Bill of Materials

P- 288

DISSERTION SUBMITTED IN PARTIAL FULFILMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF COMPUTER APPLICATIONS
OF BHARATIAR UNIVERSITY

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Contents

CHAPTER CONTENTS PAGE NO.

ACKNOWLEDGEMENT

SYNOPSIS

1. **INTRODUCTION**

1.1. Organization Overview

1.2. Computer System: Hardware & Software

1.3. About ORACLE

2. **SYSTEM ANALYSIS**

2.1. Existing System

2.2. Limitations of Existing System

2.3. Proposed System Objectives

2.4. Advantages of Proposed System

3. **SYSTEM DESIGN**

3.1. Overview of System

3.2. Database Design

3.3. Screen Design

3.4. Report Design

4. **SYSTEM DEVELOPMENT & IMPLEMENTATION**

4.1. Design Review

4.2. Creation of Tables

4.3. Input Formats

4.4. Output Layouts

4.5. Menu tree

4.6. Reports

4.7. Testing & Implementation

Conclusion

Bibliography

Certificate

CERTIFICATE

This is to certify that this project work entitled

"BILL OF MATERIALS"

submitted to Kumaraguru College of Technology, Coimbatore laffiliated to Bharathiar University in partial fulfillment of the requirements for the award of the Degree of Master of Computer Applications is record of original work done by **Mr.N.RAMESH KUMAR, Reg. No. 9438M0203** during his period of study in the Department of Computer Science and Engineering, Kumaraguru College of Technology, Coimbatore under my supervision and guidance and this project work has not formed the basis for the award of any Degree/Diploma/Associateship/Fellowship or similar title to any Candidate of any University.

Professor and Head

Staff-in-charge

submitted for University Examination held on 03/06/1997

Internal Examiner

External Examiner

LAKSHMI SYSTEMS ACADEMY

Mani Higher Secondary School, Coimbatore - 641 037

April 22, 1997

TO WHOMSOEVER IT MAY CONCERN

This is to certify that Mr. N. Ramesh Kumar (Reg. No. 9438M0203) Final Year M.C.A student of Kumaraguru College of Technology - Coimbatore, did his project on MILL OF MATERIAL in our Concern. He has been dedicated, hard working and his performance has been GOOD. (Due to confidentiality of the concern the student is not permitted to take the source code outside)

K.T. Sriram
Manager - Education

DECLARATION

I hereby declare that the project work entitled

" BILL OF MATERIALS"

at

Lakshmi Systems Academy, Coimbatore Submitted in Partial fulfillment of the requirements for the award of the degree of

Master of Computer Application

is a report of original work done by me during my period of study in

Kumaraguru College of Technology

(Affiliated to Bharathiyar University)

Coimbatore - 6.

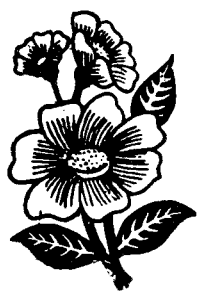
Under the supervision of

Ms.R.Jones Anitha Rani , M.C.A

Name	Register Number	Signature of the candidate
RAMESH KUMAR.N	9433M0203	

Date : 02/06/97

Place : COIMBATORE



Dedicated To Our Beloved Parents

Acknowledgement

ACKNOWLEDGEMENT

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Synopsis

SYNOPSIS

This project entitled **"BILL OF MATERIALS"** has been done at **LAKSHMI SYSTEMS ACADEMY**, Coimbatore for one of its clients.

The Bill of Materials system developed monitors all the activities of the design department and also provides all key information like the parts usage list or Product Structure list and design changes details in manufacturing a product. The different activities monitored by this software developed includes preparation of the Bill of Materials list for the products manufactured, release of Engineering Change Notes which incorporates all the design change specifications, monitoring these design changes and maintaining an upto date Bill of Materials List, Version Control of the design for different products.

This system also ensures for the issue of correct Bill of Materials list to the production planning department by incorporating all the requested design changes with the help of changes monitoring and versi control module. The system also helps in processing the item revisions made for each of the products.

The programs have been developed in **ORACLE 7.0 with SQL*FORMS 3.0** as the Front End. There is also much scope for further development of the system. All programs have been tested with test data.

1.1 ORGANIZATION OVERVIEW

LAKSHMI SYSTEMS ACADEMY - a non-profit motive unit of Kuppusamy Naidu Charity Trust for education and Medical relief, having started their operation of imparting knowledgle on computers with a unique kind of education called **INDUSTRY INTERFACED COMPUTER EDUCATION** to cope with the present day needs of the industries in the field of information of interfacing the participants to appraise the industrial scenario and to match the industrial standards, in the line of software development and training.

LSA has started its operation on software development and maintenance for Lakshmi Group concerns as well as corporate clients with proficiency in different hardware and software platforms.

THE EDUCATION DIVISION

The Academy offers programme for Corporate sector, Executives, Professionals, Students Community and others to enhance their computing skills. **LSA's** training methododlogy is well designed with live case studies apart from text - based Instructions, Video Clippings and Self-study materials. Also the participants will have a unique experience meeting the experts in this field to share their expertise during software development.

LSA offers standard and customised programmes to meet the changing needs of the industry. **RDBMS** like **ORACLE 7.0** X-base Packages like **FOXBASE/FOXPRO** are the programmes offered for the public on full time and part time basis. Senior executive programmer, Managerial decision making and secretarial programmes are also conducted periodically. The Academy also conducts special programmes for various segment like

Banks, Insurance Companies, Business Establishment and corporate group based on requirements.

AN EXCLUSIVE SOFTWARE DIVISION

LSA, as part of its organization has a Software division coimprising of team of dynamic information technology professionals with rich experience in development and implementation of information systems for a variety of industries. Apart from its own team of system personnel, it has interface with the stream of computer engineers working for Multi Billion Lakshmi group of companies.

The division has a very high expertise on the following Industrial segments.

Hospital

Engineering

Finance

Textile

CAD

With its experience in software development, **LSA** has started spreading its wings over Export segment too. Technical expertise available on,

UNIX

WINDOWS/DOS

ORACLE

INGRES

NETWARE

C++/X-BASE

LSA has its own stringent quality control procedures, before a software product/package is released to customer location.

LSA's documentations tandards for the software packages are well defined and made absolutely user friendly.

1.2 COMPUTER SYSTEM: HARDWARE AND SOFTWARE

HARDWARE:

Processor	:	80486SX
Clock Speed	:	66 Mhz
Main Memory (RAM)	:	16 MB
Hard Disk	:	I GB
Printers	:	EPSON FX1000 (132 column, 24 cps)
Catridge Tape Drive	:	150 MB

SOFTWARE

Operating System Used	:	UNIX system VR 4.0
RDMS Used	:	ORACLE 7.0

1.3 ABOUT ORACLE

ORACLE - One of the most important and powerful **RDBMS** available is supplied by the **ORACLE** corporation of California. It comes as a complete system for accessing, manipulating and controlling the Database. It maintains data structures in relational form, which allows any actual or logical data structure to be represented as a set of two dimensional tables. Additional columns (i.e., fields) may be added to a table at any instant without requiring re-organisation of data or amendment to existing programs.

Data independence is further provider by the idea of views. The defininitions of thes views, to gether with all other data names, data descriptions and security rules, are held in a data dictionaryp which is an active part of the database.

WHY ORACLE SERVER?

ORACLE SERVER provides efficient and effective solutions for the major database features which proved to be the right choice for this package, though other packages such as **INGRES, SYBASE, INFORMIX, UNIFY** etc., are available. The following are some of its features.

* **ORACLE** supports large number of concurrent users executing a variety of database applications operating on the same data. It minimizes data contention and guarantees data concurrency.
* Applications developed using **ORACLE** can be ported to any operating system with little or no modification.
* **ORACLE** allows different types of computers and **OS** to share information across networks due to **ORACLE'S** software compatibility with Industry Standards.

* **ORACLE** provides powerful utilities for configuring and implementing the applications liek loading data from external file, backup/restore selected data, control disk space utilisation etc.,
* **ORACLE** provides a varietyof application development tools like **SQL * MENU, SQL REPORT**.
* **ORACLE** supports two types of programming intefaces precompilers and procedural inter faces.

APPLICATION UTILITIES IN ORACLE

ORACLE supports a wide range of application utilities. Some of the Utilities which are widely used in application development are

-SQL * plus

-SQL * Forms

-SQL * Menus

-SQL * Reportwriter

-Pro * C

SQL * Plus

SQL * Plus is an interactive command driven interface to Oracle, useful form adhoc queries and reports. It is the user's itnerface to the **ORACLE RDBMS.** It serves the needs of both the beginners, by its simplicity and the programmers by its powerful language constructs for efficient programming. It can be user by End Users, Programmers and the DBA to suit their requirements.

SQL * Forms

SQL * FORMS is a forms based tool used in the process of application development. Quick development of forms-based applications for entering, querying, updating and deleting data is possible with this tool.

SQL * Forms solves the complex problems that cause other 4th generation products to falter. The non-procedural structure of **SQL * Forms** and the flexibility of the **ORACLE RDBMS** ensure the success. Instead of writing programs, the user can specify the application needs using simple menus, spread tables and a powerful screen painter. **SQL * Forms** combines the user instructions with the information from the **ORACLE** Data Dictionary to generate the application required by the user.

SQUL * FORMS OBJECT HIERARCHY

At the highest level of hierarchy is the Form. A form can own the following interface objects.

* Blocks
* Pages
* Form-Level Procedures
* Triggers

At the next level is the block, which owns the following objects.

* Fields
* Triggers

At the third level of the object hierarchy is the field. Fields can own Triggers.

At the fourth and the deepest level is the Trigger, which owns the trigger steps. The trigger statements comprise of **PL/SQL** statements.

TRIGGERS

Triggers are set of procesing commands. When an even occurs, the trigger associated with that event 'Fires' executing the commands present in the trigger. Triggers play an important role in SQL * Forms. Triggers can be either system defined or user defined. System defined triggers can also be modified according to the application need.

A trigger can contain

* PL/SQLA Statements
* Procedural Logic Statements
* Form Processing Statements

Several routines can be defined and can be called from the triggers.

PROCEDURES

Procedure is another feature of SQL * Forms. Procedures are callable set of commands consisting of sequence of PL/SQL statements. They can take arguments and return values,just as subroutines do in 3rdgeneration languages such as C.

These procedures can be called any number of times with in the scope. The procedures can be system defined packaged procedures or user defined Form - Level procedures.

SQL * MENUS

SQL * Menus is a menu driven tool for the quick development of menus required by the user for his application. The user can link all his aplication modules in **SQL * MENUS.**

SQUL * REPORTWRITER

ORACLE provides the report formatting and printing capability using the **SQL * REPORTWRITER. SQL** commands can be used within the report writer to extract data from the database and a variety of sequencing and formattting facilities are used to direct the layout and printing of the report. Using this utility high quality reports can be generated with less effort.

PRO * C

PRO * C is one of the High Level Language Interface tool provided with **ORACLE RDBMS**. The other **HLL** Interfaces available are **PRO * COBOL, PRO * PASCAL, PRO * ASSEMBLY. PRO * C** is designed to convert a C program which includes SQL statements, into a C program which can access and manipuate data in an **ORACLE** database.

A PRO * C program has the following parts.

* Application prologue, which defines the variables.

* Application body, which contains the PRO * C calls, consisting of Embedded SQL statements such as insert, update, delete, select etc., to manipulate the **ORACLE** database.

2.1 EXISTING SYSTEM

The user system that takes the responsibility of preparation of design specifications when a new product is introduced or when an existing product design is changed is the design department. The design deparptment issues the Bill of Materials list for a given product to assist in the Production control and assembly process of the product. the system consists of various processes to be processeod before issuing an exploded Bill of

Materials list for a given product to the production department based on their product structure requisition.

Initially the requesition for Bill of Materials list for the product(s) originates from the Production Planning department which is passed on to the desing department, that is responsible for the issue of exploded Bill of Materials list accordingly. Based on the product structure requirements from the production planning department, the design department verifies if any design changes are to be made to meet the user requirements. If any deisng changes are to be made, an engineering Change Note (ECN) is released. The Engineering Change Note records all the design change specifications that are made on the actual product design. The changes that are to be made permanent is then incorporated in the Bil of Materials list. The final Bill of Materials list with all the rquired changes is then issued to the production planning department.

The design department also take sthe reponsibility of version control. When a requisition from planning department arises to issue a Bill of Materials list for earlier versions of the product stucture, then the design department rolls back all the design changes made after the requested version. Once this roll back is accomplished the exploded Bill of Materials list is produced.

2.2 LIMITATIONS OF EXISTING SYSTEM

The limitations of existing Bill of Materials system can be briefed as follows.

i. It is very time consuming and cumbersome to calculate the raw material and component requirements for any given product.

ii. Tracking of assemblies in which an item is used and the different levels where item is used becomes time consuming.

iii. Identifying the number of revisions and their respective stages for different items becomes a cumbersome process.

iv. When the prodcut structure is large it becomes difficult to identify the items required at a gien level.

v. Version control becomes a difficult task to accomplish since all the changes made after the required version is to be identified and replaced to get the prodct structure list for the earlier version of design.

vi. The other areas like the design changes requested, changes accomplished, daily changes that are done are also examples where the data processing and monitoring tasks becomes time consuming and cumbersome.

2.3 PROPOSED SYSTEM OBJECTIVES

The proposed system "**BILL OF MATERIALS**" has been developed to cater to the needs of the user (design) department and overcome the limitations of the existing system. The main objective of this software is to help in the release of Bill of Materials list for the product requested by the production planning department. The Bill of Materials list which is the key manufacturing document contains information such as the date of reparation, product identification code and name, level numbers, component identification code and name, drawing number, quantity requirements, raw material code and name and the surface operations required. The second objective which is to help monitoring the deisng changes made on a given product is accomplished thru the release of Engineering Change Note (ECN) and maintainance of the change note register. The third objective is the version control which is accomplished thru the version control module that helps in rolling back to th eprevious design structure of the product.

Provision for entering the new product structure i.e., their assemblies, sub assemblies, parts and the finish operations for a given item are given thru master maintenance module. The Engineering Change Note release which records the design changes made on aproduct to meet the user requirements is incorporated in the Transaction Maintenance module. Provisions for adition, modification and deletion of the ECN's are also provided. The maintenance choice is given based ont he daily change note report that is released. Various hard copy and soft copy reports are also generated. Soft copy reports in this sytem include the level wise details for the products. Hard copy reports produced include bill of materials list, Engineering change note release change note register production wise, daily ECN check list, assembly wise revision details, item wise revision details, assemblies requirement list, raw material requirement list and raw material usage list. The version control Bill of Materials reports helps the user to roll back to a previous version of the repoduct design effectively without the need to make duplicate entries of the design change in Engineering Change Note.

2.4 ADVANTAGES OF PROPOSED SYSTEM

The advantages of proposed sytem can be briefed as follows.

i. This software helps in generation of a quick and error free Biil of Materials list.

ii. Tracking of items usage in assemblies and at different levels is made possible thru the generation of raw material usage list report.

iii. The total raw material requirement for the product calculation is made easier with the help of Bill of Materials list.

iv. The daily change note preparation helps in tracking the design changes at every stage and also ensures for effective changes monitoring process.

v. Version control for a given product is accomplished thru version control module which ensures quick and error free generation of Bill of Materials list for an earlier design version.

vi. Helps in effective decision making process. As the raw material requirements list is generated, decision on whether the materials are to be purchased or is availabel can be effectively taken. The Bill of Matrials list also provides as a check list and helps in taking decisions regarding the manufacturing and scheduling dates.

vii. Security measures for this software is incorporated thru user names and passwords. Anu master maintenance, transaction modules or as such to access this software each user of the system is given a suerid and password, Any unauthorised access is not allowed by this software.

3.1 OVERVIEW OF SYSTEM

This system **"BILL OF MATERIALS"** is developed to cater to the needs of the design department and satisfy the prodcution planning personnel by generating and issuing the required reports for effective decision making purposes. This sytem takes care of collecting storing and retrieving all relevant information regarding the product design specifications i.e., the Bill of Materials list. The other activities taken care of by this system includes the monitoring of design change specifications and version control in the design of products. The system also helps in issuing the Bill of Materials list which includes the design specifications as requested by the customer to ensure customer satisfaction. This system consists of three important modules under consideration.

i. INITIAL BILL OF MATERIALS PREPARATION

This module helps in building up an initial product design specifications by the design department personnel. Whenever a new product is introduced this module is

invoked and the design specification is entered. The system takes care of this module by maintaining a master table, the assemblies master (assy mast). All the assemblies and component parts required are entered in this table.

ii. CHANGES MONITORING

This module helps in keeping track of all the changes that are made on the initial product desing. The changes specification is released as a document called the engineering change note. The Engineering change Note contains details of the changes made in product design like the assembly code in which the change has taken place, the old and new part codes under that specified assembly and the quantity requirements for each of these parts. The changes released if found permanent, is incorporated int he initial Bill of Materials list otherwise the initial Bill of Materials list is not affected. This temporary change is made known by just issuing the change note only. This transaction module is taken care of with the help of two transaction tables, the chages master (change mast) and changes detail (change detail) table.

iii. VERSION CONTROL AND BILL OF MATERIAL EXPLOSION

This module helps in tracking out the design specifications for the previous or earlier versions of the product. The parts in a product mayhave undergone several revisons and the current Bill of Materials list will have only the latest product design specifications. Suppose the requisition for an earlier version (ie. neglecting the latest revisions made on a given product) is given, then the version control module takes care to roll back the assemblies master file to the previous stages of design. This is taken care of with the help of two control tables having the product code, the date of revision and change note number details.

System Design

The Bill of Material explosion process helps in the release of Final bill of materials list to the production planning department taking into account the design changes made if any and version control required if any.

3.2 DATABASE DESIGN

The design of the database includes decision about the nature and content of the database, the tables that are to be used and its attributes in our system. The database design in this sytem incorporates the use of six master table, two transaction tables one table for version control and Bill of Material explosion. The different master tables made use of in this system are:

i. The products master table that holds information about all the products that are manufactured like its code, name and unit of measurement.

ii. The items master table holds all relevant information about the complete set of items that are being used in the organization. The information held in this table includes its code, name, unit of measurement, drawing number etc.,

iii. The assemblies master table contains details about the product structure of design specification like the assemblies and parts used in manufacturing a given product.

iv. The operations master table helps in maintaining a detailed information regarding all the operations that are possible on a given raw material. The information her includes the raw material code, operation code and name and the operation time in days.

v. The finish surface operations master includes specifications of the operations that are relevant on the raw material to produce a given item. The information here includes the item code, raw code, operation code and the quantity of raw material required per unit of the item.

vi. The supplier master table contains the details about the company which supplies the parts and items required for any given product.

The transaction tables used in this sytem are

i. The changes master table that holds information about the product, the assembly in which the change is to be done, the document number and the type of change whether temporary or permanent.

ii. The changes detail table that hold information about the parts in the assembly for which the changes are done and also the quantity required for each of its parts.

iii. The Bill of materials explosion master is used whenever a Bill of Material list is to be exploded and released and also if version control is to be done. The contents of this table include the Bill of Material number, version control code if required andd the revision date if a complete set of changes is to be neglected when version control is requested.

iv. The supplier item table holds the information about the supplier code, product code of the item, product description and also the lead -time of the product.

3.3 SCREEN DESIGN

The design of screens is mainly used to handle different kinds of input and to specify how data are accepted for computer processing. All the screens in this sytem has been developed to be user friendly. The user friendliness is brought by appropriate arrangement of messages and comments at relevant entry positions and providing online help and popup facilities. The popup screens reduces the entry of input by the user (i.e., with the help of appropriate selections) thereby reducing the chances of errors during entry. The different entry screens used in this sytem are

i. The item master entry screen helps in entry of the items and their associated information.

ii. The products master entry screen helps in entering all the product details that are manufactured namely its code, name etc.,

iii. The assemblies master entry screen helps in entering all the assemblies and their component parts that are used in the manufacture of a given product.

iv. The supplier master entry screen helps in entering the supplier details who are supplying the parts required for the product.

v The operations master entry screen helps in entering all the operation details information for any given item.

vi. The surface operations or finish operations entry screen helps in the entry of finish operations details for any given assembly or item.

vii. The transaction entry screen which is master detail entry screen helps in entering all relevant changes information in the product design. This screen is also called as the Engineering Change Note maintenance screen.

viii. The version control entry screen is invoked only when version control is requested and Bill of Materials is to be exploded.

The screen formats and their design is depicted in chapter 4.3.

3.4 REPORT DESIGN

The report layouts in this system are designed taking into view the end user requirements. The reports generated by this system gives relevant information as preferred by the end uses. The different reports generated by this system are classified as soft copy and hard copy reports. The soft copy reports generated are the level wise item details. In this system six levels are taken into consideration and the details regarding each of the six

level items includes the assembly code in which the item is used, the item code and name the quantity used per assembly and its unit of measurement. The hard copy reports generated by this system are

* Bill of Materials list
* Engineering change note release
* Cange note register - rpoduct wise
* Daily ECN check list
* Engineering change note assembly wise revision details
* Engineering change note item wise revision details
* Product assemblies requirement list
* Product raw material requirement list
* Raw material usage list
* Supplier Details

i. The Bill of Materials list report gives the hierarchical tree structured information about the product parts requirements list. The information provided by this report includes the level numbers, the part and assembly code and their names, the quantity requirement per assembly and product, the raw material code and the surface operations required.

ii. The Engineering change note release is a document released that gives complete specification of the design changes made like the product code, assembly code and the old and new parts description.

iii. Change note register report holds the details of all the changes that are made on the product design.

iv. Daily ECN check list reprot helps in maintaining a daily note of the design changes made for the different products.

v. ECN assembly wise revision details report gives a detailed information about the revisions made for a given assembly and the contents of this reports include the revision number, revised date, the old and newly replaced part details, the revised quantity details for the parts and the type of change whether permanent of temporary.

vi. The item revision details report contains information about the different revisions made on a particular item. The contents for this report include the document number in which this revision date, the new item i.e revised item and the quantity required.

vii. The Product assemblies requirement list report holds information about all the assembly's their codes, descriptions, unit of measurement and the required quantity per product.

viii. The raw material requirements list report lists out all the raw materials that are used in making up a product.

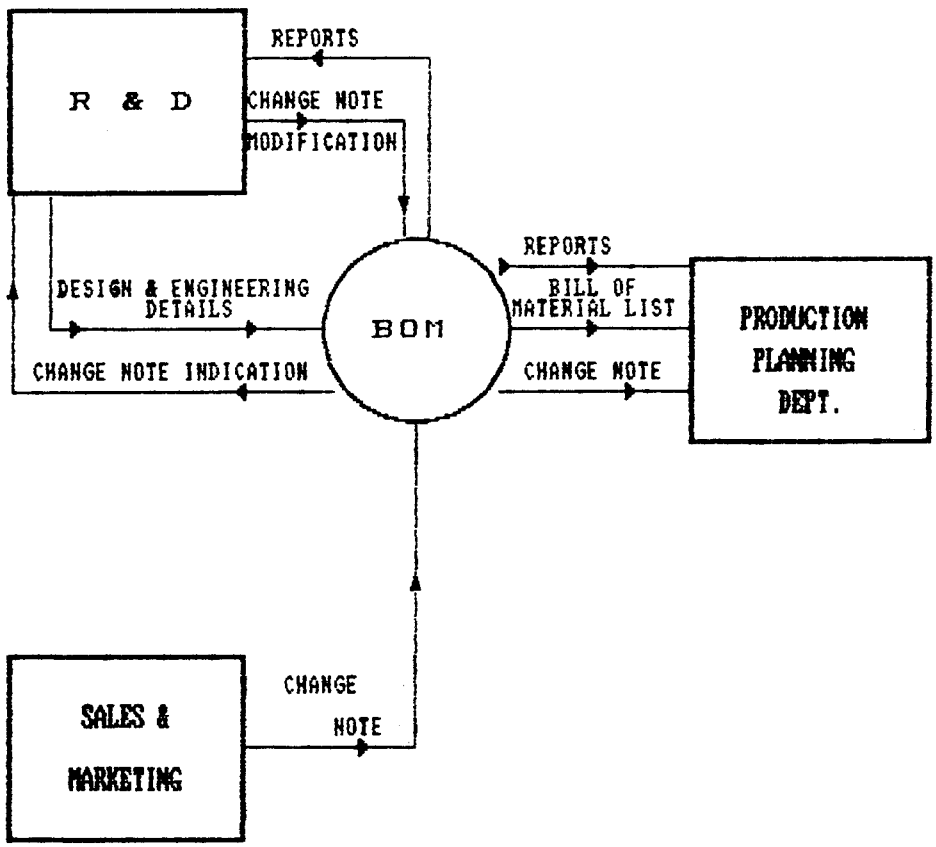
ix. The raw material usage list reprt holds all information regarding the assemblies and other finished components in which the item is used. It also specifies the quantity of item used in each of the assemblies.

x. The supplier details holds the information regarding company code, company Name, address contact number Fax number.

The report layouts and their design are depicted in chapter 4.4.

System Development & Implementation

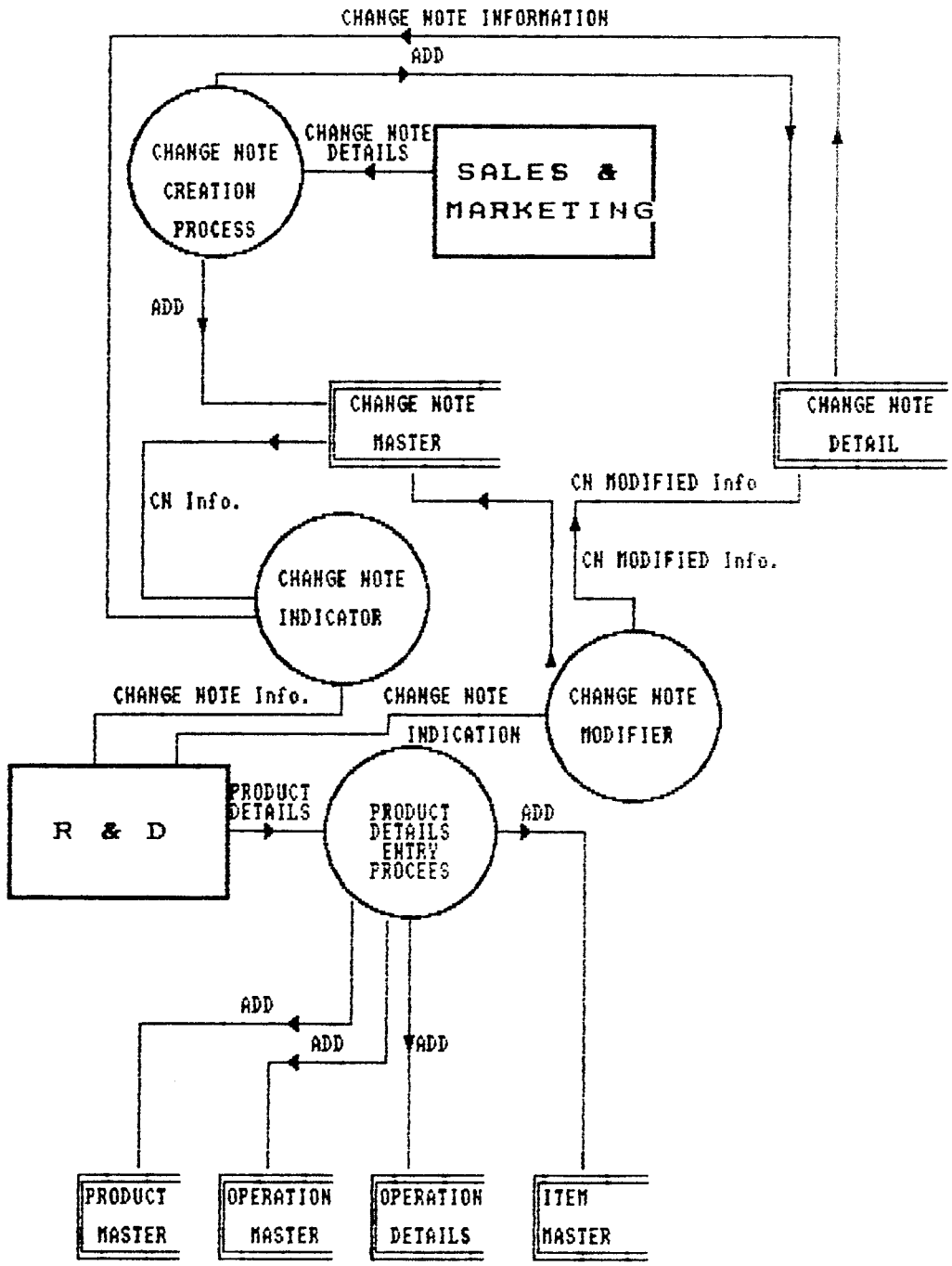
CAD FOR BILL OF MATERIAL



BILL OF MATERIAL

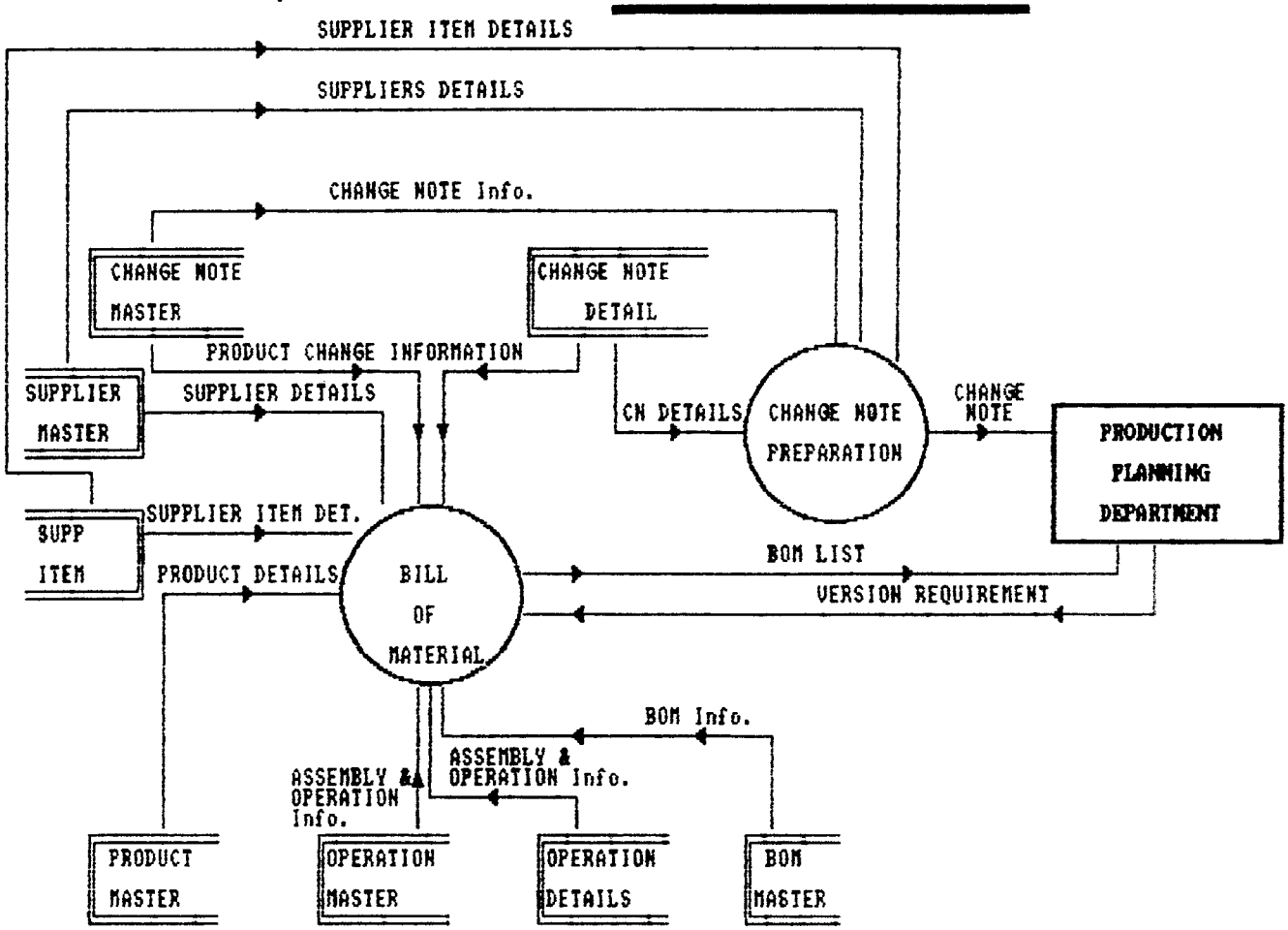
DATA FLOW DIAGRAM

LEVEL - 1.



BILL OF MATERIAL

DATA FLOW DIAGRAM (CONT.)



4.2. CREATION OF TABLES

4.2.1. TABLE NAME : item _ mast

DESCTIPTION : Item Master Table

COLUMN NAME	DESCRIPTION	TYPE	WIDTH	CONSTRAINTS
item_code	Item Code	char	8	PRIMARY KEY
item_desc	Item Name	char	30	
drawing_no	Drawing Number	char	8	NOT NULL
uom	Unit of Measurement	char	3	NOT NULL
alt_uom	Alternate Unot of Measurement			
conv_fact	Conversion factor	number	5	
type	Type of Item (raw mat., Assembly....)	number	5	

COLUMN VALIDATIONS:

* item_code cannot be blank or already existing in the table
* drawing_no cannot be blank
* uom cannot be blank and it should hold only specific values as shown on the message prompt.
* item_type cannot be blank and should hold only specific values as shown as the message prompt.

4.2.2 TABLE NAME : **prod_mast**

DESCRIPTION : **Product Master Table**

COLUMN NAME	DESCRIPTION	TYPE	WIDTH	CONSTRAINTS
prod_code	Product Code	char	8	PRIMARY KEY
prod_desc	Product Name	char	30	
uom	Unit of Measurement	char	3	

COLUMN VALIDATIONS

* prod_code cannot be blank or already existing in the table
* uom cannot be blank and should hold only specific values as shown at the message prompt

4.2.3. TABLE NAME : assy_mast

DESCRIPTION : Assemblies Master Table for the Products Manufactured.

COLUMN NAME	DESCRIPTION	TYPE	WIDTH	CONSTRAINTS
prod_code	Product Code	char	8	FOREIGN KEY NOT NULL REFERENCES prod_mas (prod_code)
assy_code	Assembly Code	char	8	FOREIGN KEY NOT NULL REFERENCES item_mast (item_code)
part_code	Component part or Item Code	char	8	FOREIGN KEY NOT NULL REFERENCES (item_mast (item_code)
qty_req	Quantity req. per assembly	number	7.2	
flag	Identification flag to enable item deletion	char	1	

COLUMN VALIDATIONS

* Prod_code cannot be blank and its values is to be derived from the values of prod_code in the prod_mast Table.
* Assy_Code cannot be blank and its values is to be derived from the values of item_code in the item_mast Table.
* Part_Code cannot be blank and its values is to be derived from the values of item_code in the item_mast Table.
* Qty_req value should be greater than ZERO.

4.2.4. TABLE NAME : opr_mast

DESCRIPTION : Raw Material Operations Master Table

COLUMN NAME	DESCRIPTION	TYPE	WIDTH	CONSTRAINTS
raw_code	Raw Material Code	char	8	FOREIGN KEY NOT NULLREFERENCE item_mast(item_code)
opr_code	Operation Code	number	1	
opr_desc	Operation Name	char	30	
opr_time	Operation Time in days	number	5.2	

COLUMN VALIDATIONS

* raw_code cannot be blank and its values is to be derived from the values of item_code in the item_code Table.
* opr_code should be greater than ZERO and the values cannot be repetitive for the given raw_code.
* opr_time should be greater than ZERO.

4.2.5. TABLE NAME : opr-detail

DESCRIPTION : Finish surface Operations Master Table

COLUMN NAME	DESCRIPTION	TYPE	WIDTH	CONSTRAINTS
item_code	Item Code	char	8	FOREIGN KEY NOT NULL REFERENCES item_mast (item_code)
raw_code	Raw Material Code	char	8	COMPOSITE FOREIGN KEY NOT NULL REFERENCES opr_mast (raw_code, opr_code)
opr_code	Operation Code	number	1	
Qty_per	Quantity Req. per unit	number	7.2	

COLUMN VALIDATIONS

* item_code should not be blank and its vlaues is to be derived from the values of item_code int he item_mast Table.

* raw code and opr_code should not be blank and this combination of values is to be derived from the raw_code and opr_code values combination int he opr_mast Table.

* qty_per should be greater than ZERO.

4.2.6. TABLE NAME : change_mast

DESCRIPTION : Engineering Change Note Master transaction Table.

COLUMN NAME	DESCRIPTION	TYPE	WIDTH	CONSTRAINTS
CN-NO	Change Number	char	6	PRIMARY KEY
change_date	Release Date	date		
prod_code	Product Code	char	8	FOREIGN KEY NOT NULL REFERENCES prod_mast (prod_code)
change_type	Type of Change done	char	1	
assy-code	Assembly Code	char	8	FOREIGN KEY NOT NULL REFEENCES item_mast (item_code)

COLUMN VALIDATIONS

* prod_code cannot be blank and its values is to be derived from the values of prod_code in prod_mast Table.
* assy_code cannot be a blank and its values is to be derived from the values of item_code in item_mast and it should also be present in assy_code for the prod_code specified in assy mast Table.

4.2.7. TABLE NAME : change_detail

DESCRIPTION : Engineering Change Note Detail Transaction Table

COLUMN NAME	DESCRIPTION	TYPE	WIDTH	CONSTRAINTS
CN-No	Change Note Number	char	6	FOREIGN KEY NOT NULL REFERENCES change_mast (doc_no)
old_item	Item Code requiring change	char	8	FOREIGN KEY NOT NULL REFERENCES item_mast (item_code)
old_qty	Old Quantity requirements	number	7.2	
new_item	Item to be Replaced	char	8	FOREIGN KEYNOT NULL REFERENCES item_mast (item_code)
new_qty	New Item Qty. Requirements	number	7.2	

COLUMN VALIDATIONS

* CN-NO should not be a blank and its value is derived from the values of CN-NO in the change_mast Table.
* old_item should derive its values from item_code of item_mast Table and also this item_code must exist in the assembly specified in change_mast of assy_mast Table.
* new_item should derive its values from the item_code in item_mast Table.
* new_qty should be greater than ZERO and greater than or less than the old_qty when old_item and new_item are the same.

4.2.8.

Table Name : supp_mast

Description : Supplier Master

COLUMN NAME	DESCRIPTION	TYPE	WIDTH	CONSTRAINTS
supp_code	Supplier code	char	8	Primary key
supp_name	Supplier code	char	20	Not Null
add_1	address	achar	15	
add_2	address	char	15	
city	address	char	15	
state	address	char	15	
pin	pin code	Number	6	
pno	contact number	Number	10	
fax	fax number	Number	15	

COLUMN VALIDATION

* supp_code cannot be a blank and should hold only specific values as shwon in the message prompt.
* supp-Name cannot be a blank.

4.2.9. TABLE NAME : born_exp

DESCRIPTION : Bill of Material Explosion Table

COLUMN NAME	DESCRIPTION	TYPE	WIDTH	CONSTRAINTS
bom_no	Bill of Material number	char	6	PRIMARY KEY
bom_date	Bill of Material Date	date		
prod_code	Product Code	char	8	FOREIGN KEY NOT NULL REFERENCES prod_mast (prod_code)
type	Type of Version Control	char	1	
rev_date	Revision Date	date		

COLUMN VALIDATIONS

* prod_code cannot be a blank and its values is to be derived fromt he values of prod_code in prod_mast Table.
* bom_no cannot be blank
* type cannot be blank and its value should be either E, P or N.

4.3.8

Table Name : **supp_item**

Description : **Supplier Item**

COLUMN NAME	DESCRIPTION	TYPE	WIDTH	CONSTRAINTS
supp_code	suppleir code	char	8	FOREIGN KEY NOT NULL REFERENCES supp_mast (supp_code)
prod_code	product code	char	8	FOREIGN KEY NOT NULL REFERENCES prod_,ast (prod_code)
prod_desc	product description	char	30	
lead_time	Quantity in hand	number	15,2	

COLUMN VALIDATIONS

* Supp_code cannot be a blank and its vlue is to be derived from the values of supp_code in supplier master table.
* prod_code cannot be a blank and its value is to be derived from the values of prod_code in product master.

Input Formates

LSA/BOM

PRODUCT MASTER MAINTENANCE

Product Code : _____

Description : _____

Uom : _____

Save (Y/N) ? __ Continue (Y/N)? __

Count *0

<List> <Replace>

LSA/BOM

ITEM MASTER MAINTENANCE

Item Code : _____ Drawing Number : _____

Description : _____

Uom : _____ Alternate Uom : _____

Conversion Factor : _____ Type: _____

Save (Y/N) ? __ Continue (Y/N)? __

Count : *0 <List> <Replace>

LSA/BOM

ASSEMBLY MASTER MAINTENANCE

Product Code : _____ Assembly Code : _____

Sl.No.	Part Code	Qty. Req	Uom

Part Description: _____

Save (Y/N) ? __ Continue (Y/N)? __

Count *0 <List> <Replace>

LSA/BOM

OPERATION MASTER MAINTENANCE

Raw Material Code : _____

Operation Code : _____

Oprn. Description : _____

Operation Time : _____
(days)

Save (Y/N) ? __ Continue (Y/N)? __

Count : *0

<List> <Replace>

LSA/BOM

FINISH OPERATIONS MAINTENANCE

Item Code : _____

Raw Material Code : _____

Operation Code: _____

Quantity / Unit : _____

(Raw Material)

Save (Y/N) ? __ Continue (Y/N)? __

Count : *0

<List> <Replace>

LSA/BOM

ENGINEERING CHANGE NOTE MAINTENANCE

CN Number : _____

Product Code : _____

Change Type : _____

Assembly Code : _____

Save (Y/N) ? __ Continue (Y/N)? __

Count : *0

<List> <Replace>

LSA/BOM

CHANGE NOTE DETAILS MAINTENANCE

Old Item	Quantity	New Item	Quantity

LSA/BOM

VERSION CONTROL MODULE

BOM No. : _____

Product Code : _____

Type _____

Revision Date : _____

CN Number : _____

Explode BOM (__)

LEVEL WISE ITEMS REQUIRED

(LEVEL :)

Product Code : _____ Page No. : _____

Description : _____ Run Date : _____

Item Code.	Dwg. No.	Description	Uom	Qty/Assy.	Qty/Prod

Save (Y/N) ? __ Continue (Y/N)? __

Count : *0

<List> <Replace>

Output Layouts

MAIN MENU

1. BILL OF MATERIALS APPLICATION
2. EXIT THE SYSTEM

ENTER YOUR CHOICE : _____

MAIN MENU OPTIONS

1. MASTER MAINTENANCE
2. TRANSACTION MAINTENANCE
3. QUERY PROCESSING
4. REPORTS GENERATION
5. EXIT

ENTER YOUR CHOICE : _____

MASTER OPTIONS MENU

1. PRODUCTS
2. ITEMS
3. ASSEMBLIES
4. RAW MATERIAL OPERATIONS
5. ITEM FINISH OPERATIONS
6. SUPPLIER DETAILS
7. EXIT

ENTER YOUR CHOICE : _____

MASTER MAINTENANCE OPTIONS MENU

1. ADD
2. MODIFY
3. DELETE
4. QUERY
5. EXIT

ENTER YOUR CHOICE : _____

TRANSACTION MAINTENANCE OPTIONS MENU

1. ADD
2. MODIFY
3. DELETE
4. QUERY
5. EXIT

ENTER YOUR CHOICE : _____

TRANSACTION OPTIONS MENU

1. ENGINEERING CHANGE NOTE RELEASE
2. EXIT

ENTER YOUR CHOICE : _____

QUERIES MENU

1. LEVEL WISE ITEMS
2. EXIT

ENTER YOUR CHOICE : _____

QUERY OPTIONS MENU

1. LEVEL 1 ITEMS
2. LEVEL 2 ITEMS
3. LEVEL 3 ITEMS
4. LEVEL 4 ITEMS
5. LEVEL 5 ITEMS
6. LEVEL 6 ITEMS
7. EXIT

ENTER YOUR CHOICE : _____

BILL OF MATERIALS

Product Code : _____ Page No. : _____

Description : _____ Run Date : _____

Level	Comp. Code	Description	Uom	Qty/Assy.	Qty/Prod. Description	Raw Code Surface Oprn.

Count : *0

<Rep>

ENGINEERING CHANGE NOTE RELEASE

Product Code : _____ Page No : _____

Description : _____ Run Date : _____

Assembly Code : _____

Description : _____

Type of Chane : _____

Old Item Code	Description	Quantity	New Item Code	Description	Quantity

Count : *0 <Rep>

ENGINEERING CHANGE NOTE DETAILS

Page No. : _____

Run Date : _____

Sl. No.	CN Number	Date of Change	Assembly Code	Old Item Code	Quantity Description	New Item Quantity

Count : *0

<Rep>

DAILY CHANGE NOTE DETAILS

Page No. : _____

Run Date : _____

Prod. Code Item Code	Description Description	Assy. Code Quantity	Description New Item	CN No. Description Quantity	Type(Chg) Uom

Count : *0

<Rep>

ASSEMBLY REVISION DETAILS

Assembly Code : _____ Page No. : _____

Description : _____ Run Date : _____

Rev. No.	Rev. Date	CN No.	Type	Item Code Description	Quantity	New Item Quantity

Count : *0

<Rep>

ITEM WISE REVISION DETAILS

Item Code : _____ Page No. : _____

Description : _____ Run Date : _____

Rev. No.	Rev. Date	CN No	Assembly Code	New Item Code	Description	Quantity

Count : *0 <Rep>

ASSEMBLIES REQUIREMENT LIST

Product Code : _____ Page No. : _____

Description : _____ Run Date : _____

Assembly Code	Description	Uom	Alternate Uom	Req. Qty/Product

Count : *0 <Rep>

RAW MATERIAL USAGE LIST

Raw Material Code :

Description :

Page No. : _____

Run Date : _____

Sl. No.	Product Code	Description	Item Code	Description	Req.Qty/ Uom

Count : *0

<Rep>

RAW MATERIAL REQUIREMENT LIST

Product Code : _____ Page No. : _____

Description : _____ Run Date : _____

Raw Code	Drawing No	Description	Uom	Alternate Uom	Qty/Product

Count : *0

<Rep>

REPORTS MENU

1. BILL OF MATERIALS
2. ECN RELEASE
3. CHANGE NOTE REGISTER - PRODUCT WISE
4. DAILY ECN CHECKLIST
5. ECN - ASSEMBLY WISE REVISION DETAILS
6. ECN - ITEM WISE REVISION DETAILS
7. PRODUCT ASSEMBLIES REQUIREMENT LIST
8. PRODUCT RAW MATERIAL REQUIREMENT LIST
9. RAW MATERIAL USAGE LIST
10. SUPPLIER DETAILS
11. EXIT

ENTER YOUR CHOICE : _____

Reports

BILL OF MATERIALS

Product Code : 001J301
Description : JS3 RING SPINNING FRAMES

Level	Component	Description	UOS	Qty/Assy.	Qty/Prod.	Raw Code	Description	Surface Oprn.
1	00150001 3000	SKELETON ASSEMBLY	NOS	1	1			
2	10220002 3001	GEARING AND FRAME	NOS	1	1	10220002	GEARING END FRAME	
2	10220003 3002	BED PLATE	NOS	1	1	10220003	BED PLATE	
2	20310004 9129	HEX BOLT	BOX	3	8	20310004	HEX BOLT	SELF FINISH
2	20350005 9316	WASHER	BOX	5	15	20350005	WASHER	
2	20310006 9355	HEX NUT	BOX	5	10	20310006	HEX NUT	SELF FINISH
2	10220007 3039	COVER PLATE	NOS	2	2	10220007	COVER PLATE	
2	2031008 9029	ROUND HEAD SCREEN	BOX	1	1	20310008	ROUND HEAD SCREEN	SELF FINISH
2	10250009 1313	GEAR AND PANEL FIXING BRACKET	NOS	1	1	10250009	GEAR AND PANEL FIXING BRACKET	
2	10250010 2008	'I' BKT FOR GEAR PANEL 7 LIFT	PCS	1	1	10250010	'L' BKT FOR GEAN PANEL 7" LIFT	
2	10250011 2009	'L' BKT FOR GEAT PANEL 8" LIFT	PCS	1	1	10250011	'L' BKT FOR GEAR PANEL 8" LIFT	

BILL OF MATERIALS

Product Code : 001J301
Description : JS3 RING SPINNING FRAMES

Level	Component	Description	UOS	Qty/Assy.	Qty/Prod.	Raw Code	Description	Surface Oprn.
2	10250012 3004	GEAR END PANEL MIDDLE	NOS	1	1	10250012	GEAR AND PANEL MIDDLE	
2	20330013 9008	SOCKET HEAD CAP SCREW	BOX	1	3	20330013	SOCKET HEAD CAP SCREEN	
2	20310014 1639	FOUNDATION BOLT	BOX	1	1	20310014	FOUNDATION BOLT	SELF FINISH
2	10250015 3003	OFF END FRAME	NOS	1	1	10250015	OF END FRAME	
2	20330016 2004	SPRING PIECE REGULAR	NOS	1	1	20330016	SPRING PIECE REGULAR	
2	20310017 9159	CARRIAGE BOLD	PCS	2	6	20310017	CARRIAGE BOLT	
2	20330018 1009	PIVOTED SPRING PIECE FOOT-TOP	NOS	1	1	20330018	PIVOTED SPRING PIECE FOOT-TOP	PAINTING
2	203030019 2007	PIVOTED SPRING PIECE FOOT-BTM	NOS	1	1	20330019	PIVOTED SPRING PIECE FOOT-BTM	
2	20350020 1011	PIVOT STUD	NOS	1	1	20350020	PIVOT STUD	

BILL OF MATERIALS

Product Code : 001J301
Description : JS3 RING SPINNING FRAMES

Level	Component	Description	UOS	Qty/Assy.	Qty/Prod.	Raw Code	Description	Surface Oprn.
2	20310022 1012	JACK SCREW	NOS	1	1	20310021	SQUARE HEAD BOLT	
2	00150023 4098	SPINDLE RAIL	NOS	1	1			
3	20310004 9129	HEX BOLT	BOX	2	8	20310004	HEX BOLT	SELF FINISH
2	20350005 9316	WASHER	BOX	5	15	20350005	WASHER	
3	20310006 9355	HEX NUT	BOX	2	10	20310006	HEX NUT	SELF FINISH
3	20350024 1013	G.E. - 10 SPLS	NOS	2	6	20350024	G.E. - 10 SPLS	SELF FINISH
3	20350025 1022	NEAR O.E	NOS	2	6	20350025	NEAR D.E.	SELF FINISH
2	20350038 2036	LOCKING COLLAR	NOS	4	4	20350038	LOCKING COLLAR	
2	20350039 2145	COTTER PIN	NOS	2	2	20350039	COTTER PIN	

Authorised Signature

(Manager)

ENGINEERING CHANGE NOTE RELEASE

Product Code : 001J301 Number : 11

Descriiption : JS3 RING SPINNING FRAMES Date : 18-May-96

Assembly Code : 00150037

Description : roller beam

Change Type : T

Old Item	Description	Old Qty
20310006	HEX NUT	2
20310004	HEX BOLT	2

New Item	Description	New Qty
20310006	HEX NUT	3
20310004	HEX BOLT	3

ENGINEERING CHANGE NOTE DETAILS FOR JS3 RING SPINNING FRAMES

Sl. No.	CN Number	Date of Change	Assembly Code	Old Item	Quantity Description	New Item Quantity
1	9	18-MAY-96	00150001	LOCKING COLLAR		20350038 4
				COTTER PIN		20350039 2
2	10	18-MAY-96	00150023	10250026 SPINDLE RAIL COUPLING	1	10250026 3
				20350027 TAPER PIN 5"	1	20350034
3	11	18-MAY-96	00150037	20310006 HEX NUT	2	20310006 3
				20310004 HEX BOLT	2	20310004 3
4	12	18-MAY-96	00150001	10220007 COVER PLATE	2	10220007 3
				20310004 HEX BOLT	3	20310004 4

DAILY CHANGE NOTE DETAILS

Page No. : 1

Run Date : 18-MAY-96

Prod. Code Name	Name Description	Assy code Name Quantity	New item	CN No. Description Quantity	Type (chg) Uom
001J301	JS3 RING SPINNING FRAMES	00150001	SKELETON ASSEMBLY 20350038 20350039	9 LOCKING 4 COTTER 2 10	P COLLAR NOS PIN NOS P
10250026	SPINDLE RAIL COUPLING	1	10250026	SPINDLE ING3	RAIL NOS.
20350027	TAPER PIN	1	20350034	TAPER PIN 5" 1	RAIL NOS PIN5" NOS
001J301	JS3 RING SPINNING FRAMES	00150037	ROLLER BEAM	11	
20310006	HEX NUT		2 2031006	HEX NUT 3	BOX
20310004	HEX BOLT		2 20310004	HEX BOLT 3	BOX
001J301	JS3 RING SPINNING FRAMES	00150001	SKELETON ASSEMBLY	12	T
1022007	COVER PLATE		2 10220007	CO ER 3	PLATE NOS
20310004	HEX BOLT		3 20310004	HEX BOLT 4	BOX

ASSEMBLY REVISION DETAILS
FOR JS3 RING SPINNING FRAMES

Assembly Code : 00150001 Page No. : 1
Description : SKELETON ASSEMBLY Run Date : 18-MAY-96

Rev. No.	Rev. Date	Document Number	Type	Item Code	Quantity Description	New Item Quantity
1	18-MAY-96	9	P			20350038
					LOCKING COLLAR	4
						20350039
					COTTER PIN	2
2	18-MAY-96	12	T	1022007	2	10220007
					COVER	3
				20310004	PLATE	
					3	20310004
					HEX BOLT	4

ITEM WISE REVISION DETAILS FOR
JS3 RING SPINNING FRAMES

Item Code : 20310004
Description : HEX BOLT

Run Date : 18-MAY-96

Rev.	CN Number	Rev. Date	Assembly Code	New Item Code	Description	Quantity Uom
1	11	18-MAY-96	00150037	20310004	HEX BOLT	3 BOX
2	12	18-MAY-96	00150001	20310004	HEX BOLT	4 BOX

ASSEMBLIES REQUIREMENT LIST

Date : 18-MAY -96

Product Code : 001J301
Description : JS 3 RING SPINNING FRAMES

Assembly	Code	Description	Uom	Alternate Uom	Req. Qty/ Product
00150001	3000	SKELETON ASSEMBLY	Nos		1
00150023	4098	SPINDLE RAIL	Nos		1
00150032	7856	DOFFING RAIL BRACKET-SPL TYPE	Nos		1
00150037	6784	ROLLER BEAM	NOS		1

RAW MATERIAL REQUIREMENT LIST

Product Code : 001J301
Description : JS3 RING SPINNING FRAMES

Run Date : 18-MAY-96

Raw Code	Drawing Number	Description	Uom	Alternate Uom	Qty/ Prod.
20310004	9129	HEX BOLT	BOX	PCS	8
20310006	9355	HEX NUT	BOX	PCS	10
20310008	9029	ROUND HEAD SCREW	BOX	PCS	1
20310014	1639	FOUNDATION BOLT	BOX	NOS	1
20310017	9159	CARRIAGE BOLT	PCS	BOX	6
20310021	9183	SQUARE HEAD BOLT	PCS		1
20310022	1012	JACK SCREW	NOS	BOX	1
20330016	2004	SPRING PIECE REGULAR	NOS	BOX	1
20330018	1009	PIVOTED SPRING PIECE FOOT-TOP	NOS	BOX	1
20330019	2007	PIVOTED SPRING PIECE FOOT-BTM	NOS	BOX	1
20330030	2005	INTERMEDIATE SPRING PIECE 7"	NOS	BOX	1
20330031	2110	INTERMEDIATE SPRING PIECE 8"	NOS	BOX	1
20350005	9316	WASHER	BOX	PCS	15
20350020	1011	PIVOT STUD	NOS	BOX	1
20350024	1013	G.E. - 10 SPLS	NOS		6
20350025	1022	NEAR O.E	NOS	BOX	6
20350034	1326	TAPER PIN 5"	NOS	BOX	4
20350038	2036	LOCKING COLLAR	NOS		4
0350039	2145	COTTER PIN	NOS	BOX	2

RAW MATERIALS USAGE LIST

Run Date : 18-MAY-96

Raw Code : 20310004
Description : HEX BOLT

Sl.No.	Product Code	Description	Item Code	Description	Required Qty. Uom
1	001J301	JS3 RING	00150001	SEKLETON	3
		SPINNING FRAMES		ASSEMBLY	NOS
2	001J301	JS3 RING	00150023	SPINDLE	2
		SPINNING FRAMES		RAIL	NOS
3	001J301	JS3 RING	00150032	DOFFING	1
		SPINNING FRAMES		RAIL	NOS
4	001J301	JS3 RING	00150037	ROLLER	2
		SPINNING FRAMES		BEAM	NOS

Supplier Code	Supplier Name	Address	City	State	Pin	Phone	Fax
SU123456	LMW	P N. Palayam	Coimbatore	Tamil Nadu	641 020	893513	0422-878787
SU456789	LECS	Arasur	Coimbatore	Tamil Nadu	641 037	842567	0422-913913
SU333333	LSM	Palladam	Coimbatore	Tamil Nadu	653 715	565656	0422-856658
SU111111	CISCOL	Mettur	Salem	Tamil Nadu	614 456	424344	0451-123123
SU786786	Reiuter	SANTACLARA	REDWOOD CITY	SWITZERLAND	500187	976854	066-992214

4.7 TESTING AND IMPLEMENTATION

The most important and final phase in the development of any software "Testing and Implementation" has been carried out successfully. All the modules in the software has been tested with test data. The test data has been used to test all the options provided in each of the modules. All entry screens have been tested with test data and each of the validations provided in the software has been tested with different options in it. The software developed is planned to run parallely with the existing system.

Conclusion

CONCLUSION

A computerised **"BILL OF MATERIALS"** system has been developed at Lakshmi Systems Academy for one of its clients which satisfies all specification laid down by the design department. The design and testing of the system is successfully done taking into account all the requirements and options laid down by the user department. The application developed in **4GL, ORACLE with SQL * FORMS 3.0** as front end has been developed to be user friendly, giving the user a wide range of meny choices. All the entry screens in this software are developed to be user friendly with the help of giving clear messaes and generating popups whenever and wherever as required by the user. The reports generated by this software are developed accordign to he specifications laid down by the company. The report formats and the specification of items incorporated in each of the reports are done as requested by the user of this system. This software also provides options for further enhancements such as inclusion of additional query modules if necessary by the user.

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PRO * C Reference Manual from ORACLE Corporation, California, U.S.A.,