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INTELLIGENT QUERYING FOR MATERIALS MANAGEMENT USING DECISION SUPPORT SYSTEM

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ABSTRACT- Every day we, as humans, make many decisions which can have immediate or long-term effects on our lives. A decision in general may be defined as the selection by the decision-maker of an act, considered to be the best according to some pre-designated standard from the available options. To make a perfect decision by an organization, it needs a suitable Decision Support System. DSS are interactive computer-based systems which help decision makers utilize data and models to solve unstructured problem. This project deals with the development of a DSS for a Pump Industry. It implements the Decision Analysis theory to solve the decision-making problem. It can support the managers understand the problems in addition to providing solutions.

A DSS couple the intellectual resources of individuals with the capabilities of the computer to improve the quality of the decisions. The objective of this project is to develop an application for decision support system using Operations Research approach in the area of business with the help of computers. Various problems and the corresponding solutions are studied and analyzed. These are the core data for this DSS. A knowledge based system is developed for analyzing these data and to make an optimal decision. The system is developed using the software, Microsoft Visual Basic 6.0 and MS ACCESS. The industrial data are stored in the database and they are effectively retrieved by the technique called Data mining. It implements the method of intelligent search to discover information within the data ware house. The resulting data is used in the development of decision trees, which is used to calculate the probability of success rate. Using the optimization techniques of OR, databases and programming languages, this system supports decisions concerning daily operations of the industry. It improves the firm's ability to make rapid and better-informed decisions.

Keywords: Decision Support Systems, Data Mining, Operations research, Decision Analysis, Decision trees, MS ACCESS

1. INTRODUCTION

Today organizations are facing many problems regarding their business. They are handling large volume of data and a number of transactions. To succeed in this competitive world the organization should be able to take optimal decisions at the right time. This process is aided by a Decision Support System. A decision in general may be defined as the selection by the decision-maker of an act, considered to be the best according to some pre-designated standard from the available options. To make a perfect decision by an organization, it needs a suitable decision support system. DSS are interactive computer-based systems which help decision makers utilize data and models to solve unstructured problem. This paper deals with the development and implementation of a DSS for a Pump Industry. It implements the Decision Analysis theory to solve the decision-making problem. It can support the managers understand the problems in addition to providing solutions.

A DSS couple the intellectual resources of individuals with the capabilities of the computer to improve the quality of the decisions. It is a computer based support system for management decision makers who deal with semi-structured problems. DSS applications are systems and subsystems that help people make decisions based on data that is culled from a wide range of sources. They are not single information resources such as a database or a program that graphically represents sales figures, but the combination of integrated resources working together.

Here the DSS is developed for a Pump industry situated at Coimbatore. It is mainly developed for Materials Management and in fixing the lead time. Materials management covers all aspects of materials, cost, materials supply and utilization. It covers the whole range of functions involved in converting `raw materials and ancillary supplies into finished products. It is concerned with the planning and programming of materials and equipments, market research for purchase; pre-design value analysis, procurement of all materials including capital goods, raw materials, components and assemblies, finishing materials, packing and packaging materials, stores control and inventory control; transportation of raw material and material handling; value analysis, disposal of scrap, surplus and salvage and operation research for materials.

The objective of this paper is to develop an application for decision support system using OR approach in the area of business with the help of computers. Various styles and the problems regarding the styles are studied and analyzed. These are the core data for this DSS. A knowledge based system is developed for analyzing these data and to make an optimal decision. The system is developed using the software, Microsoft Visual Basic 6.0 and MS Access. The industrial data are stored in the database and they are effectively retrieved by the technique called Data mining. It implements the method of intelligent search to discover information within data ware houses. The resulting data is used

in the development of decision trees. Decision analysis theory is used for constructing the decision tree. Decision analysis is a technique which helps to find the best decision to take in certain types of problems with particular characteristics. A decision-tree is a graphic display of various decision alternatives and the sequence of events. When probabilities of various events are known, they are written along the corresponding branches. Multiplying the probabilities along the branches results in the joint probabilities for the corresponding act-event sequence Depending upon the probability of success rate the system decides whether the decision is optimal or not.

Using the optimization techniques of OR, databases and programming languages, this system supports decisions concerning daily operations of the industry. It improves the firm's ability to make rapid and better-informed decisions.

2.LITERATURE SURVEY

Ganapathy, S., Narayanan, S. and Srinivasan, K. (2003) studied the supply chain logistics planning and developed a model. Their study dealt with a simulation based decision support for supply chain logistics. Their model featured a decision support system that aided humans in making decisions and studied the role of a decision support system in enhancing the performance of the supply chain logistics system. The model was object oriented in nature which helped the rapid prototyping of the different components of the system.

Raj Gopal, K. and Sudhakara Reddy, A. (2004) made a study on productivity measurement and monitoring models of a SSI unit. They had developed a DSS for the SSI unit for generation of dynamic planning.

Retzlaff-Roberts, D.L and Amini, M. (2004) studied the supply chain management and cycle time reduction at the University of Memphis. They developed a DSS which examined the problem for a major international manufacturer of medical diagnostic equipment. A decision support tool was developed to assist the organization in deciding where service parts should be inventoried and in what quantity to minimize total inventory and logistics cost while meeting a demanding customer service requirement. An application of DSS to the time table scheduling using goal programming model states that DSS is an integral part of decision maker's approach to "Problem Finding". The DSS with the computer base blends operations research to help the management in solving the problems.

Lehmann, H. and Lehner, F. (2005) made a study on Holistic Perspectives of information sharing and knowledge exchange. The aim of their study is to provide a review from a predominantly European perspective that allows an overall evaluation of the state of the literature on this subject. They illustrated with a set of models – selected predominantly for their link to empirical research. They summarized and evaluated with their potential for providing a basis for future research.

Adelina, G.A and Venkataramanaiah, S. (2004) studied the process involved in a food processing industry and developed a database for productivity analysis. Their study focused on the process measurement, evaluation and improvement of labor productivity through human resource planning in a food processing industry. A suitable database was designed to comprehensively and accurately deal with the productivity data for future reference and comparative analysis. Their study has shown 35% average man power productivity growth.

Moole, B.R and Korrapati, R.B. (2004) developed a model for forecasting in inventory management using probabilistic multidimensional data model. An algorithm using mathematical concept based on set theory, probability axioms and the Bayesian framework, as well as algebra to manipulate data and a framework to modify data, were developed and a decision support system model for business in the area of inventory management was presented. The DSS model is in continuous process improvement and it has made significant progress over prior models.

The study shows that there is an immense need for further study in respect of materials management for effective planning and decision making.

3. MANUFACTURING INFORMATION SYSTEMS

Manufacturing management uses the computer both as a conceptual system and as an element in the physical production system. The evolution of the computer as a conceptual manufacturing system is easiest to handle the inventory problems. Initially there were systems that keyed on reorder points. Then came the MRP concept-first applied as material requirements planning and then as manufacturing resource planning. The MRP systems are one approach to inventory management. Another is Just-In-Time (JIT). JIT is unique among modern production concepts in that it does not rely heavily on computer technology.

The manufacturing information system consists of three input subsystems and four output subsystems. The accounting information system captures data in real time, describing the utilization of the physical resources. The industrial engineering subsystem provides production standards that facilitate management by exception. The manufacturing intelligence subsystem enables management to stay current on activities of its labor unions and suppliers.

This input data is transformed into information by the output subsystems. The production subsystem enables management to both build and operate manufacturing facilities. The inventory subsystem uses mathematical formulae for when to reorder and how much. The quality subsystem is based on the fundamentals of total quality management (TQM), and it enables the firm to achieve product quality by monitoring the flow of materials, beginning with its receipt from suppliers, through the production process, and ending with consumption or use by the firm's customers. The cost subsystem permits management to control the cost of these production activities by means of information feedback.

4. COMPUTERS AS AN INFORMATION SYSTEM

The term manufacturing information system describes the CBIS subsystem that provides information concerning the production operation. The output from the manufacturing information system is used to both create and operate the physical production system. After the first computers were successfully applied in the accounting area, they were given the task of managing the firm's inventory. The simplest approach is a reactive one waiting for an item balance to reach a particular level, which then triggers a purchase order or a production process. The item level that serves as the trigger is called the reorder point (ROP) and a system that bases the purchasing decision on the reorder point is called a reorder point system. Much has been accomplished in the use of computer-controlled machines in the production area. These machines can do jobs that were formerly done by workers. The machines cost less than the workers and are capable of performing better. Attempts to automate the factory initially met with resistance from organized labor. Overtime, however, resistance has diminished as it has become clear that a firm must take advantage of computer technology if it is to survive in the world market.

The manufacturing information system encompasses all of the applications of the computer in the manufacturing area as a conceptual system. A model of such a system is illustrated in the following figure:

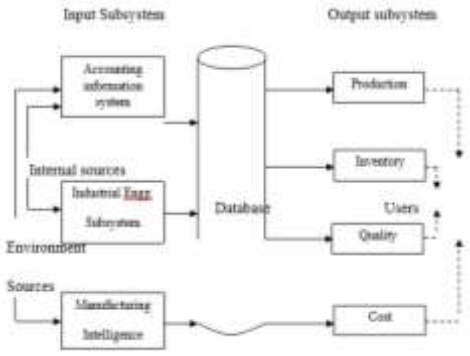


Figure 1. A Model of a Manufacturing Information System.

The accounting information system gathers internal data describing the manufacturing operation and environmental data that describe the firm's transactions with its suppliers. The industrial engineering subsystem is like the marketing research subsystem in so far as it consists primarily of special data-gathering projects. The two subsystems are dissimilar in that the industrial engineering subsystem gathers data from inside the firm rather than from the environment. The manufacturing intelligence subsystem gathers data from the environment. Suppliers and labors are the special responsibility of manufacturing.

The four output subsystems measure separate dimensions of the production process. The production subsystem measures the process in terms of time - tracking the work flow from one step to the next. The inventory subsystem measures the volume of the production activity as the inventory is transformed from raw materials into work-in-process and finally into finished goods. The quality subsystem measures the quality of the materials as they are transformed. The cost subsystem measures the costs that are incurred in the production process.

5. MATERIALS MANAGEMENT

Materials management covers all aspects of materials, cost, materials supply and utilization. It covers the whole range of functions involved in converting raw materials and ancillary supplies into finished products. It is concerned with the planning and programming of materials and equipments, market research for purchase; pre-design value analysis, procurement of all materials including capital goods, raw materials, components and assemblies, finishing materials, packing and packaging materials, stores control and inventory control; transportation of raw material and material handling; value analysis, disposal of scrap, surplus and salvage and operation research for materials.

Materials management can be defined as a body of knowledge which helps the manager to improve the productivity of capital by reducing materials costs, preventing large amounts of capital being locked up for long periods and improving the capital turnover ratio. The prime objective is to supply the user department with the required quantity at a constant rate with uniform quality, so that production or service rendered is not held up. Materials management objective should be balanced and responsibility for achievement should be delegated to a materials manager who has authority to do the job. The materials manager should always reevaluate the objective when business conditions change.

6. MANAGEMENT INFORMATION SYSTEMS

6.1 The Decision Support Role

The business decision-making support function goes one step further. It becomes an integral part -- even a vital part -- of decision -making. It allows users to ask very powerful "What if…?" questions: What if we increase the price by 5%? What if we increase price by 10%? What if we decrease price by 5%? What if we increase price by 10% now, then decrease it by 5% in three months? It also allows users to deal with contingencies: If inflation increases by 5% (instead of 2% as we are assuming), then what do we do? What do we do if we are faced with a strike or a new competitive threat? An organization succeeds or fails based on the quality of its decisions. The enhanced ability to explore "what if" questions is central to analyzing the likely results of possible decisions and choosing those most likely to shape the future as desired. "Business decision-making support function" is a phrase likely to quicken the pulse of no one but an accountant, but, in fact, it is all about turned wonderful dreams into solid realities.

6.2 The Communication Decision Support System Role

Information systems can support a company's competitive positioning. Here are three levels of analysis:

1.The supports for help in piloting the chain of internal value. They are the most recent and the most pragmatic systems within the reach of the manager. They are the solutions to reductions of costs and management of performance. They are typically named "Business Workflow Analysis" (BWA) or of "Business Management Systems p2p". Tool networks, they ensure control over piloting the set functions of a company. The real-time mastery in the costs of dysfunctions cause distances from accounts, evaluation and accounting that are presented in the evaluation and qualitative reports.

2..All successful companies have one (or two) business functions that they do better than the competition. These are called core competencies. If a company's core competency gives it a long term advantage in the marketplace, it is referred to as a sustainable competitive advantage. For a core competency to become a sustainable competitive advantage it must be difficult to mimic, unique, sustainable, superior to the competition, and applicable to multiple situations. For a small or medium business a nice alternative is a MSP or a Managed Service Provider such as Virtual IT Solution. This is a cost effective solution compared to paying for a IT staff or local technicians. Other examples of company characteristics that could constitute a sustainable competitive advantage include: superior product quality, extensive distribution contracts, accumulated brand equity and positive company reputation, low cost production techniques, patents and copyrights, government protected monopoly, and superior employees and management team. The list of potential sustainable competitive advantage characteristics is very long. However, some experts hold that in today's changing and competitive world, no advantage can be sustained in the long run. They argue that the only truly sustainable competitive advantage is to build an organization that is so alert and so agile that it will always be able to find an advantage, no matter what changes occur.

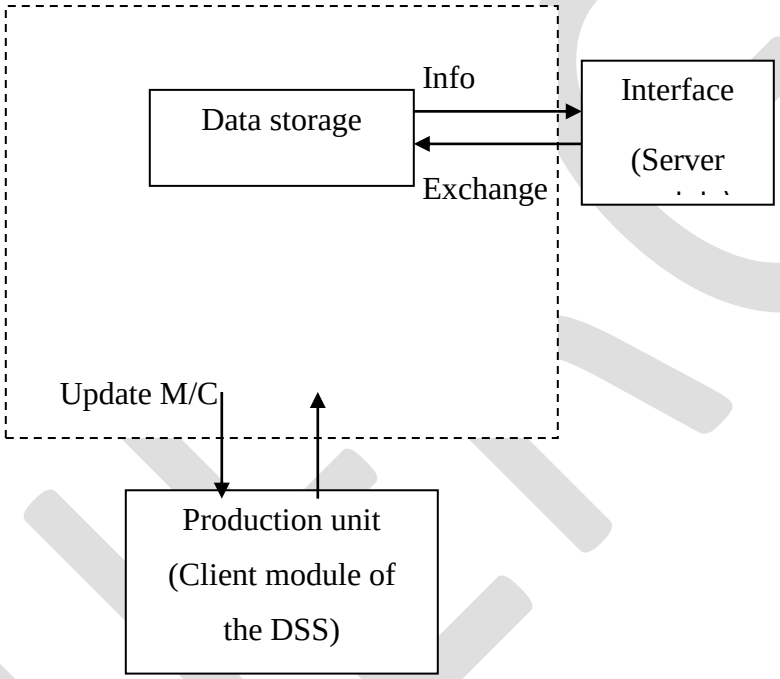
3. Information systems often support and occasionally constitute these competitive advantages. The rapid change has made access to timely and current information critical in a competitive environment. Information systems, like business environmental scanning systems, support almost all sustainable competitive advantages. Occasionally, the information system itself is the competitive advantage. One example is Wal-Mart. They used an extranet to integrate their whole supply chain. This use of information systems gave Sam Walton a competitive advantage for two decades. Another example is Dell Computer. They used the internet to market custom assembled PC's. Michael Dell is still benefitting from this low-cost promotion and distribution technique. Other examples are eBay, Amazon.com, Federal Express, and Business Workflow Analysis.

6.3 The Performance Monitoring Role

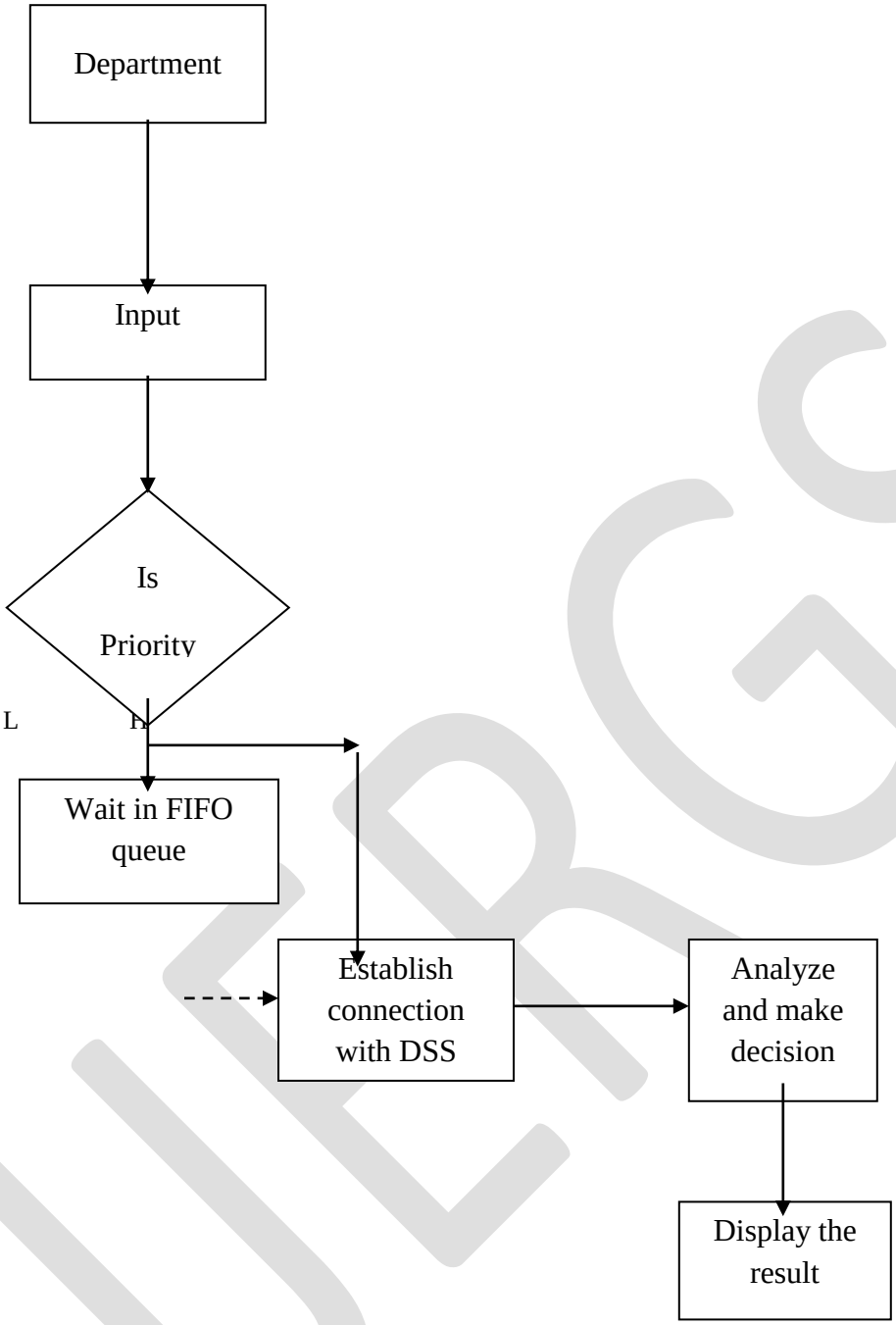
MIS are not just statistics and data analysis. They have to be used as an MBO (Management by objectives) tool. They help

- To establish relevant and measurable objectives
- To monitor results and performances (reach ratios)
- To send alerts, in some cases daily, to managers at each level of the organisation, on all deviations between results and pre-established objectives and budgets.

Businesses today are recording volumes of data reaching terabytes in size. Millions of transactions among retail chains, utility companies, banks, and insurance companies take place each day. Representative financial transactions of the International Technology Group (ITG) report indicate that a telecommunications company receives over 80 million transactions a month, or approximately 2.6 million transactions per day (ITG, 2000). It would be humanly impossible to interpret these transactions to find, for example, which class of customers makes more long distance calls. Similarly, a representative retail chain with 63 supermarkets selling 19,000 products can record a staggering 3.6 million transactions per day (SUN-Microsystems, 1999). Even a small percentage of waste or fraud will result in a loss of millions of dollars and, consequently, higher prices to customers. At same time, manual inspection of these data is not possible, as they are imprecise and change continuously. Decision Support Systems (DSS) are used to support managerial decisions. Usually DSS involves analyzing many units of data in heuristic fashion (Inmon, 1990). To make optimal decisions using large volumes of data, managers of large enterprises need decision support Systems that interpret huge volumes of uncertain data as well as handle data modifications.



Figures 2: The DSS Model



Figures 3: Flowchart of the decision process

7. MASTERS AND ITS APPLICATION

There are totally five master created to execute the project application in successful manner. There are given below,

- Supplier/Customer Master.
- Item Master.
- Machineries Master.
- Bill of Materials (BOM).

- Routing.

The Visual Basic is started with Password entry screen (Fig: 5)

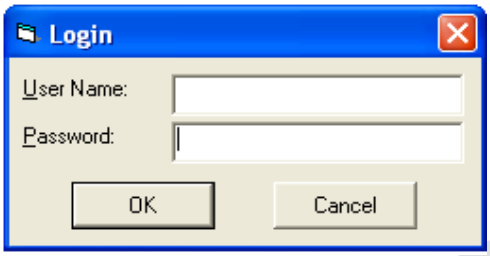


Figure 4: Password entry screen

After enter the assigned respective user's USERNAME and PASSWORD, the master list of form will be opened by selecting the respective menu. The menu selection screen is shown below.

Figure 5: Start-up Screen.

The start-up screen includes the three menus in menu bar. There are

- **Master Menu.**

The Menu is used to select the particular application to perform the operation. Master menu is contains both master form and operational forms.

- **Report Menu.**

The Reporting menu is used to get the report easily and also used to take the print out easily. It is perform as a Quick operation.

- **Exit Menu.**

It is used for close the window.

The title bar having the VB Logo in lift side top corner and Minimize, Maximize and close button is available in right side top corner.

The menu options are provided to perform the project operation. The menu file list is shown below.

Figure 6: Main Master Menu Screen

Menu file's lists are:

- Supplier / Customer Master.
- Item Master.
- Machineries Master.
- Receipt Entry.
- Bill of Materials (BOM).
- Inventory Master.
- Order Booking.
- Routing.
- Calendar / Machine Time.
- Machine Utilization.
- Performance History.

The above parameters are explained below briefly.

7.1 SUPPLIER / CUSTOMER MASTER:

The Supplier/Customer is used to create the database with their mandatory profile. Supplier profile is updated with system after supplier passed the necessary supplier performance appraisal. The evaluation is carried out in Performance History. The Supplier/Customer Master is shown below.

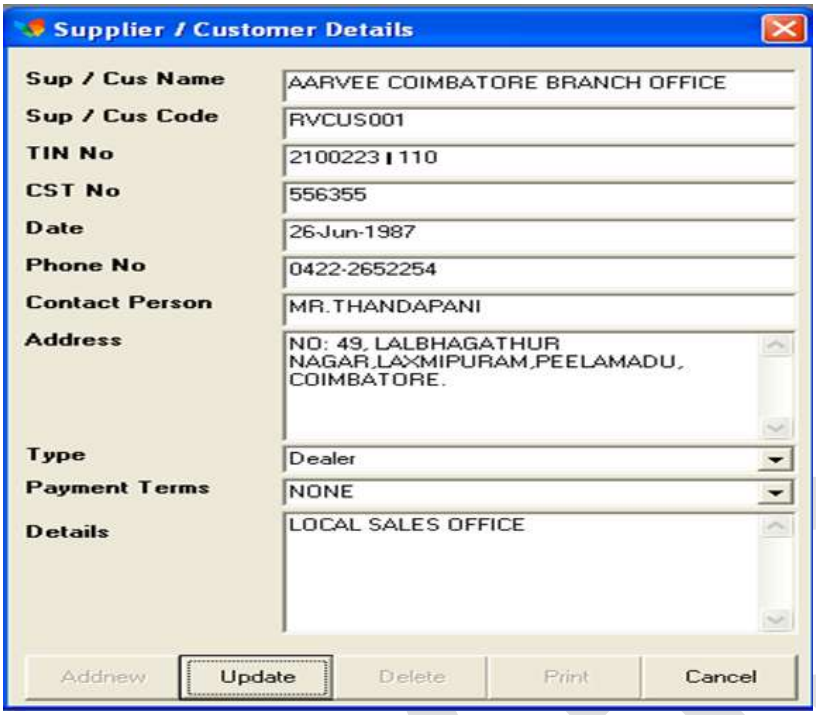


Figure 7: Supplier/Customer Master Screen.

The Supplier/Customer Master is having the following field while creating the master data. There are,

- Sup / Cus Name (Supplier/Customer Name):
  The Supplier or Customer Name is entered in this column.
- Sup / Cus Code (Supplier/Customer Code):
  The separate code is assigned for each supplier as well as customer for identification.
- TIN No:
  Tax Identification number is to be entered in this column (if required).
- CST No:
  Central sales Tax number is to be entered in this column (if required).
- Date:
  Date of the CST No issued.
- Phone No:
- Contact Person:
- Address:
  The address of the customer or supplier is entered for further mailing communication
- Type:
  This master is contains two types. There are customer based Master and Supplier based Master.
  The Customer based master is further classified into three categories, like,

  1. Dealer.
  2. Distributor.
  3. End User.

The type assignment is useful for retrieval the data for analysis.

- Payment Terms:
  The payment terms are assigned from 0 to 100%.
- Details:
  The provided column is useful for specify the details are remarkable points about the customers / Suppliers.

7.2 ITEM MASTER:

The Item master is developed for assigning the item code against each item with necessary details like ROL Qty and Safety stock concepts. The item master is included the following field while new item code.

- Item Name
- Item Code
- Description
- UOM (Unit of Measurement).
  Each item is classified with respective measuring parameter like EA- Each, Kgs – Kilograms, PKT – Packets, LTS – Litres.
- Item Type.
  The item type is classified as like Raw materials, Rough casting, Consumables, Work in progress and Finished Goods.
- Lead Time.
  The lead time is time taken for processing the procurement of product. It includes the preprocessing time (Indent, Quotation and PO Release time), processing time and Post processing time (Gate entry, Store receipt entry and Inspection and clearance time).
- Planning Method.
  The planning method is nothing but how this item is planned for further replenishment. It is divided into two categories like Re-order level and safety stock. The Re-Order level and Safety stock is fixed based on the following considerable parameter.
  - Past particular periods consumption.
  - Upcoming months projected forecast quantity.
  - Class of the product (ABC Class).
  - Considering what are all the difficulties finding this item procurement process.

Generally the ROL Quantity is arrived based on the below formula.

ROL = Qty consumed per day X Lead time of the product.

If necessary, buffer stock also added with ROL Quality. It is done to play the production activities within the safety margin to avoid the unexpected delay in material arrival.

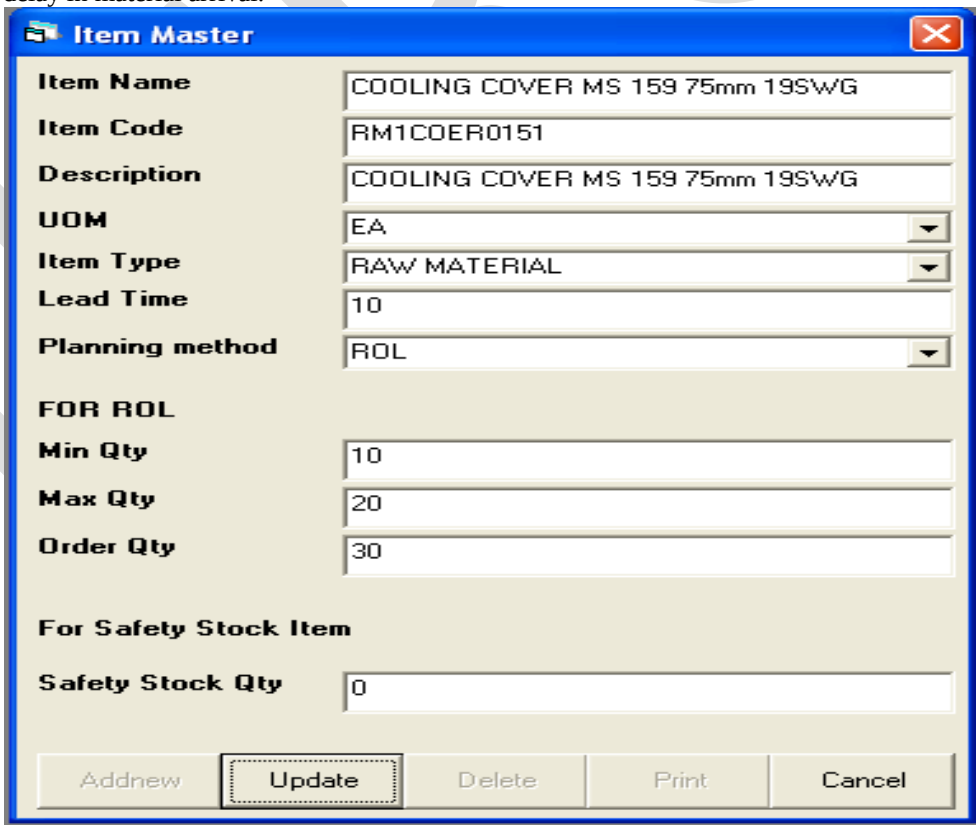


Figure 8: Item Master screen.

7.3 MACHINERIES MASTER.

The Master of machineries is created to develop a data base for company asset properties. It is very useful for identify the specific machine if number of machine are available in same specification while production scheduling. It having the following filed in master form.

- Resource code
- Description
- UOM
- Hour rate.
- Resource Sl.No
- Purchased on.

The hour rate is fixed for each machine based on the labour and machineries cost. It is widely helps to production and Sales Managers while product cost calculation. The resource code is mainly taken into account for Machine utilization calculation form. The machineries master form is shown below.

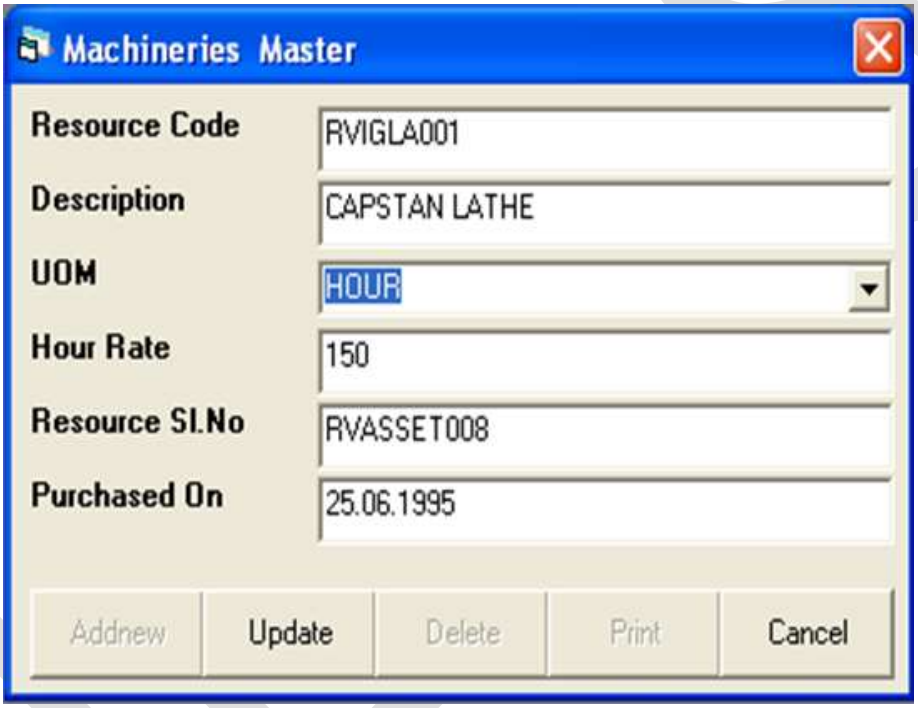


Figure 9: Resource Master Screen

7.4 RECEIPT ENTRY:

The receipt entry is made against the Purchase order released by us. It is the process will covers the activities of verification of purchased product and adding the receipt items stock with inventory master. The receipt entry is made against the following parameter.

- Supplier Name.
- PO No / Date
- Item Code
- Line item qty.

The receipt master screen is shown below.

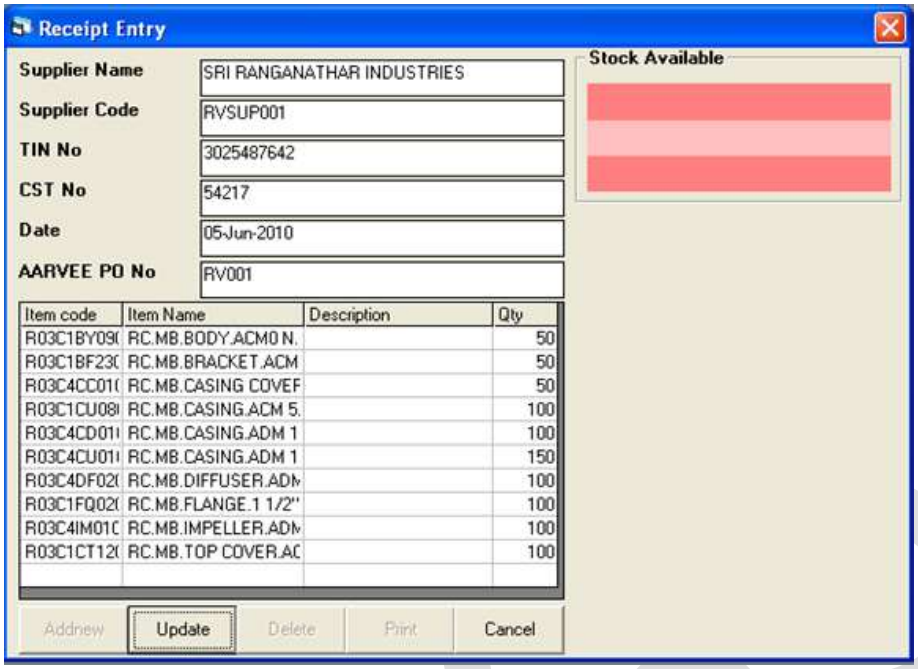


Figure 10: Receipt Entry Screen.

7.5 BILL OF MATERIALS:

The Bill of Materials is a back bone of every product. The Bill of materials is normally released by engineering department. It contains the specification of materials and quantity required for manufacturing one unit. In this project the finished product item code is created in bill of materials creating stage itself. Here the created item code is used for routing process and order booking process. The bill of materials is subjected subsequent revision. The revision takes while item code or change or MOC is change or required quantity changes. The bill of materials screen is shown below.

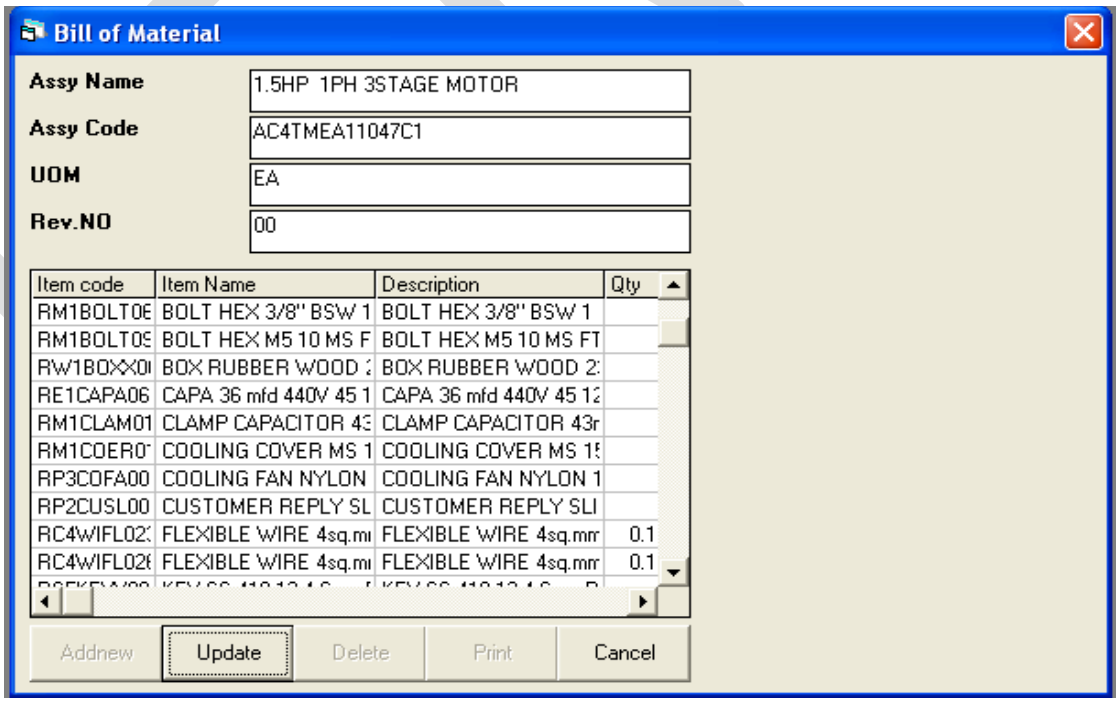


Figure 11: Bill of Materials Screen

The bill of Materials updation is done by engineering department only. All other user can be use the viewing option.

7.6 ROUTING:

The Routing is nothing but designing the sequence of operation for processing the product. Routing is not only created for machining component, it includes the special process like NDT (Non-destructive testing), Welding, Painting and Assembly operation.The Routing is include to set up the setting time of process component and running time of component for completion of that particular process. The Routing data is play as a vital role in Machine capacity calculation. Because after finalizing the sequence of operation, machine is selected for performing that particular operation. The

Routing screen is shown below.

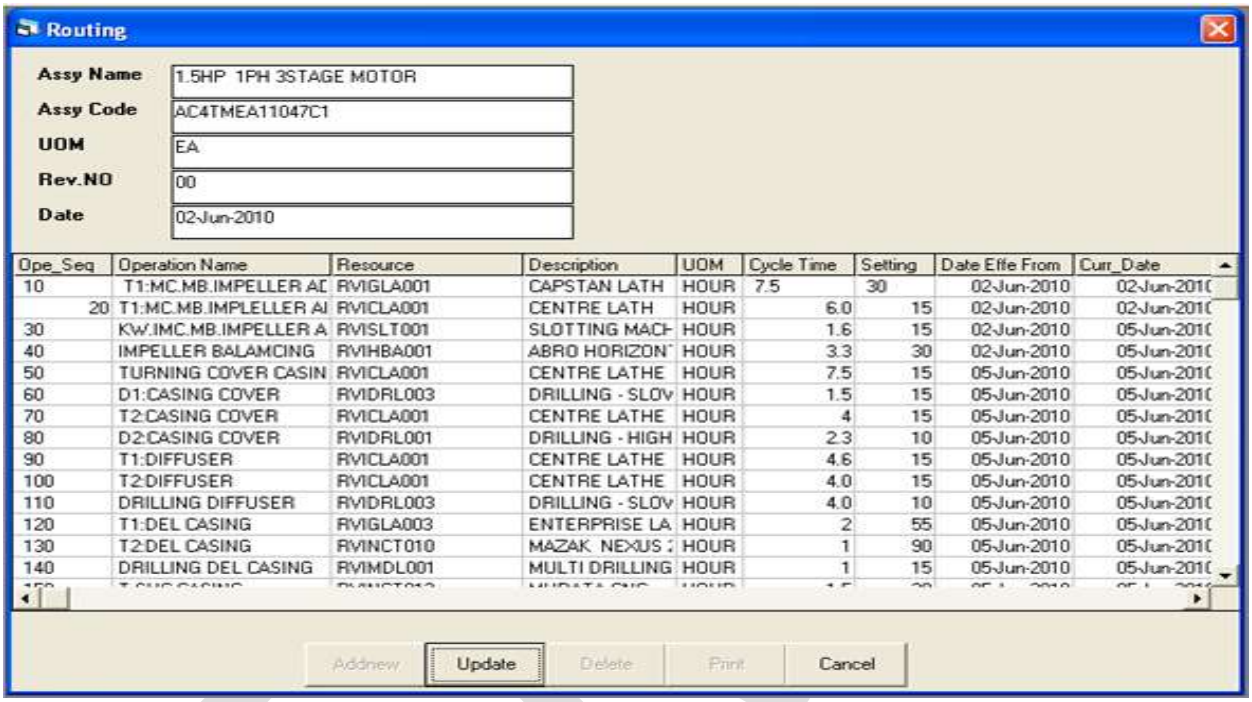


Figure 12: Routing Screen.

7.7 CALENDAR / MACHINE TIME:

Every month planning department personnel has to identify the available working hours of each machine. This is the basic input of machine capacity calculation.

Available Working day/month = Calendars days – Week off days – declared leave days.

Normally all the companies are following with 22.5 hours of working per day.

Available working minutes / Month = (Available working day / month) X Available hours per day X 60.

The Calendar / Machine Time form is shown below.

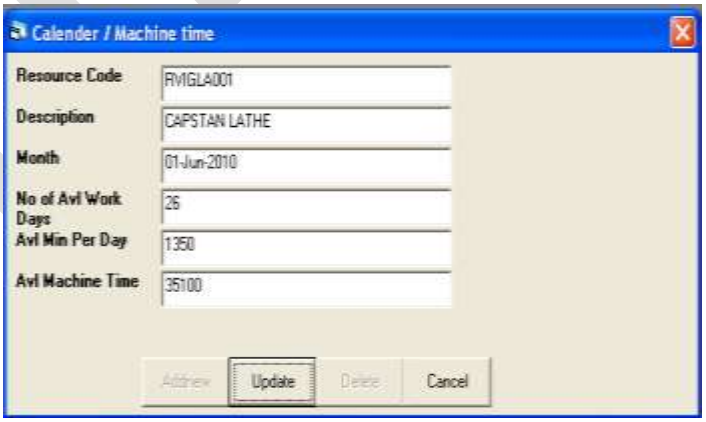


Figure 13: Calendar / Machine Time Screen.

The Available Machine is calculated automatically based on the above said formula.

7.8 MACHINE UTILIZATION:

The Machine Utilization is calculated for checking whether can we able to ship the materials with in the customer requested date or not? The month wise machine utilization and available hours is checked at any time for giving the actual firm shipment date of product. It is happened after analyzing the every machine assigned load prior. The response time for each customer is very important for growth. The Machine Utilization is arrived based on the order booking item and quantity. It is basically linked with routing master and Machine time master. The Machine utilization screen is shown below.

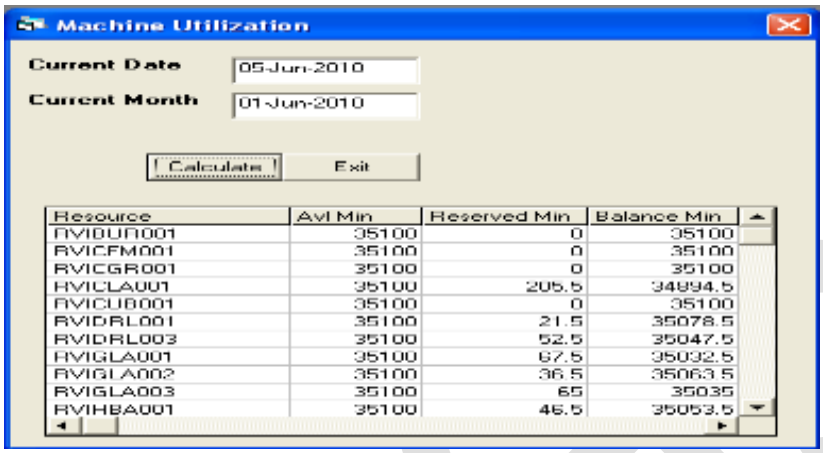


Figure 14: Machine Utilization Screen

If found any one of the machine remaining time is zero, the machining outsourcing decision also made to fulfill the order at stipulated span of time.

7.9 PERFORMANCE HISTORY:

The supplier performance is evaluated as per the parameter mentioned in performance history screen. The supplier is selected which one is having the maximum mark out of three. Normally all the companies are taking the three suppliers for selection process. After the evaluation only they will select the supplier and add its profile supplier master screen for further procurement process. The performance evaluation screen is shown below.

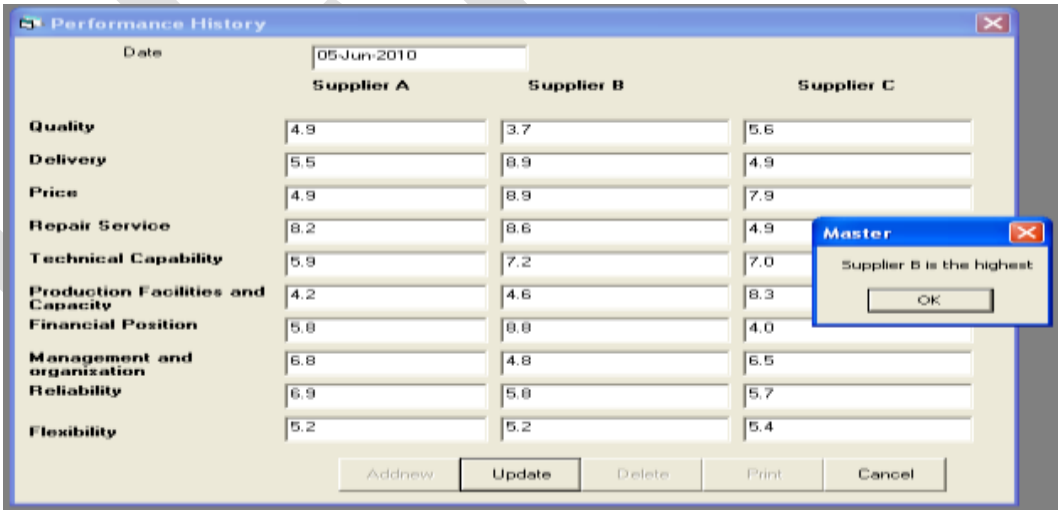


Figure 15: Supplier Performance History Screen

7.10 INVENTORY MASTER:

The Inventory master is used for known the on-line stock of all the materials. It is used to issue the materials while production of final product and maintenance consumables items. The inventory screen is shown below.

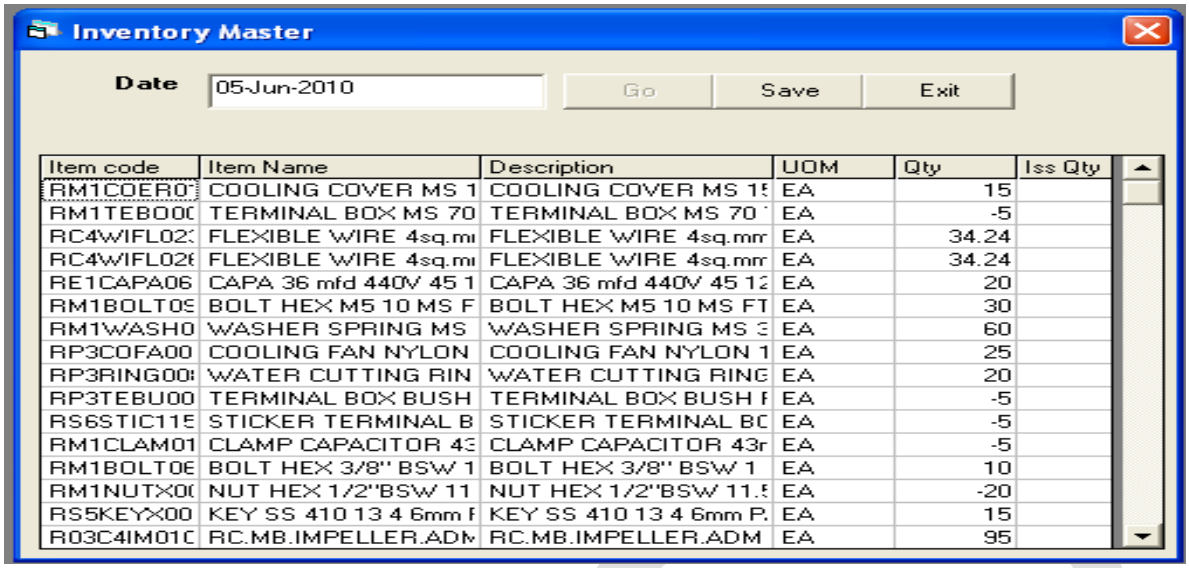


Figure 16: Inventory Master Screen.

7.11 ORDER BOOKING:

The Order Execution is play a major role in all industries. For every order Sales and planning personnel have to do some frame work for successful completion of the order. While order booking the following things has to be verified.

- The customer master is already available or not. If it is not created, customer profile has to be updated in Customer master.
- The ordered item code availability.
- Availabilty of BOM and Routing for requested item.
- Verify the feasibility of completion of order within the requested date for creating Schedule date in order booking form.

The order booking form is shown below.

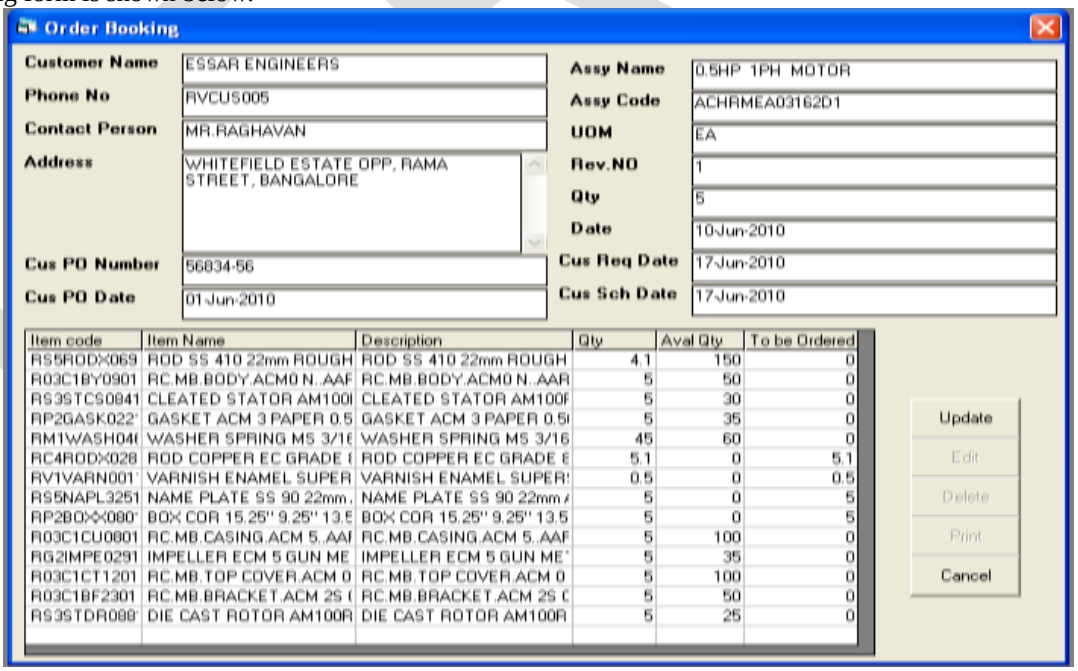


Figure 17: Order Booking Screen

The shortage materials are identified while order booking for initiating the requestion raising and PO Release. The Available stock quantity is taken from inventory master. The required materials are retreived from BOM Master.

8. SYSTEM IMPLEMENTATION

The developed materials management system is useful to run the organisation for making decision and proper handing of inventory status. Intially company has to work on data feeding activities. The available supplier and customer master, item master are to be created in Visual basic system. Then company subsequently take the time study in proper manner to create routing and proper available machine selection. The Bill of materials creation is needed for every final product code.

System implementation is one of the major part in organisation. Because all working people in the companies are fully molted with existing traditional system eventhough if it is hand written. They don't bother about the new system benefits. Initially people want to train-up and taking the necessary preliminary trainning session to understand the new system benefits.

The system implementation is done as per the following steps. There are,

1. Study the process and product requirement.
2. Develop a software system regarding the requirement study.
3. Initiative the members to understanding sytem benefits.
4. Conduct the necessary train-up session to implement the system in successful manner.
5. Data feeding to be done which is already available in company.
6. Asign the user responsibilty in system screen.

9. CONCLUSION

Now a days all medium sacle industries are facing problem in business interm of data storage and data transcation. To succeed this competitive world the organisation should be able to take the optimal decision in right time. Based on this point only the project is deveopled to identify the needs and delivery the data in successful maner.

The developed system has a following benefits for organisation in various manner.

- Reduction of manual entry in stores, Order executioon, Bill of materilas and machinery list and cycle time updation.
- Store large amount of data.
- Subsequent back-up will be available in server at any time.
- Take the decision in supplier selection, Capital budget allotment based on the inventory level.
- Take the decision of Make or Outsource in Machining side.
- Check the availability of machine hours to identify the whether customer request date is applicable or ammendable in order booking stage.

10. FUTURE ENHANCEMENT

The project has been enhanncement in future in following aspects.

- Integration of Puschase module with existing system.
- Integration Finance and Account Module with exsting system.
- Integration of Human resource module with existing system.
- Integration of Planning strategy with existing system.

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