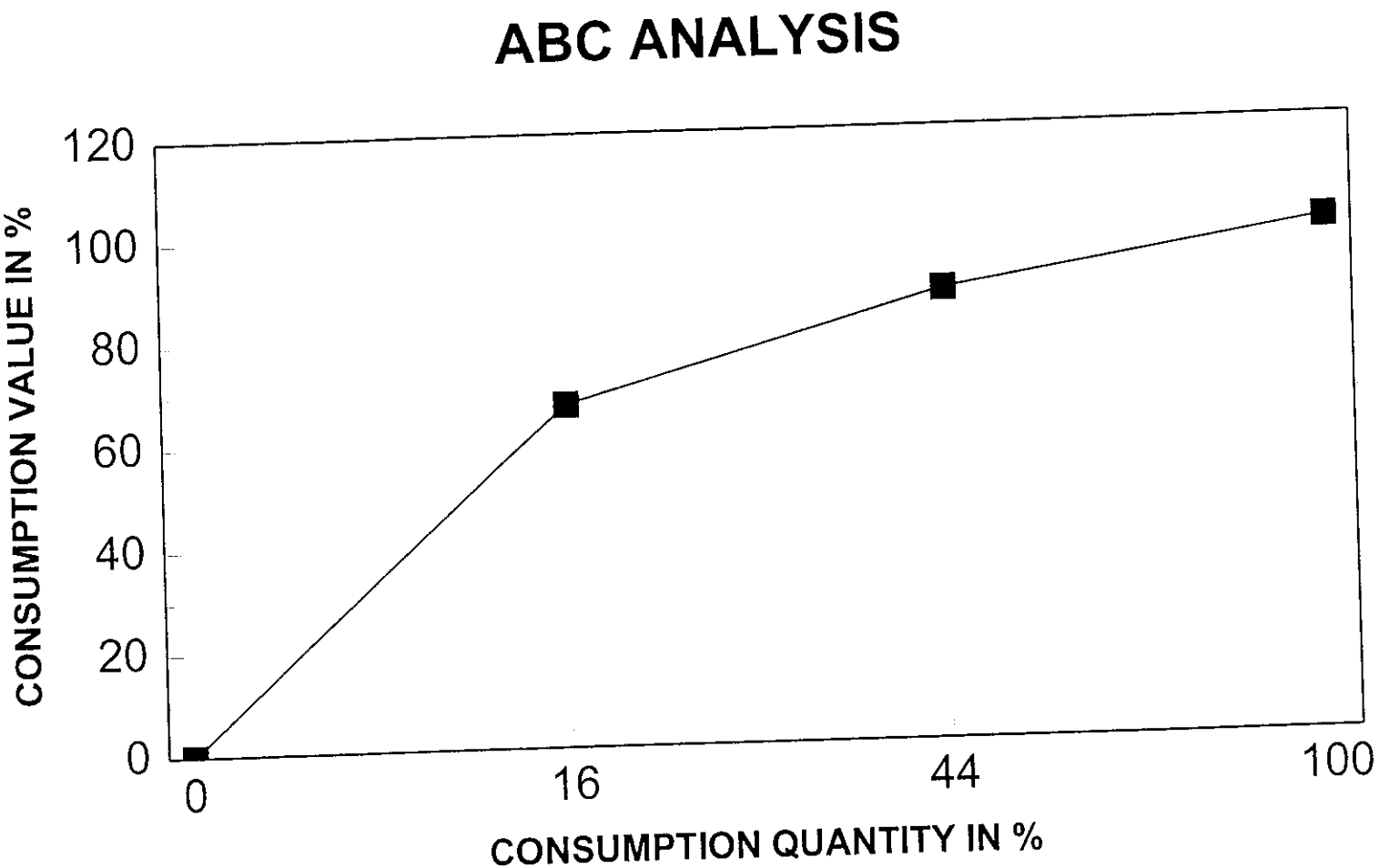

ABC ANALYSIS
120
100
80
60
40
20
0
CONSUMPTION VALUE IN %
0
16
44
100
CONSUMPTION QUANTITY IN %

Figure No.4

7.2. Classification of the items based on consumption (FSN):

All the items in the inventory are classified into Fast, Slow, Non-moving items depending on the movement or consumption frequency of the item in the shop floor.

Analysis:

Procedure for making FSN analysis:

1. The items are classified into Fast, Slow; Non-moving based on their frequency of consumption i.e. either daily, weekly, monthly or yearly.
2. The items that are issued daily are classified into fast moving items.
3. The items that are issued once or twice in a week; more than three times a month and above three to four times a year are classified into slow moving items.
4. The items that are not at all issued, once in a year, once in two years and the consumption may be less than one to two units are classified into non-moving items.

The procedures above described are followed for the making the analysis and the quantified results are as follows

Quantification:

Total number of items taken for analysis = 1307 Items

Fast moving items:

A category = 51 Items

B category = 25 Items

C category = 17 Items

Total number of fast moving items = 87

Slow moving items:

A category = 75 items

B category = 167 items

C category = 336 items

Total number of slow moving items = 578

Non-moving items:

A category = 17 items

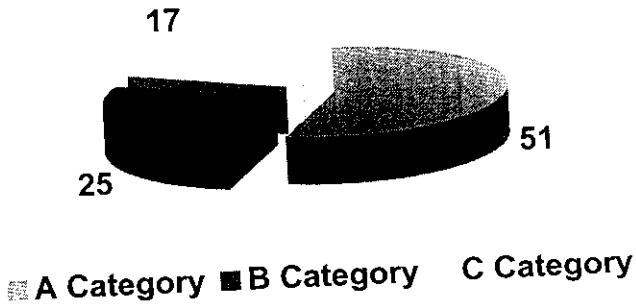
B category = 75 items

C category = 550 items

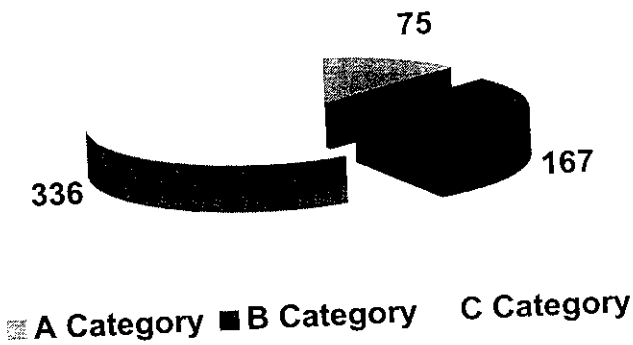
Total number of non moving items = 642

A pie chart representing the different category of items classified according to their consumption is shown in Figure 4 refer page no 45.

Fast moving items:



Slow moving items:



Non-moving items:

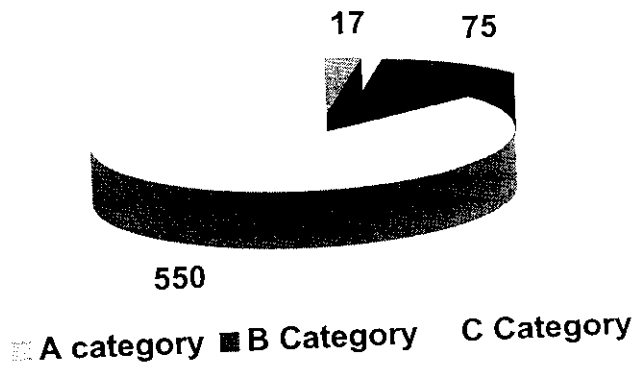


Figure 4

7.3.Classification of the items based on value (HML):

The items in this analysis are classified into three group's i.e. high, medium and low value items depending on the price of the item. The main objective of this classification in the thesis is to frame the ordering policies on the basis of item value.

Analysis:

Procedure for making HML analysis:

1. The items are tabulated and arranged in the descending order based on the unit price of the item.
2. The tabulated items are checked for the unit price range.
3. The items that have a price range of rupees two thousand and five hundred and above are grouped as high value items.
4. The items that fall in the price ranging from above rupees three hundred and less than rupees two thousand five hundred are grouped as medium value items.
5. The items that that have a price range below rupees three hundred are grouped as low value items.

The procedures above described are followed for the making the analysis and the quantified results arc as follows

Quantification:

Total number of items taken for analysis = 1307 items

Fast moving items:

High value	= Nil
Medium value	= 54 Items
Low value	= 33 Items

Slow moving items:

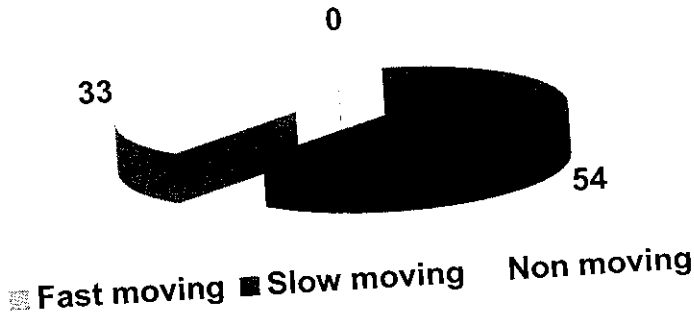
High value	= 13 Items
Medium value	= 174 Items
Low value	= 381 Items

Non-moving items:

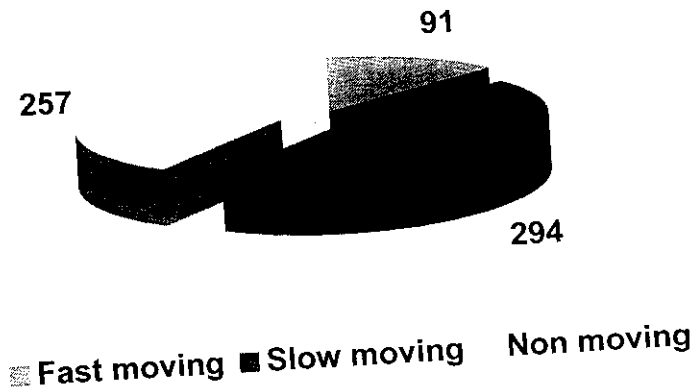
High value	= 91 Items
Medium value	= 294 Items
Low value	= 257 Items

A pie chart representing the different category of items classified according to their value is shown in Figure 5 refer Page no.48.

High value items:



Low value items:



Medium value items:

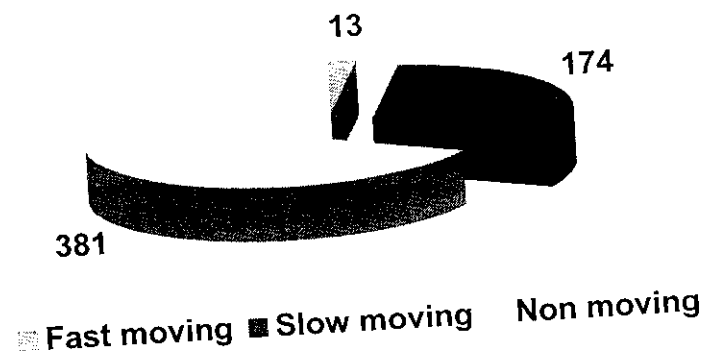


Figure 5

7.4.Classification of the items based on criticality (VED):

This analysis represents classification of items on criticality. The analysis classifies the items into three groups called vital, essential and desirable. The stock out of these vital, essential items leads to greater down time of vehicles influencing indirect costs like customer dissatisfaction and the stock outs of the desirable items does not affect the downtime of the vehicles. The main objective of classifying only the Slow and Non-moving items is that all the fast moving items are to be definitely stored to prevent their higher stock out costs.

Analysis:

Procedure for making VED analysis

1. The fundamental knowledge required for doing the analysis purely technical i.e. knowing about the criticality of the item in the vehicle for its performance.
2. The analysis is mainly carried out for the items falling under the slow and non-moving category.
3. The spare part items that are vital for performance of the vehicle i.e., without them the vehicle cannot function are classified as vital items.
4. The spare part items that are essential for the optimal performance of the vehicle i.e. on failure of the items does completely stop the vehicle but affect the performance of the vehicle are classified as

5. The spare part item that does not influence the performance of the vehicle but it is a part of it is classified as desirable items.

Quantification:

Total number of items taken for analysis

a) Slow moving = 578 items

b) Non moving = 642 items

Slow moving items:

Vital = 13 Items

Essential = 217Items

Desirable = 348 Items

Non-moving items:

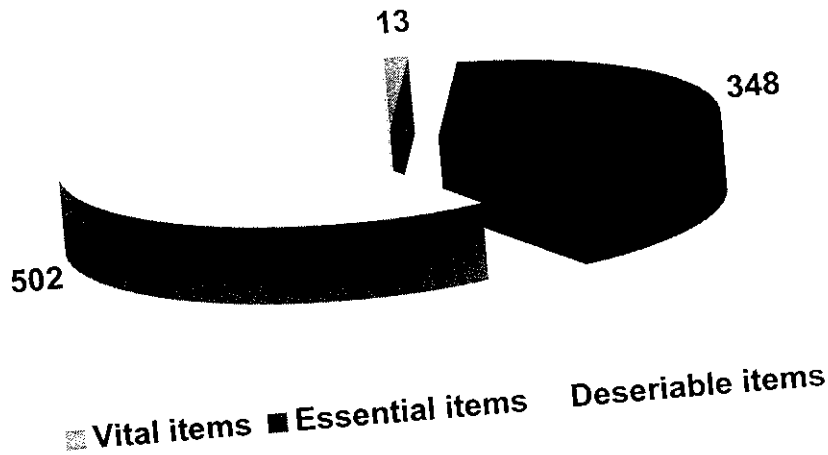
Vital = 6 Items

Essential = 234 Items

Desirable = 402 Items

A pie chart representing the different category of items classified according to their criticality is shown in Figure 6 refer Page no.51.

Slow moving items:



Non moving items:

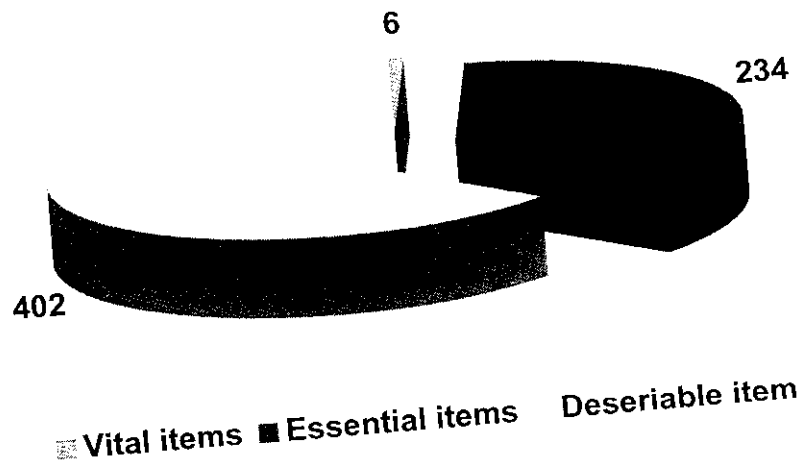


Figure 6

The proposed inventory system will systematically maintain the stock level of the spare part items with the help of the controlling procedures and norms fixed on the basis of their classification. The controlling procedures and the norms have been defined for the three main categories and the sub categories under them. The controlling procedure has been decided based on the nature of each category and is the most optimum for that category. Each of the categories is taken up and the inventory system is explained as under.

8.1.Fast Moving items:

The spare part items that are consumed daily i.e. more than three items consumed per week are classified as fast moving items. As they are fast moving items the ordering system is to be such that for any variation in the consumption or supply by the vendor should not lead to the stock outs. There are no further classifications in this category of items. The periodic review system is selected and used for the inventory control of the items.

In the periodic review system the replenishment period varies depending on the annual consumption of the item and the period is calculated by using the formula

Optimum review period in weeks

= SQRT [(288 x Cost/order) / (Annual usage in units x cost/unit x Inventory carrying cost)]

The reorder level of the spare (ROL)

= Safety stock equal to review period under the Periodic Review system + lead time stock.

The ordering quantity is calculated as follows

1. The demand for the item in the fourth week is forecasted by the moving average technique using the consumption data of the previous three weeks.
2. The quantity forecasted for the fourth week is taken as the maximum inventory level for the week.
3. The lead-time stock depends on the average lead-time consumption of the item and the lead-time of the vendor to supply the item.
4. The safety stock is calculated depending on the variation in the consumption and supply during the lead-time period.

The ordering quantity

= [(Quantity forecasted + Lead time stock + safety stock) - stock in hand]

8.2.Slow moving items:

The spare part items that are consumed less than three per week, more than three per month and more than three to four per year are classified as slow moving items. By the HML and VED Analysis the items are further classified into the High, Low, Medium value items and the vital, essential, desirable items. The ordering systems for these different categories of items are

a) Vital items:

High value items = minimum stock and ordering system

Medium value items = economic order quantity system

Low value items = economic order quantity system

b) Essential items:

High value items = minimum stock and ordering system

Medium value items = economic order quantity system

Low value items = economic order quantity system

c) Desirable items:

High value items = Just in time purchase

Medium value items = Just in time purchase

Low value items = minimum stock and ordering system

8.3.Nonmoving items:

The spare part items that are consumed less than two per year are classified as slow moving items. By the HML and VED Analysis the items are further classified into High, Low, Medium value items and the Vital, Essential, Desirable items. The ordering systems for these different categories of items are

a) Vital items:

High value items = minimum stock and ordering system

Medium value items = minimum stock and ordering system

Low value items = minimum stock and ordering system

d) Essential items:

High value items = minimum stock and ordering system

Medium value items = Just in time purchase

Low value items = Just in time purchase

e) Desirable items:

High value items = Just in time purchase

Medium value items = Just in time purchase

Low value items = Just in time purchase

The ordering quantity for the different ordering system is calculated as follows

Minimum stock and ordering system:

In the case of the minimum stock and ordering system the minimum stock is fixed based on its consumption and is the reorder level for it. An

order is placed for purchase of the item to maintain the minimum stock level when it is consumed

Economic quantity ordering system:

The economic ordering quantity system the order quantity is calculated using the economic order quantity formula. The annual demand for the item is forecasted from the previous year consumption data with some percentage addition for the current year.

The ordering cost includes the cost for getting the quotation, processing and the receipt of the order. The carrying cost includes the insurance, rent, tax, salary paid for the stores in charge, his assistant and the amount spent for house keeping.

The reorder level is calculated based on the lead-time stock and the safety stock. The formulas for calculating them are as follows

Lead time stock (LTS) = Avg lead time consumption (D) x lead time taken by the Vendor (L)

Safcty stock (S) = K x SQRT (D)

The value for k (constant)

A Category items = 1

B category items = 2

C Category items = 3

The reorder level = lead time stock + safety stock

Just in time purchase:

Most of the items are available with the local Dealers, and hence they can be procured within a day, in other words they have a lead-time of only one day. So the item is purchased only on requirement due to their value and criticality.

a) The slow moving desirable items of high, medium, low value use this system of purchase.

b) Thc non-moving essential and desirable items of high, medium, low value use this system of purchase.

The development of a computerized inventory control system involves the use of database i.e. backend that integrates, monitors, controls and establishes accountability for all spare part requirements. The front end consisting of the different screens for data entry and display of record sets is also formed and acts as an interface between the user and the database.

9.1.Back end of the user:

The backend of the user is formed using ORACLE 7.0.3 PRODUCTION version. Different tables are created with the suitable data fields for the purpose of recording the data entry and they totally form the database. The different tables created are

9.1.1.Item Master:

This table contains all the details of the spare parts like the item code, description, make, issue price etc.

9.1.2.Purchase Master:

This table contains the purchase details i.e. the ordering and receipt details of the spare parts.

9.1.3.Issue Master:

This table contains the issue details of the spare parts like the issue date, item, mode and price.

9.1.4.Vendor Master:

This table contains all the details about the vendor like the vendor

9.1.5.Supply Master:

This table contains the details of the vendors who can supply that particular item with their supply price and lead-time.

9.1.6.Claim Master:

This table contains the details about the spare parts that are to be claimed from TELCO while placing an order, for the warranty replacements done in the vehicles.

9.1.7.Scrap Master:

This table contains the details about the scrap i.e. the spare parts that are returned back to the stores due to the breakage during replacement or mishandling.

Database Structure:

The database structure building facilities the modern day relational database management system (RDBMS) offer, as they provide a wide range of options to the system programmer to store the data in the most optimum manner. The RDBMS gives a wide range of security options for data entry, retrieval and manipulation and can be programmed during the programming phase.

Thus the database structure has been shown in two parts, description aspect coming up first and the inventory aspects coming later.

Data base structure of item master:

S.NO	FIELD NAME	DATA TYPE	DESCRIPTION
1.	UV Code	Varchar2 (6)	A six digit code which uniquely identifies each spare
2.	UV Desc	Varchar2 (40)	The name of the spare part for the unique six digit code
3.	TELCO Code	Varchar2 (15)	A twelve digit code which uniquely identifies each spare part as per TELCO
4.	TELCO Name	Varchar2 (50)	The name of the spare part for the unique 12 digit code As per TELCO
5.	Item Make	Varchar2 (40)	Specifies the item make or brand
6.	Item Value	Char (1)	Gives the value of the item i.e., high, low, medium value item
7.	Movement	Char (1)	Gives the frequency of movement of the item i.e. fast, slow, non moving item
8.	Max issue qty	Number	Gives the details about the qty to be issued for a card

9.	Issue price	Number	Gives the details about the price at which the item is to be issued
10.	Reorder Qty	Number	Gives the quantity at which the order for the item is to be placed
11.	Order qty	Number	Gives the details about the qty to be ordered.
12.	Order cost	Number	Gives the details about the cost incurred for ordering the item
13.	Carrying cost	Number	Gives the details about the cost incurred for storing the item
14.	Review period	Number	Gives the details about the time period between stock verification
15.	Safety period	Number	Gives the details about the safety stock period for the item

Database structure of the claim master:

S.NO	FIED NAME	DATA TYPE	DESCRIPTION
1.	Vendor code	Varchar2 (8)	A six digit code which uniquely identifies each vendor
2.	Issue date	Date	Gives the date of issue of the spare parts for the vehicle
3.	CP Number	Number	It is a four digit numbers allotted for the vehicle for that service period
4.	UV Code	Varchar2 (6)	A six digit code which uniquely identifies each spare
5.	Quantity	Number	Gives the quantity that is issued for the vehicle

Data base structure of the purchase master:

S.NO	FIELD NAME	DATA TYPE	DESCRIPTION
1.	UV Code	Varchar2 (8)	A six digit code which uniquely identifies each spare
2.	Order date	Date	Gives the date when the order was placed
3.	PO number	Varchar2 (12)	Gives the unique four digit code for the purchase order form
4.	Qty Ord (warr)	Number	Gives the details about the qty ordered against warranty replacement
5.	Qty Ord (cost)	Number	Gives the details about the qty ordered against cost
6.	Receipt date	Date	Gives the date of the receipt of the order
7.	PI number	Number	Gives the purchase invoice number of the purchase invoice of the vendor
8.	Vendor code	Varchar2 (12)	A six digit code which uniquely identifies each vendor
9.	Receipt qty (warr)	Number	Gives the details about the qty received for warranty replacement
10.	Receipt qty (cost)	Number	Gives the details about the qty received for warranty replacement
11.	Receipt cost	Number	Gives the unit price of the item received

Data base structure of supply master:

S.NO	FIELD NAME	DATA TYPE	DESCRIPTION
1.	UV code	Varchar2 (6)	A six digit code which uniquely identifies each spare
2.	Vendor code	Varchar2 (10)	A six digit code which uniquely identifies each vendor
3.	Purchase price	Number	Gives the price at which the vendor is ready to supply the item
4.	Lead time	Number	Gives the time taken by the vendor to supply the item from the date of order

Data base structure for scrap master:

S.NO	FIELD NAME	DATA TYPE	DESCRIPTION
1.	Scrap date	Date	Gives the on which the item was scraped
2.	CP number	Number	It is a four digit numbers allotted for the vehicle for that service period
3.	UV code	Varchar2 (6)	A six digit code which uniquely identifies each spare
4.	Scrap Qty	Number	Gives details about the quantity that is scraped

Data base structure of issue master:

S.NO	FIELD NAME	DATA TYPE	DESCRIPTION
1.	Vehicle Reg No	Varchar2(10)	Gives the vehicle registration number for which the items are issued
2.	Customer point No	Number	It is a four digit numbers allotted for the vehicle for that service period
3.	Issue date	Date	Gives the date of issue of the spare parts for the vehicle
4.	UV Code	Varchar2 (6)	A six digit code which uniquely identifies each spare
5.	UV Desc	Varchar2 (30)	Gives the name of the spare part for the unique six digit code
6.	Item make	Varchar2 (20)	Specifies the item make or brand
7.	Issue Qty	Number	Gives the quantity that is issued for the vehicle
8.	Issue mode	Number	Gives the mode in which the item are issued i.e. warranty, free, for cost.
9.	Issue price	Number	Gives the price at which the items is issued to the vehicle

Data base structure for vendor master:

S.NO	FIELD NAME	DATA TYPE	DESCRIPTION
1.	Vendor code	Varchar2 (40)	A six digit code which uniquely identifies each vendor
2.	Vendor name	Varchar2 (50)	Gives the name of the vendor for the unique code
3.	Vendor address1	Varchar2 (40)	Gives the address detail of the vendor
4.	Vendor address2	Varchar2 (40)	Gives the address detail of the vendor
5.	Vendor address3	Varchar2 (40)	Gives the address detail of the vendor
6.	Vendor address4	Varchar2 (40)	Gives the address detail of the vendor
7.	Pin code	Number	Gives the pin code of the address of the vendor
8.	Phone	Number	Gives the phone number to contact the vendor

9.2.The Front end of the Software system:

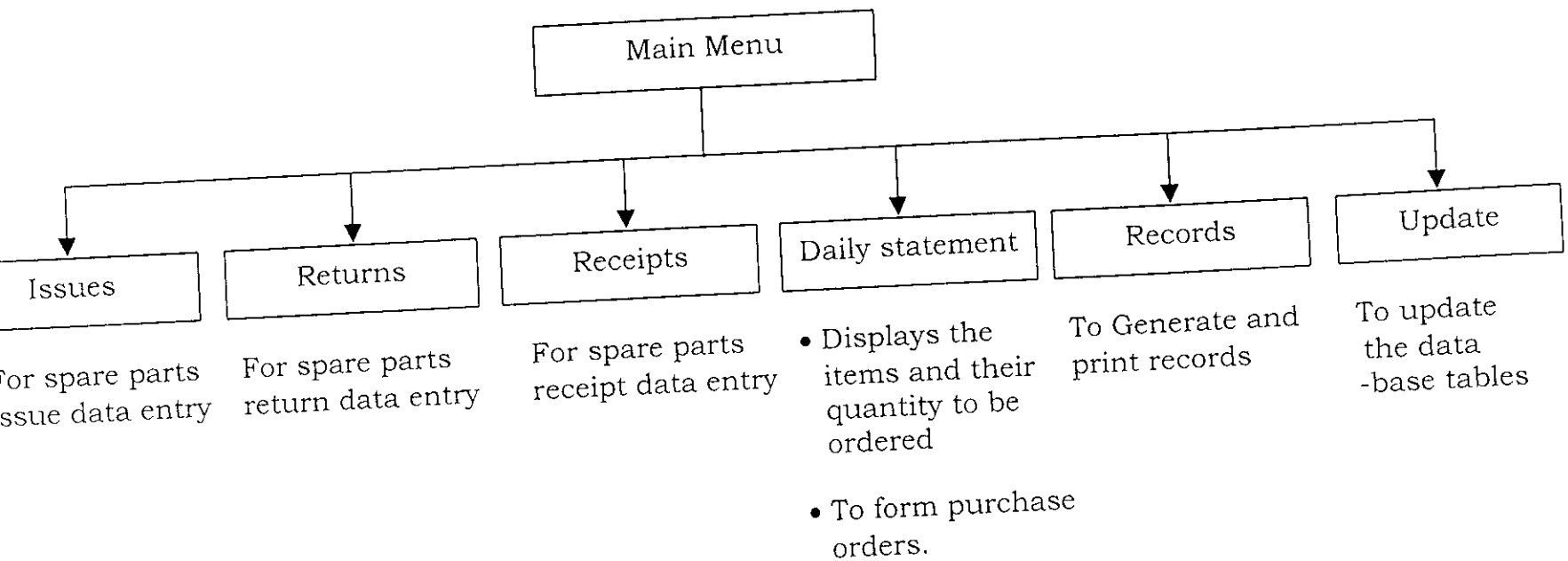
The user is never allowed to access the database, which stores the crucial information in the most optimal form. Yet the user has his own responsibilities in recording the daily transactions i.e. issues, returns and receipt of the spare parts ensuring by the end of the day that the various tables in the database are updated. To solve this problem, the system programmer is asked to provide an interface between the user and the database. The interface, which is provided in the form of separate forms called data entry forms, is called the front end.

The front has been so efficiently created that the user should not know at any stage that the data he is entering indirectly goes into the back end i.e. the database. The programming for managing the database has been done in VISUAL BASIC 5.0 basically an event driven programming language. The complete front end consisting of various facilities for data entry for issues, returns, receipts, record generation, records deletion and updating the database tables are programmed as events and have been described in the following pages.

9.3.Interfacing:

The front end is interfaced with the back end using the 32-Bit ODBC drivers for Oracle in the system for the data entry, retrieval, and updating into the data base and the search engine used for the handling of data is the active data objects controls (ADO).

FRONT END OF THE SOFTWARE



9.4.How to invoke the system:

1. After transferring the entire front end programming into the desired directory and the database into the system click the project icon in the screen to enter into the software.
2. The main menu is displayed in the screen containing the various options displayed for entering the data.
3. When the require option is clicked then the screen for the option is displayed allowing the data entry.
4. After entering the data in the appropriate screen when the button labeled "Main Menu" is clicked then the main menu screen is displayed.
5. One can come out of the menu by clicking "exit".

9.5.Brief summary of the system:

The main menu displays a bar menu having six options:

1) Issues
2) Returns
3) Receipts
4) Daily statement
5) Records
6) Update
7) Exit

(Refer Annexure 1)

9.5.1.Issues:

On clicking the option issue the screen for the entry of the issue details item code, item name, items make, current stock, unit price, issue quantity and the issue mode is displayed.

The first entry is the vehicle registration number and for the vehicle the customer point number which is automatically generated by the system serially .On entry of the spare part name the help menu appears on the screen for selecting the correct spare part name and its appropriate code. The current stock details can be had from the issue master table. For the code selected the data from the item master like the maximum quantity to be issued for the card and the unit price for item are displayed. On selection of the issue mode the amount for the issue is displayed by multiplying the unit price with the quantity issued. On

clicking of the "update" button the issue entry is updated to the issue master table as well as in the claim master table on requirement. The same procedure is repeated until all the entries are over. To exit from the screen press the "Main Menu" button. *(Refer Annexure 2)*

9.5.2.Returns:

On clicking the option returns in the main menu the software displays the data entry screen, which is a part of the issue screen for entering the returns details, quantity returned and the reason for the return of the item.

On entering the customer point number the details of the issues are taken from the issue master and displayed in a data grid. The item that is to be returned is selected from the grid displayed. The quantity that is to be returned is entered in the appropriate text box and the reason is selected from the combo box. After the data entry on press of the "update" button the entries are updated in the issue master as well as in the scrap master on requirement. *(Refer Annexure 2)*

9.5.3.Receipts:

On clicking the option receipt in the main menu the software displays the data entry screen for the entry of the receipt details, items received ordered against warranty replacement, for cost and the purchase price of the item.

On entering the purchase order number the details of the items [illegible] under the order are taken from the purchase master table like

the quantity ordered for warranty replacement and for cost are displayed in the grid. The purchase invoice form number is entered in the appropriate text box continued by the receipt entries for the items selected from the grid. After the data entry is over the on clicking the "update" button the data entries are updated in the purchase master.

(Refer Annexure 3)

9.5.4.Daily statement:

The daily statement in the main menu displays the screen with the details of items that are to be ordered when the current stock in the issue screen is equal to the reorder quantity in the item master table. The quantity to be ordered is calculated using the ordering and the purchase policies for the items replaced for warranty and cost.

This screen also includes options for generating purchase orders either automatically by the system or manually by the user. When the button "form PO" is pressed the vendor details for the supply of the item are taken from the supply master table and based on the price priority or the lead-time priority the purchase order is placed to the vendor. In case of manual mode the user enters the name of the vendor and selects the items from the grid for placing the order to him. On clicking the "open PO list" displays another screen displaying the list of the purchase orders formed and the grid to display the purchase order placed for each vendor with the vendor name and address taken from the vendor master table.

(Refer Annexure 4)

9.5.5.Update:

On clicking the option update in the main menu displays the menu screen having the different options as given below to update the database tables.

1) Item master
2) Vendor master
3) Supply master

On clicking any one of the options the appropriate screen appears with the data fields of the table having the options for adding, deletion, editing and updating of the records available in it. *(Refer Annexure 6,7)*

Search:

This option is selected after entering the item code or name finds the records related to the item entered in the text box from the appropriate table and are displayed in the in their appropriate text boxes in the screen.

Addition:

This option selected to add new items its details to the database table selected. The details are entered in the text boxes. Entries displayed in the screen depend on the table that is updated.

Deletion:

This option is used to delete the records from the data base tables.

Edit:

This option is selected to edit the data that are displayed in the screen taken from the database table.

Vendor addition:

This option is used to any new vendors to the to the vendor master table

Update:

This option is selected to update the changes in the database table after addition, deletion, editing of the details of the item.

9.5.6.Records:

On clicking the records option in the main menu displays the data entry screen for the generation and printing of the purchase, issue, stock, item and vendor records on requirement either for a fixed period of time for all the items or for a fixed period of time for a particular item.

The different records that can be obtained from the system are;

Pending purchase order list:

This report lists all the purchase orders that are pending, Columns which are printed are the vendor code, vendor name and address, PO number, PO date, item code, item description, quantity to be supplied.

Stock list:

This report lists all the items with the value of the quantities stocked for a period specified by the user. The list can be generated for a particular item as specified by the user. Details

printed are item code, item desc, quantity purchased, unit price and consumption value.

Fast, slow and Non moving items list:

This report lists the items that are fast, slow, Non-moving depending on their consumption. Details printed are item code and item description.

Issue statement:

On choosing this option one can obtain the consumption history of a particular item or for all items for a particular period of time. Columns in this report are issue date, customer point card, item code, item desc, issue qty, issue mode, issue price and the total issue value.

Receipt statement:

This report lists the receipt of a particular item or for all the items for any period specified by the user. Columns printed in this report are purchase invoice number, purchase date, item code, item desc, purchase quantity and purchase value. *(Refer Annexure 8)*

9.5.7.Exit:

This option is used to exit from the system.

10.1.Findings:

In an automobile service industry production schedules cannot be prepared as done in a manufacturing industry. The failure of the spare parts in a vehicle cannot be predicted because of the different factors like operating conditions and maintenance that influence the failure. The demand for the spare parts for servicing the vehicles depends only on the service requirement and is not based on any assumption.

As the demand for the spare parts are very fluctuating they are to be classified based on their value, consumption and criticality for their effective maintenance and control.

Even though the stores in charge has adequate experience he cannot evenly define the degree of importance for each material. For this they should practice inventory management techniques to manage stock efficiently.

The quantitative findings from the analysis are as follows

ABC Analysis:

From the analysis it is found that 'A' category consists of 209 items and the 'B' category consists of 365 items. The remaining 731 items goes to the 'C' category.

FSN analysis:

From the analysis it is found that 87 items are fast moving, 578 items are slow moving and the remaining 642 items are non-moving items.

HML Analysis:

	High Value	**Medium Value**	**Low Value**
Fast Moving	Nil	54 items	33 items
Slow moving	13 items	174 items	391 items
Non Moving	74 items	294 items	257 items

VED Analysis:

	Vital	**Essential**	**Desirable**
Slow moving	13 items	217 items	348 items
Non moving	6 items	234 items	402 items

10.2. Recommendations:

10.2.1.The inventory system:

The inventory system that is recommended and incorporated in the system software for the different categories of items is as follows

1. The company should maintain all the fast moving items in the stores without considering their value and criticality to serve the shop floor and the periodic review system should be used for stocks replenishment.
2. A minimum stock and ordering inventory system should be practiced for the high value vital and essential items, the low value desirable items of the slow moving nature and the non moving vital items of high low and medium value.
3. The fixed quantity ordering inventory system or the economic quantity ordering should be practiced for slow moving vital and desirable items of low and medium value.
4. The just in time purchase inventory system should be practiced for the slow moving desirable items of high and medium value, the essential desirable items of medium and low value.

10.2.2.Implementation of the software developed:

A computer powered by any processor of the Pentium family with a minimum configuration of 16 MB random access memory, 640 MB of Hard disk memory, 1 MB of video memory, color or monochrome monitor with Keyboard and mouse working in windows platform is required for the successful implementation and effective performance of the software developed.

10.2.3.Maintenance:

1. The first and the foremost prerequisite for the successful operation of the system is that the new spares, which are added to the master database, must be given a unique code. This requires that the stores in charge understands the logic of codification and employs the logic to code new items added to the stores.
2. When accounting the issues and returns it is suggested that the item is to be given to the user or received from the user only after entering the data into the PC.
3. The spare part receipts are strictly to be accounted only after inspection.
4. Valuation of all the items in the database should be complete at any point of time so that the stock values printed in the reports reflect the true value.

5. The accuracy of data entry during operation and the updating of the database tables govern the effective outputs of the system software.

The present system identifies the spare parts into three categories based on their consumption without considering their value and criticality. As a result of this the reordering procedure is not clear and the stores either overflows with non-critical items or runs out of stock of the critical ones. This leads to the tangible and intangible losses to the management. Tangible losses in the form of excess money locked in the form of inventory or the longer down time of vehicles due to the non-availability of the vital but slow and non-moving spares. Intangible losses in the form of customer dissatisfaction due to longer down time and customer regrets due to the poor delivery schedule of the vehicles.

The proposed system:

The following assets proposed by the new system rectify the above deficiencies in the present system.

1. The spare parts are identified on the basis of the value and criticality. The classification further acts as a basis for the inventory system.
2. The inventory system built on such a classification defines the logistics for each spare part and triggers orders automatically.
3. Fixing the maximum issue quantity per job card for every spare part and limiting the issue to fixed quantity solve the problem of over consumption.

4. The shelf life for each item is fixed and back counted from the date of purchase. To prevent the issue of those items after the specified period.

5. Precious manual labour hours spent for inventory forecasting and planning is saved by using the inventory maintenance software system developed based on the proposed system.

6. The location of the items is specified in the form of rows and columns in the vertical rack type storage system. To over come the problem of improper location and mixing.

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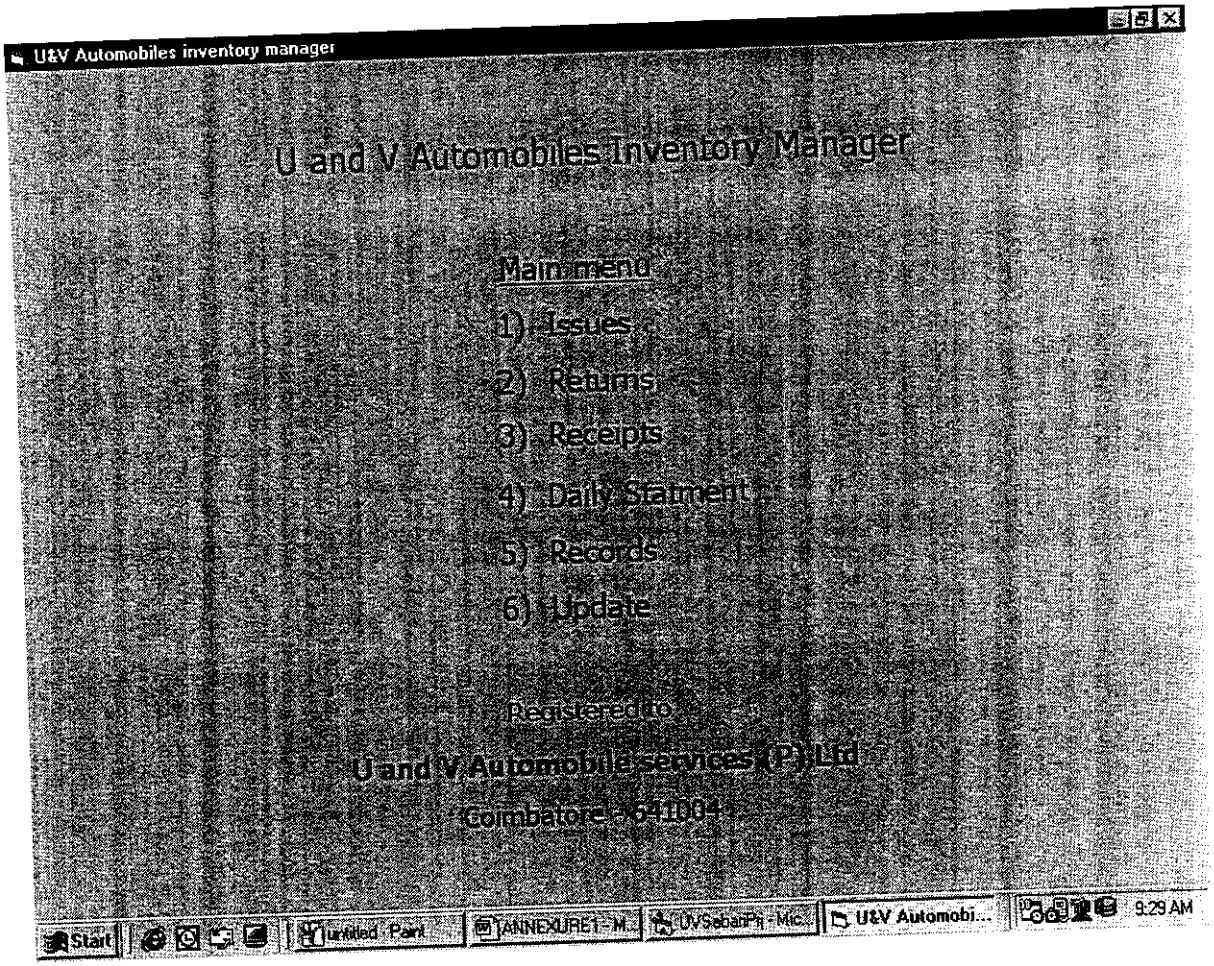
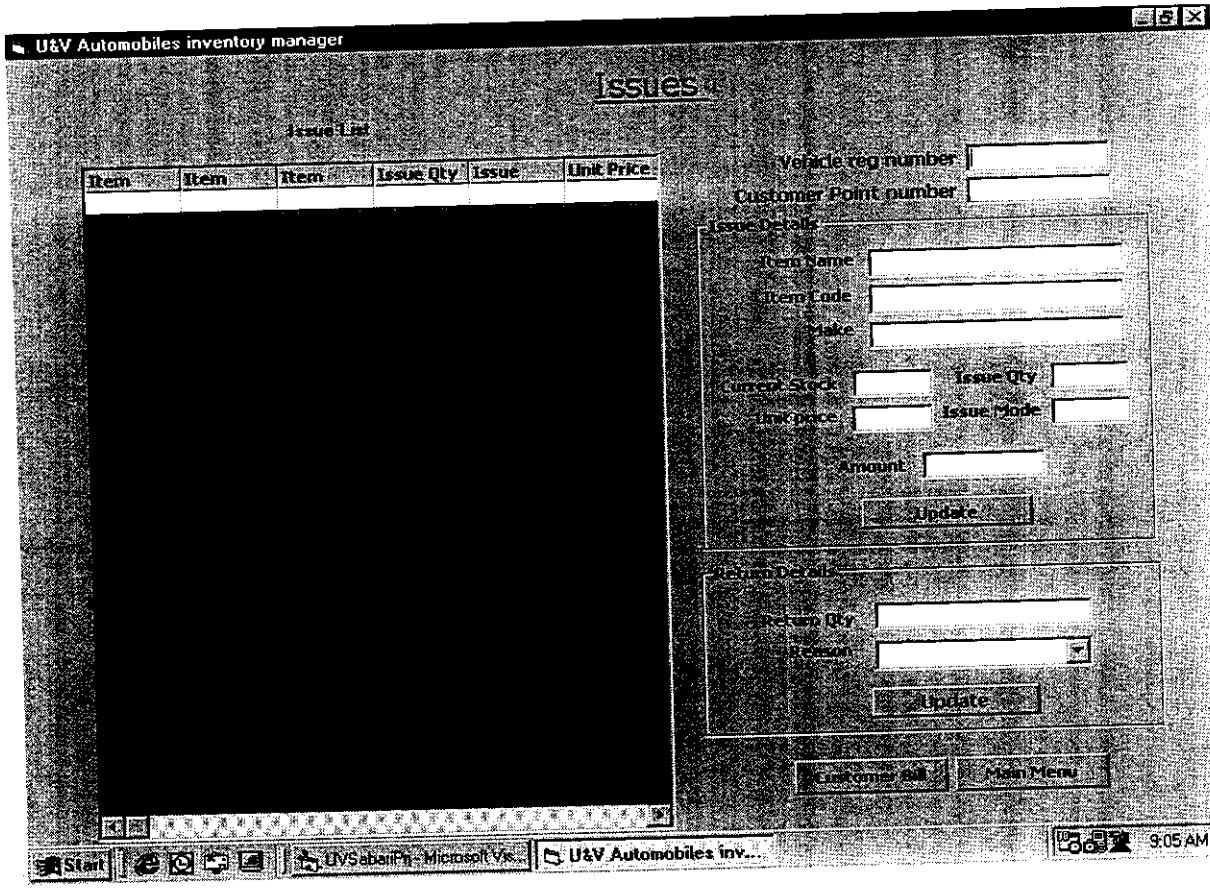
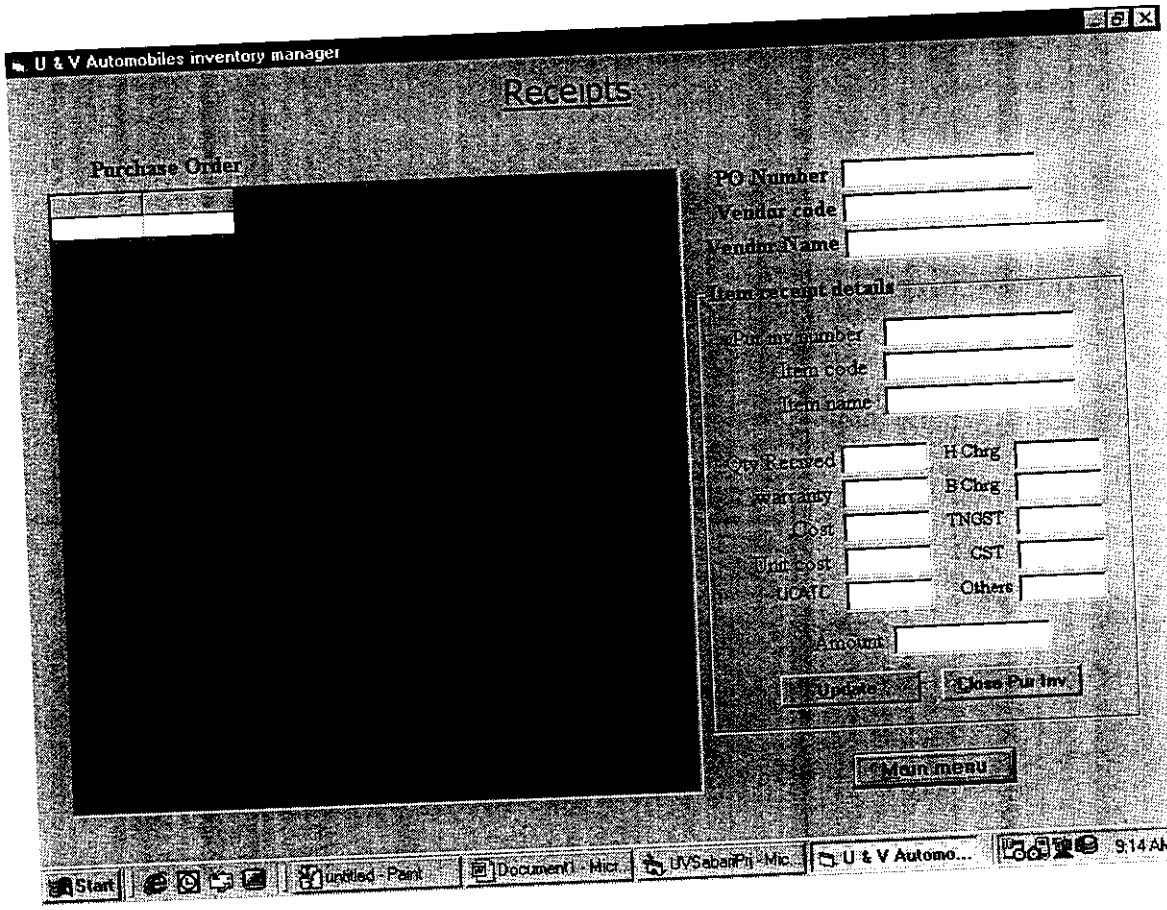
2. P.GOPALAKRISHNAN: "materials management an integrated approach", prentice hall of India.
3. GOPALAKRISHNAN.K: "integrated spares parts management", BPB Publications New Delhi.
4. STARR.M.K & MILLER.M.W. "Inventory control theory and practices", Prentice Hall of India, New Delhi, 1986.
5. JEROME .H.F: "computerized inventory control systems", Prentice Hall Inc., New Jersey, U.S.A.
6. JOSEPH MONKS "Operation Management", Mc-Graw Hill International Edition Management Series, Third Edition, 1987.
7. S.N. CHARRY "Production and Operation Management" Tata Mc-Graw Hill Publishing Company Ltd., 1995.

ANNEXURE I

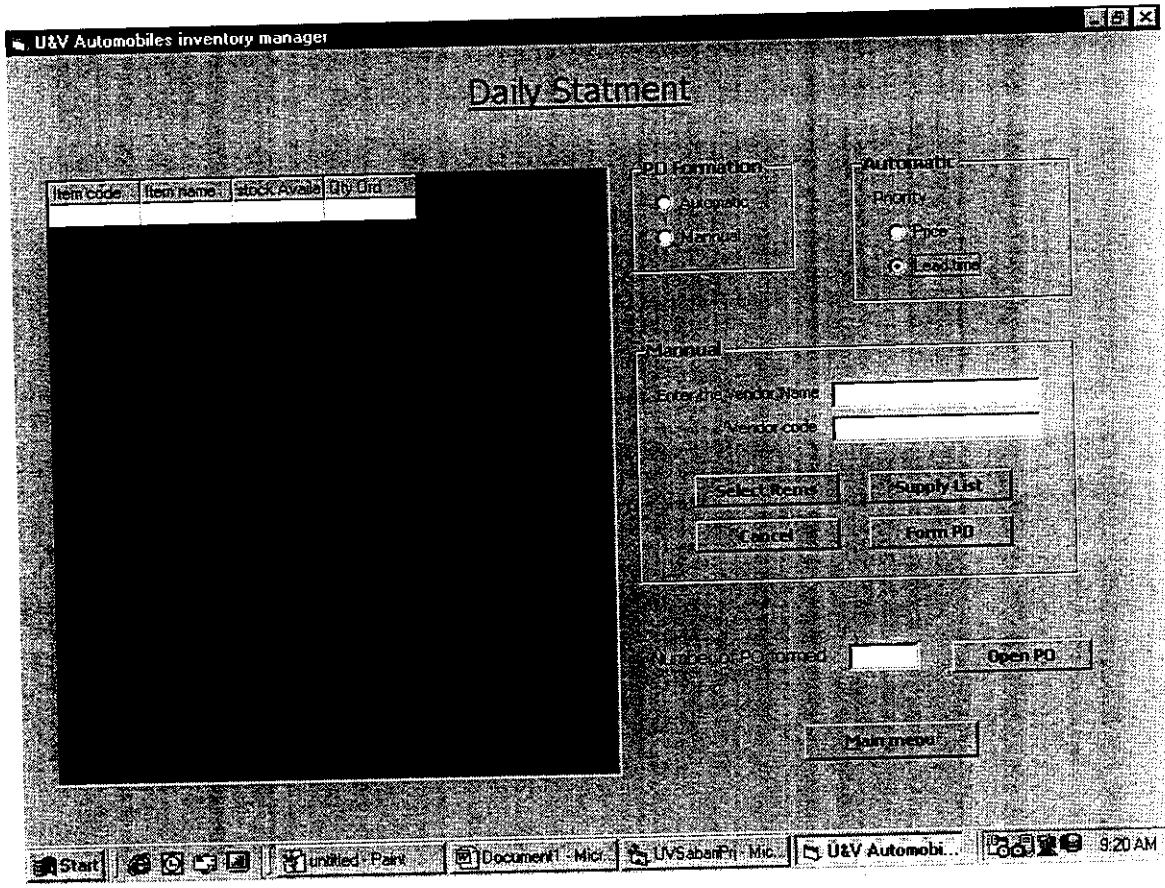

U&V Automobiles inventory manager
U and V Automobiles Inventory Manager
Main menu
1) Issues
2) Returns
3) Receipts
4) Daily Statment
5) Records
6) Update
Registered to
U and V Automobile services (P) Ltd
Coimbatore - 641004
Start
Untitled - Paint
ANNEXURE1 - M...
UVSabariPr - Mic...
U&V Automobi...
9:29 AM

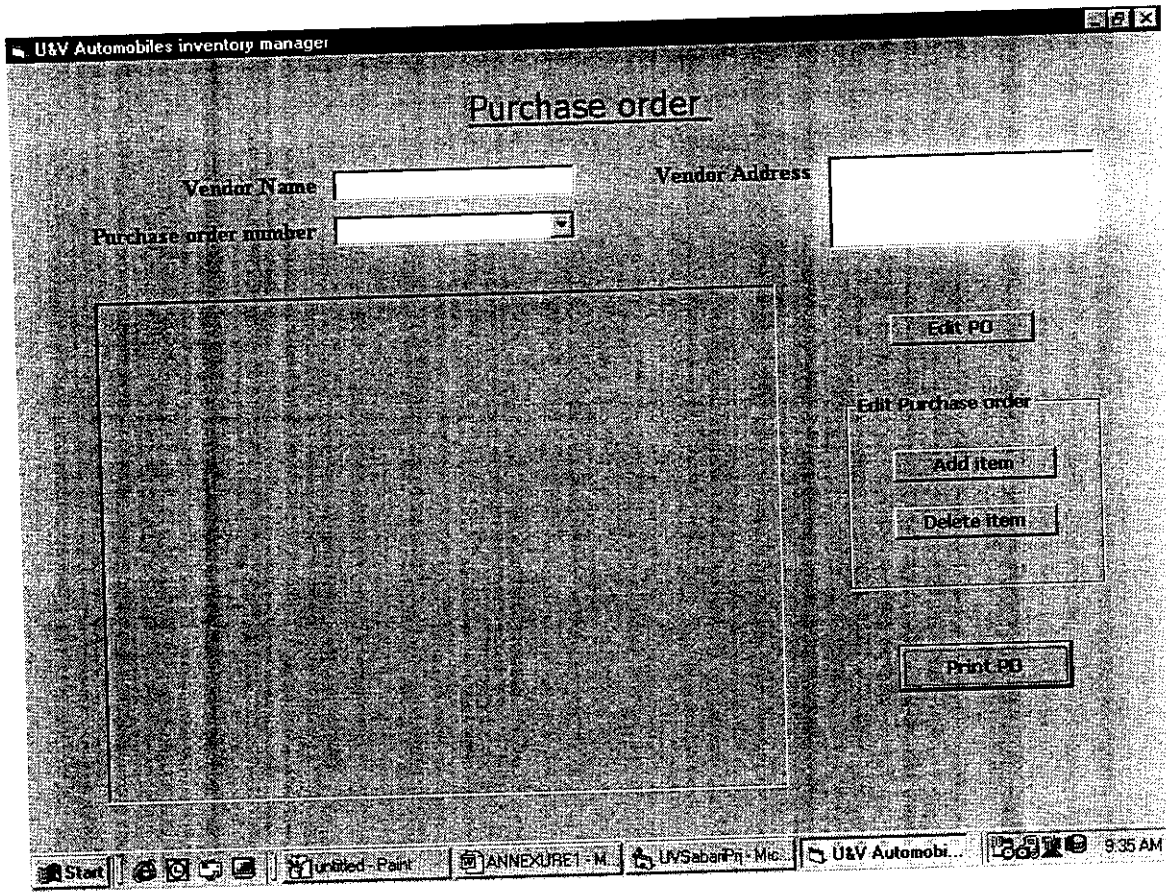
ANNEXURE 2

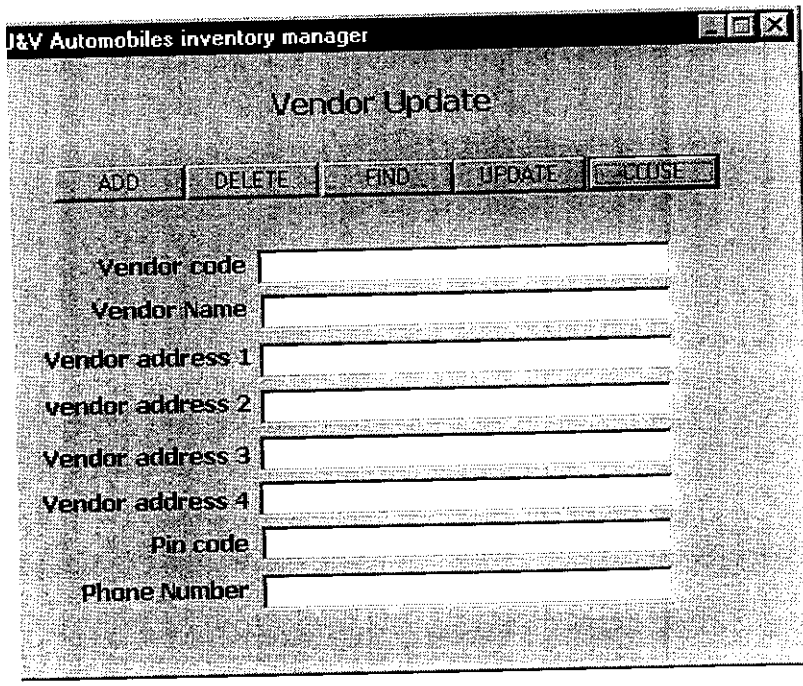

U&V Automobiles inventory manager
Issues
Issue List
Item
Item
Item
Issue Qty
Issue
Unit Price
Vehicle reg number
Customer Point number
Issue Details
Item Name
Item Code
Make
Current Stock
Issue Qty
Unit price
Issue Mode
Amount
Update
Return Details
Return Qty
Reason
Update
Customer Add
Main Menu
Start
UVSabariPa - Microsoft Vis...
U&V Automobiles inv...
9:05 AM

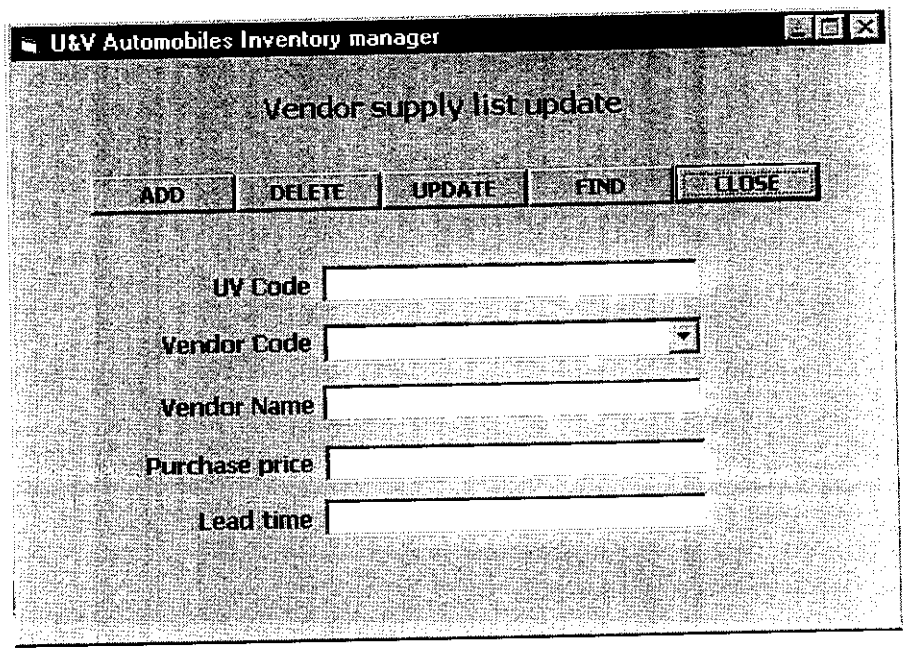

U & V Automobiles inventory manager
Receipts
Purchase Order
PO Number
Vendor code
Vendor Name
Item receipt details
Purchase number
Item code
Item name
Qty Received
Warranty
Cost
Unit cost
UOM
H Chrg
B Chrg
TNGST
CST
Others
Amount
Update
Close Pur Inv
Main menu
Start
untitled - Paint
Document1 - Micr...
UVSabariPj - Mic...
U & V Automo...
9:14 AM

ANNEXURE 4

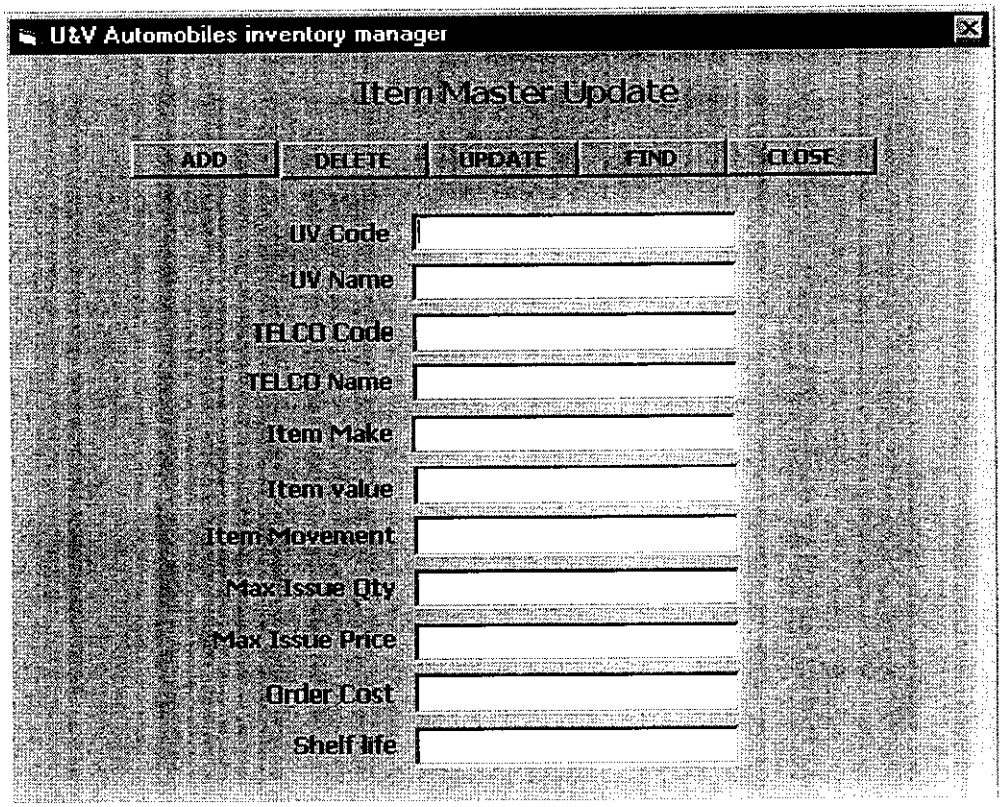

U&V Automobiles inventory manager
Daily Statment
Item code
Item name
stock Availa
Qty Ord
PO Formation
Automatic
Manual
Automatic
Priority
Price
Lead time
Manual
Enter the vendor Name
Vendor code
Select Items
Supply List
Cancel
Form PO
Open PO
Manage PO
Start
untitled - Paint
Document1 - Micr...
U&V Automobi...
9:20 AM

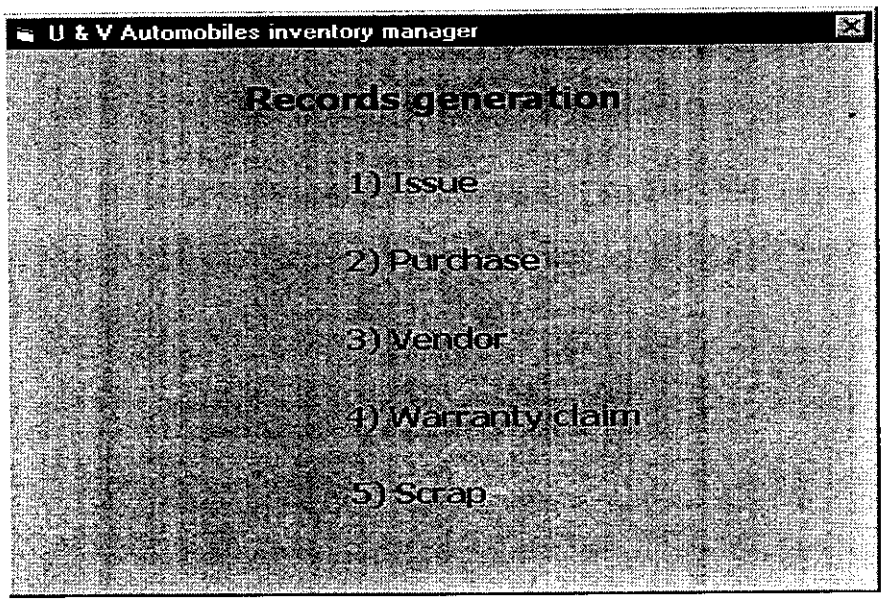

U&V Automobiles inventory manager
Purchase order
Vendor Name
Vendor Address
Purchase order number
Edit PO
Edit Purchase order
Add item
Delete item
Print PO
Start
Untitled - Paint
ANNEXURE1 - M...
UVSabariPri - Mic...
U&V Automobi...
9:35 AM

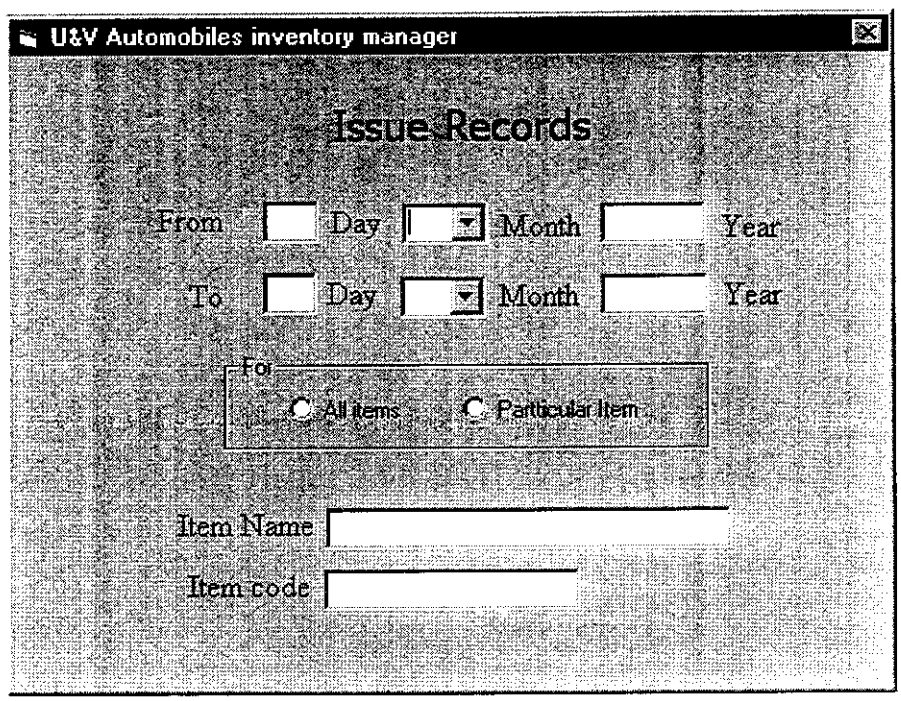

U&V Automobiles inventory manager
Vendor Update
ADD
DELETE
FIND
UPDATE
CLOSE
Vendor code
Vendor Name
Vendor address 1
vendor address 2
Vendor address 3
Vendor address 4
Pin code
Phone Number


U&V Automobiles Inventory manager
Vendor supply list update
ADD
DELETE
UPDATE
FIND
CLOSE
UV Code
Vendor Code
Vendor Name
Purchase price
Lead time

ANNEXURE 7


U&V Automobiles inventory manager
Item Master Update
ADD
DELETE
UPDATE
FIND
CLOSE
UV Code
UV Name
TELCO Code
TELCO Name
Item Make
Item value
Item Movement
Max Issue Qty
Max Issue Price
Order Cost
Shelf life


U & V Automobiles inventory manager
Records generation
1) Issue
2) Purchase
3) Vendor
4) Warranty claim
5) Scrap


U&V Automobiles inventory manager
Issue Records
From
Day
Month
Year
To
Day
Month
Year
For
All items
Particular item
Item Name
Item code