A PERSONAL COMPUTER-BASED MATERIAL REQUIREMENTS PLANNING (MRP) SOFTWARE

by

Mr. Kriangkrai Akkajit

A Final Report of the Three-Credit Course
CE 6998 Project

Submitted in Partial Fulfillment
of the Requirements for the Degree of
Master of Science
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Project Title	A Personal Computer-Based Material Requirements Planning (MRP) Software
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The Graduate School of Assumption University has approved this final report of the three-credit course, CE 6998 PROJECT, submitted in partial fulfillment of the requirements for the degree of Master of Science in Computer and Engineering Management.

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ABSTRACT

The significant objective of this project is the development of a personal computer-based Material Requirements Planning (MRP) software with Microsoft Access to assist the users in managing production schedules and orderi nurchased items.

The basic philosophy and mechanics of Material Requirements Planning software are simple. The software assumes that the end product is made up of a hierarchy of assemblies, subassemblies, components and raw materials. The schedule of end product requirements is developed outside the MRP software. Using these end product requirements (Master Production Schedule), product structure data, and inventory master file as the MRP software input. The primary output of the MRP software is planned order report, that is, a schedule of how much is needed and when is it needed. The steps to create the MRP software are described in this report.

According to the comparison of the results from using the MRP matrices and applying Material Requirements Planning (MRP) software, the results are the same. Therefore, software evaluation was accomplished to test the MRP software's verification and validation, and it also meets project specifications and requirements for its intended use and performance.

For the next development of MRP software version, the developer should consider the methods for determining lot size and applying 4 methods of lot size as the functions in the MRP software. The other important aspect that should be developed is display or user interface in the good designed and attractive forms.

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I. INTRODUCTION

Nowadays, the inventory department is more important than ever before in the industrial world. Material Requirements Planning (MRP) is applied for materials management to make sure materials are available when needed and to maintain the lowest possible level of inventory. MRP starts with a schedule for the finished goods that is converted into a schedule of requirements for the subassemblies, component parts, and raw materials needed to produce the finished items in the specified time frame. Thus, MRP is designed to answer three questions: what is needed, how much is needed, and when it is needed?

1.1 Overview of Material Requirements Planning

MRP begins with the principle that many materials held in inventory have dependent demand. Materials in raw materials inventory and partially completed products held in in-process inventory are materials with dependent demand. The amount of a particular material with dependent demand that is needed in any week depending on the number of products to be produced that require the material. The demand for raw materials and partially completed products does not have to be forecast, therefore, because if it is known what finished products must be produced in a week, the amount of each material needed to produce these finished products can be calculated.

MRP is adopted in order to:

(1) Improve customer service. It means more than just having products on hand when customer orders are received. To have satisfied customers also means meeting delivery promises and shortening delivery times. Not only does MRP provide the necessary management information to make delivery promises that can be kept, but also the promises are locked into the MRP

control system that guides production. Therefore, promised delivery dates become goals to be met by the organization, and the probability of meeting promised delivery dates is improved.

(2) Reduce inventory investment. When fixed order quantity, order point systems are used to plan orders for a raw material, the order quantity plus safety stock remains in inventory until the raw material's end item appears in the Master Production Schedule (MPS). Because these appearances may be in several weeks apart, the pattern of inventory levels is in long periods of full inventories interspersed with brief periods of low levels. In MRP, on the other hand, orders for raw materials are timed to arrive at approximately the time that the raw material's end item appears in the MPS. The pattern of inventory levels in MRP is in long periods of low levels of inventory interspersed with brief periods of full inventories. The impact of MRP on raw-materials inventory levels is therefore dramatically reduced average inventory levels.

(3) Improve plant operation efficiency. Because MRP better controls the quantity and timing of deliveries of raw materials, parts, subassemblies, and assemblies to production operations, the right materials are delivered to production at the right time. Additionally, inflows can be slowed or accelerated in response to changes in production schedules. These controls of MRP result in reduced labor, material, and variable overhead costs because of (1) Reduced numbers of stockouts and material delivery delays resulting in more production without increases in the number of employees and machines. (2) Reduction of the incidence of scrapped subassemblies, assemblies, and products resulting from the use of incorrect parts. (3)

Increase in capacity of the production departments by decreasing production on idle time, increased efficiency of the physical movements of materials, and reduced confusion and planning delays (Gaither 1996).

MRP has three major sources of information:

(1) Master Production Schedule (MPS) states which end items are to be produced, when they are needed, and in what quantities.

(2) Bills of material file (BOM) contains a listing of all of the assemblies, subassemblies, parts, and raw materials that are needed to produce one unit of a finished product. Thus, each finished product has its own bill of materials.

(3) Inventory master file is used to store information on the status of each item by time period. This includes gross requirements, scheduled receipts, and expected amount on hand. It also includes other details for each item, such as supplier, lead time, and lot size. Changes due to stock receipts and withdrawals, canceled orders, and similar events also are recorded in this file.

The computerized system is appropriate for applying MRP. Microsoft Access is a powerful and robust 32-bit relational database management system (RDBMS) for creating desktop and client / server database applications that run under Windows. Microsoft Access is not only an application that runs in the Windows environment but also allows people to write Windows applications without being a Windows expert. Access has a unique database structure that can combine all related data tables and their indexes, forms, reports, macro, and VBA code within a single. It can import data from and export data to the more popular PC database and spreadsheet files, as well as text files. Access is specifically designed for creating multiuser applications where database

files are shared, and Access incorporates a sophisticated security system to prevent unauthorized persons from viewing or modifying the database (Jennings 1997).

1.2 Database Objects

Access provides a technology that breaks the development bottleneck and provides a way for you and the specialist to work in the same media Access. Instead of using memos and diagrams to communicate what needs to be done, Access enables you to enter the design process in a useful and efficient way.

Access accomplishes this goal by moving away from procedures as the basis of database activities to objects. A database consists of variety of different objects that are tables of data, forms for entry and printing, queries that supply the answers to questions, and reports that summarize database information. In Access, all of database objects are listed in a central database window. When you can use an object, it is selected from the list and displayed on the desktop. The database object windows contain information in various formats and styles. The key is that the visual nature of Windows applications presents you with easily identifiable an accessible objects the you can open, stack, move, size, and close just like the documents in any other Windows application (Krumm 1993).

Microsoft Access would be interesting and considered to be implemented. Microsoft Access is a database management system that is at home on the desktop as much as it is on the back-end server. Access is composed of the database engine which handles all the server tasks, such as file management and query resolution, and front-end toolkit for building database applications. But a plethora of desktop and server database management systems are available, so:

(a) Access appeals to a wide range of users and developers, from novices to system integrators, because of the depth o its inherent capabilities and relative ease-of-use.

(b) Access is a product that gives a tremendous amount of assistance to novice users (who often cannot even define what a database is), and allows them to build applications that get work done.

(c) Access uses a powerful relational engine that is an industry leader in ODBC support and inter-database, inter-application connectivity.

(d) Access has a rich workbench of tools for forms and reports development.

(e) Access support two industry-wide standard programming languages-the procedural programming language Visual Basic for Applications (for those who like lots of program code), and the non-procedural Structured Query Language-SQL (for those of you who just want to get the job done).

(f) Access is the database management system that provides closest adherence to the ANSI SQL-92 Standard, the database access language standard that is supported by nearly every vendor in the computer industry.

(g) Access has the strongest support for the relational model of all desktop database management systems and arguably, of the server database management systems as well (good news for you database designers).

(h) It supports the updateable dynaset, view definition in the form of optimized compiled queries, a fully integrated data dictionary, full referential integrity including cascading both updated and deleted (which previously had to be done in code).

(i) It exposed and exceedingly rich event model that allows for manipulation of nearly every property at run time, for maximum program control.

(j) Access supports a robust security model that allows full discretionary allocation of permissions throughout an application.

(k) Access was one of the first database management systems to support Object Linking and Embedding (OLE) technology, which allows inter-application communication and integration with other programs.

(l) Since version 2, Access has been empowered with the Rushmore technology, which enables the Jet engine to resolve complex queries with extreme quickness.

(m) Access supports the full range of use, from single-user to file-server to client/ server environments, which means that you can scale your application across multiple hardware platforms and software operating systems, using the same front-end tools.

(n) Access has a supplementary package-the Microsoft Access Developer's Toolkit, Available at separate cost-that allows developers to compile run-time copies of their applications and develop full Help subsystems to complement, for distribution, either internally or externally-with no royalty strings attached.

1.3 The Access Advantage

Access is a full-featured database application development package that can be used by a wide range of people. Computer users who need to put together quick databases for limited use can, with the assistance of the Wizards, build reasonably respectable and very functional applications without having to write code. Experienced developers can use Access as a rapid-application development tool to put together prototype applications and databases and demonstrate proof-of-concept. All levels of

database developers and database applications, which in turn can be used in a multiuser, multi-programming client/ server environment.

(1) Strong Database Capabilities

Access also is a powerful database engine that can multi-thread queries and provide concurrent access to multiple tables, either its own tables or those of another database management system. Access supports both pessimistic and optimistic locking, which can be modified at the programming level, and generally locks at the page level, which allows for fast and flexible modifications to the stored data.

(2) Working from Multiple Sources

Access can integrate, present, and update data from diverse data sources, A form of report can, all at the same time, show data from a SQL server database, an Oracle database, a dBASE file, and an Access internal reference table. The user who is looking at the data may not be aware that the data is being compiled from multiple data sources, with each source on a different computer.

(3) Cost Efficiency of a Run-Time Environment

In this time of tightened budgets ant cost cutting, Access is a cost-effective product. Obviously, in the standard development environments, each developer needs a full copy of Access in order to build the databases and assemble the applications. However, it is unnecessary to put a full copy of Access on the desktop of each user. To create a run-time environment, on both client and server machines, you need only compile the data and application databases by using the Microsoft Access Developers' Toolkit (ADR), create an installation set, and install where needed. Applications

compiled with the ADT can be legally distributed with no further royalties owed to Microsoft. For the cost of a single copy of Access and the Microsoft Access Develpers'Toolkit for Windows 95, you can deliver professional-quality database applications to your organization or to your clients. Whether you are a corporate developer in search of cost-cutting measures or a consultant who wants to persuade a client to deploy your application, this approach can result in significant savings to all involved.

The run-time software takes up far less disk space than a full installation of Access, which may be a factor on client workstations. Because the run-time version of Access does not include all the features of the development system, it will run in eight megabytes of memory. An additional benefit is that the run —time version can be configured so that the users cannot look at or change the design of the tables, forms, and reports. You also can do the same with applications that are interned to run under a full version of Access, but the run-time software makes it easier to remove the menu options and capabilities that may allow a user to inadvertently damage the database.

(4) Built-In Security

Access has built-in security so that different users can be allowed varying degrees of access to data. Some users may need to view and edit data with no restriction, others may be allowed only to read and modify certain tables, and yet another group may have read-only permissions. From the developer's perspective, the ability to control permissions means that it is unnecessary to develop different custom client applications for the various user groups.

1.4 Disadvantages of Using MS-Access

No system is perfect; no tool will do everything for everyone. This is as true in software packages as anywhere in the world. A software package, like a country, is defined by its boundaries. As a developer, you will push Access or any other product to its limits to extract the most value from your investment in learning that product. So it is important that you are aware of the major limitations of Access before you begin to use it as a development tool. Although the following list may seem a bit alarming, forewarned in forearmed. With the knowledge you gain from the following list, you can move forward with your development projects, avoiding the pitfalls listed here, and plan appropriately:

(1) No backward compatibility

On its own, access cannot provide backward compatibility to previous versions of Access. It would be nice to be able to upgrade the server database to Access and connect into it with older Access client applications but at the time of writing, backward compatibility was not an option. Out of the box, Access will readily recognize and link to Access 3 databases, but Access does not recognize Access database files.

(2) No Support for distributed databases

Although Access has the new replication facility, it isn't a true distribution function. Access manages its replicated databases through a manual synchronization, unlike the true distributed database scheme, which synchronizes through the use of a two-phase commit. Two-phase commit is a technique of synchronizing changes to stored databases by broadcasting to commits (instructions to commit changes to the physical database) throughout the group of databases participating in the distributed system.

(3) Access doesn't offer a completely object-oriented programming environment

Visual Basic for Applications 4, the programming language of Access, is an object-oriented programming language but, according to the purists, it falls short of being a true and full object-oriented environment. However, in the experience of the authors, Visual Basic for Applications 4 seems more than adequate for the task.

(4) Access does not provide a programming workgroup environment

One problem that the authors ran into is how to coordinate more than one developer who is working on the same .MDB file. Because all objects foe application (forms, reports, program code, macros, and queries) are contained within a single file, coordinating development changes being made to an application when there are multiple programmers can be tricky. A high level of organization is a must for developers in the environment. Third-party packages ate available that appear to do a reasonable job of controlling revisions and changes to data objects within an .MDB file. The authors have developed their own scheme, which works most of the time (Poolet and Reilly 1996).

The development of a Personal Computer-Based Material Requirements Planning (MRP) Software with Microsoft Access would be interesting and considered to implement.

II. SYSTEM CONCEPT

The concept of Material Requirements Planning (MRP) was developed and refined by Joseph Orlicky at IBM and Oliver Wight, a consult, in the 1960s and 1970s. It is a mathematical modeling tool for determining the needs of dependent components, such as raw materials, parts and sub-assemblies in a manufacturing or warehousing/ distribution environment. An MRP system is computer based and companies may have their own developed system or have purchased one of the many commercial packages that are available (Waller 1999).

2.1 Objectives of MRP and the Supply Chain

The MRP is driven by the master production schedule the basic purpose of which is to indicate:

(a) What types of material, have to ordered from outside, and in what quantities, taking into account current inventory levels;

(b) What types of material need to be manufactured internally, and in what quantities, taking into account current inventory levels;

(c) When to place these orders, either for purchases from outside or for manufacturing inside, taking into account to lead time for materials.

As a planning tool, the MRP provides precise control for operations personnel regarding the amounts and timing of deliveries of materials necessary to produce end-items, as indicated by the master production schedule. This control helps to avoid inventory stockouts, to minimize excessive levels of inventory and to optimize the utilization of labour and machines. The MRP system is one of the major planning tools for supply-chain management linking the purchasing and manufacturing activities.

When the MRP is coupled to a distribution requirements planning type system the combination servers to manage the supply chain as a complete integrated operation.

2.2 Inputs/outputs for Material Requirements Planning

In order for the MRP to provide an accurate program of material requirements, the following inputs are necessary:

(a) Master production schedule;

(b) Production structure on bill of materials;

(c) Inventory file.

2.3 The Computer-Based Material Requirements Planning

Material requirements planning (MRP) is a computer-based information system designed to handle ordering and scheduling of dependent-demand inventories (e.g., raw materials, component parts, and subassemblies). A production plan for a specified number of finished products is translated into requirements for component parts and raw materials working backward form the date, using lead times and other information to determine when and how much to order. Hence, requirements for end items generate requirements for lower-level components, which are broken down by planning periods (e.g., weeks) so that ordering, fabrication, and assembly can be scheduled for timely completion of end items while inventory levels are kept reasonably low.

Material Requirements Planning (MRP) is as much a philosophy as it is a technique, and as much an approach to scheduling as it is to inventory control.

Requirements in order to implement and operate an effective MRP system, it is necessary to have;

(1) A computer and the necessary software programs to handle computations and maintain records.

(2) Accurate and up-to-date

(a) Master Production Schedules.

(b) Bills of materials.

(c) Inventory file.

(3) Integrity of file data

MRP begins with a schedule for finished goods that is converted into a schedule of requirements for the subassemblies, component parts, and raw materials needed to produce the finished items in the specified time frame. Thus, MRP is designed to answer three questions: what is needed: how much is needed? And when is it needed?

The primary inputs of MRP are a bill of materials, which tells the composition of a finished product; a master schedule, which tells how much finished product is desired and when; and an inventory records file, which tells how much inventory is on hand or on order. The planner processes this information to determine the net requirements for each period of the planning horizon.

Outputs form the process include planned-order schedules, order releases, changes, performance-control reports, and exception reports. These topics are discussed in more detail in subsequent sections (Stevenson 1999).

An MRP system has three major sources of information.

(1) Master Production Schedule

A Master Production Schedule (MPS) is devise to either replenish finished-goods inventories or to fill customer orders. An MPS begins as a trial schedule to be tested for feasibility through MRP and CRP. As these schedules are proved feasible, they become the MPS that is put into action. MRP cannot distinguish between feasible and infeasible master production schedules. That is to say, MRP assumes that the MPS can be produced within the production capacity constraints. MRP explodes the master

schedule into material requirements. If these requirements cannot be met by the materials available form inventory or form materials, or if insufficient time is available for new orders, then the MPS will need to be modified to a new MPS.

The MPS drives the MRP system, and as the MPS is updated, the MRP results are also modified. Material orders are speeded up or slowed down or canceled. When the MPS is frozen, the plan for the inflow of materials emanating MRP is also frozen.

(2) Bills of Material

A bill of material is a list of the materials and their quantities required to produce one unit of a product, or end item. Each product therefore has a bill of material. A bills of material file. Or product structure file as it is sometimes called, is a complete list of all finished products. The quantity of each material in each product, and the structure (assemblies, subassemblies, parts, and raw materials and their relationship) of products. Another term for a bill of material is indented bill of material, a list in which the parent is in the margin and its components are indented to show structure.

The bills of material file is an up-to-date computerized file that must be revised as products are redesigned. Accuracy of the bills of material file is a major hurdle that must be overcome in most MRP applications. With the confidence that the file is current, once the MPS is prepared, end items in the MPS can be exploded into the assemblies, subassemblies, parts, and raw materials required. These units may be either purchased form outside suppliers or produced in in-house production departments.

(3) Inventory Status File

The inventory status file is a computerized file with a complete record of each material held in inventory. Each material, no matter at how many levels it is used in a product or in many products, has one and only one material record. A material record includes the low-level code, inventory on hand, materials on order, and customer orders for the item. These records are kept up to date by inventory transactions such as receipts, disbursements, scrapped materials, planned orders, and order releases.

Another part of the file includes planning factors that are used by the MRP system These factors include such information as lot sizes, lead times, safety stock levels, and scrap rates.

Some parts, subassemblies. And assemblies are carried as end items supplied to customers as replacement parts These materials may not be a part of the MPS because they are purchased directly form suppliers and placed directly in inventory for customer demand; in other words, they are not produced and so they are not included in the MPS The orders or forecast orders for these materials therefore, are fed directly into the inventory status file that directly becomes a part of the MRP system

The inventory status file not only provides the MRP system with a complete status record for each material in inventory, but the planning factors are also used in the MRP computer program to project delivery dates of orders. Quantities of each material to order and when to place the orders.

The MRP computer program operates this way;

(1) First, with the MPS it begins to determine the number of end items needed is each time period. Time periods are sometimes called buckets in MRP terminology.

(2) Next, the number of service parts not included in the MPS but deduced from customer orders are included as end items.

(3) Next, the MPS and service parts are exploded into gross requirement s for all materials by time period into the future by consulting the bills of material file.

(4) Next, the gross materials requirements are modified by the amount of materials on hand and on order for each period by consulting the inventory status file. The net requirements of each material for each bucket are computed as follows:

Net requirements = Gross Requirements — [Inventory on hand Safety stock — Inventory allocated to other uses]

If the net requirements are greater than zero, orders for the material must be placed.

(5) Finally, the orders are offset to earlier time periods to allow for lead times at each step in the production process and supplier lead times.

2.4 List of Terms

(a) Gross requirements

The total expected demand for an item or raw material during each time period without regard to the amount on hand. For end items, these quantities are shown in the master schedule; for components, these quantities are derived from the planned-order releases of their immediate "parents."

(b) Scheduled receipts

Open orders scheduled to arrive from vendors or elsewhere in the pipeline by the beginning of a period.

(c) Projected on hand

The expected amount of inventory that will be on hand at the beginning of each time period: scheduled receipts plus available inventory from last period.

(d) Net requirements

The actual amount needed in each time period.

(e) Planned-order receipts

The quantity expected to be received by the beginning of the period in which it is shown. Under lot-for-lot ordering, this quantity will equal net requirements. Under lot-size ordering, this quantity may exceed net requirements. Any excess is added to available inventory in the next time period for simplicity, although in reality, it would be available in that period.

(f) Planned-order releases

Indicates a planned amount to order in each time period: equals planned-order receipts offset by lead time. This amount generates gross requirements at the next level in the assembly or production chain. When an order is executed. It is removed from "planned-order releases" and entered under "scheduled receipts."

2.5 Outputs of MRP

The outputs of MRP systems dynamically provide the schedule of materials for the future-amount of each material required in each time period to support the MPS. Two primary outputs result:

(1) Planned order schedule-a plan of the quantity of each material to be ordered in each time period. This schedule is used by purchasing to place orders with suppliers and by production to order parts, subassemblies, or assemblies from upstream production departments. The planned orders become a guide for future production at suppliers and for in-house production schedules.

(2) Changes in planned orders-modification of previous planned orders. Quantities of orders can be changed, orders can be canceled, or the orders can be delayed or advanced to different time periods through the updating process.

2.6 The Secondary MRP Outputs

The secondary MRP outputs provide this information:

(1) Exception reports-reports that flag items requiring management attention in order to provide the right quantity of materials in each time period. Typical exceptions noted are reporting errors, late orders, and excessive scrap.

(2) Performance reports-reports that indicate how well the system is operating. Examples of performance measures utilized are inventory turns, percentage of delivery promises kept, and stock out incidences.

(3) Planning reports-reports to be used in future inventory-planning activities. Examples of such planning information are inventory forecasts, purchase

commitment reports, traces to demand sources (pegging), and long-range material requirements planning.

These are the major elements of MRP- the inputs, the MRP computer program, and the outputs (Gaither 1996).

III. SYSTEM DEVELOPMENT

3.1 Database Management System Concept

Database management system vary in their capabilities, but they **all** have the same basic functions illustrated here. As you read further, you will discover how Microsoft Access handles each of these important functions.

(a) Database management systems let you store and change tables of related data. All the data you enter in Microsoft Access is stored in one or more tables.

(b) A field is a category of information, and a record is all the information relating to a single entity (such as one product).

(c) Queries pull subsets of information form tables. Let's say a table lists your company's products, their dates of introduction, distribution regions, and sales results. A query can locate and show you only those products introduced after 1992, only those products distributed in the Northeast-whatever interests you. You can store a query and reuse it as your table changes to get an updated list instantly.

(d) A report is the best way to print and present your data. Reports include organizational and decorative features that make your data easy for others to understand and appreciate.

(e) A form is an optional way to look at, enter, and change data in a table. While tables force you to examine many records at a time, forms let you concentrate on individual records in a way that is far easier on the eyes.

Microsoft Access is a product-a brand, if you will. Just as there is a variety of similar soft drinks on the market, so there are many database management systems.

While some are excellent, none is plainly superior-although, as with soft drinks, people tend to have their preferences. You may have heard of other database management systems such as paradox and dBASE. These products compete with Microsoft Access for the hearts and dollars of people involved in database management. Are forever beefing up their database management systems with new features and greater speed to win over users.

(1) Microsoft Access is not built into your computer; you buy it and in-stall it. It might seem like Microsoft Access was built into your computer if someone else installed it on the computer's hard disk for you, or if you use a copy that's installed on your office network.

(2) Microsoft Access is based on Microsoft Windows, a program that controls, among other things, the "look" of your computer screen. The Microsoft Access interface (the way you give instructions to it and receive information form it) is similar to that of many other Windows-based programs, including some you may already use.

(3) Microsoft Access is quite well regarded. Many database experts-and ordinary users, too-consider it the finest of the small crop of database management systems for Windows. You'll using a product that earned the respect of the computing community almost immediately upon its introduction.

(4) What makes Microsoft Access such a stand- out? Well, it has of useful Features, plenty of convenient shortcuts, and a stockpile of powerful customization tools for expert uses and programmers. But most users would answer in less tangible terms; "It's easy," or "It feels right." As a beginner,

you're apt to take a quick liking to Microsoft Access not because of what it can do but because you feel comfortable using it.

(5) Microsoft Access is a database management system, and it sports the same basic features as other modern database management systems. Like the others, it helps you store, change, find, and present information. You may have heard about fancy Microsoft Access features such as those that let you place pictures in reports. While impressive, these are not the features most people use frequently (Stone 1994).

3.2 Elements of Database

An Access database consists of six elements.

(1) Tables

Tables are where the actual data-all the basic data objects in an Access database-is stored. All databases must have at least one table. The definition of the table is the starting point for all Access database operations. The number of tables is limited only by the memory capacity of your system.

(2) Queries

Queries are used to extract logical sets of data from one or more of the tables in the database. Queries create database objects that reflect the answer to a logical inquiry. For example, you might create a query to select all of the data related to a particular client or group of clients. Queries do not create more data, and they do not make duplicate copies of existing client records. Rather, they act as selection criteria for drawing information form the tables in the database.

(3) Forms

Forms are used for displaying information on-screen and creating interactions between the user and various types of database objects, such as tables or queries. Forms can be used for data entry and revision. Although most database programs support the creation of screen forms, Access forms have powerful interactive qualities that enable screen forms to perform many functions that would require programming in to her applications.

(4) Reports

Reports are similar to forms because they display database objects in special forms, but they are not used for data entry or revision. The primary function of a report is to produce documents, such invoices, summary reports, or mailing labels.

(5) Macros

Macros are small programs or procedures that can be executed in a variety of ways to automate tasks or provide custom-designed functions. Access macros are not equivalent to the key-stroke macros used by applications, such as Lotus 1-2-3 for DOS, to record and play back interactions between the user and the program's menu and command structure. Access macros are actually program snippets that use many of the same commands and structures as the Access Basic programming language.

(6) Modules

Modules are program modules, and user-defined functions written in the Access Basic language. Access Basic is part of the Windows Basic family that includes Visual Basic and Word Basic. All of these languages share a common command structure with special extensions related to the

applications (word processing or database management). Modules are used when macro program snippets are not powerful enough to handle the desired application.

You do not need to use all of the elements to design and implement a database application. If you have worked with other databases, you may find that Access elements are considerably more powerful than their rough equivalents in other applications. For example, you can build a form with a sharp graphical appearance that can be directly used to print documents without the need to create a printer-oriented report for the same information. Because macros can perform many event-oriented or action-triggered programming functions, writing full program modules is often unnecessary (Krumm 1993).

3.3 Developing Material Requirements Planning Software

3.3.1 Creating a Database

A database is a collection of related tables and other objects. When you start a new database to enter and manage data that does not fit logically in an existing database you must create the new one. The first step to using Access is creating a new database named MPS.

To create the database:

(a) Choose Files New database from the Access menu bar, or press Ctrl + N.

(b) In the File Name text box, type MPS and then choose OK.

(c) So it is an empty Database window titled Database: MPS.

3.3.2 Creating a Table

Tables are the backbone of a database. Forms, queries, and reports rely on a database's underlying tables to do their work. All data in your database, even if entered

through a form, is stored in at least one table. Given the importance of tables, hoe to divide data into table, what information to include in each record of table.

(1) Creating MPS Tables

Now that it is the MPS database, you need to create tables to store data in the steps below:

(a) Click on the Table object button in the database window, and then click on the New button. Or choose File New Table.

(b) Click on New Table in the dialog box that appears next.

(c) Create Tables named:

(1) DETAIL

(2) MATERIAL

(3) PAR CHILD_MAT

(4) PERIOD

(5) RESULT

(2) Defining a Table's Fields

Next you need to define the fields in the tables. Follow these steps, and also glance down at the hint box on the screen for additional information as you go along (You can also press Fl for more information as you follow each step):

(a) Type a field name, up to 64 characters including blank spaces. Make sure the file name starts with a letter or number, and avoid using punctuation marks. You can include spaces in the field name, but you cannot start the name with a space.

(b) Click the Data Type column next to the field name, and select the appropriate data type from the drop-down list.

(c) Optionally, click the Description column, and type a description of the field. This description will appear in the status bar later, when you're entering data.

(d) Optionally, move the cursor down to the Field properties list an set properties for the field.

(e) Repeat steps 1 through 4, putting each field definition on its own row, until defined all the fields in the tables as the figures following:

Table DETAIL has 2 fields; DETAIL ID and DETAIL NAME as follows:

Table 3.1. DETAIL.

DETAIL ID	DETAIL NAME
1	GROSS REQUIREMENT
2	SCHEDULE RECEIPTS
3	PROJECT ON HAND
4	NET REQUIREMENTS
5	PLANNED ORDER RECEIPTS
6	PLANNED ORDER RELEASES
(Auto Number)	

Table MATERIAL has 7 fields: MATERIAL ID, ITEM, LT, LOT SIZE, SCHEDULE PERIOD, SCHEDULE RECEIPTS, and ON HAND as follows:

Table 3.2. MATERIAL.

MATERIAL_ID	ITEM	LT	LOT SIZE	SCHEDULE PERIOD	SCHEDULE RECEIPTS	ON HAND
(Auto Number)						

Table PAR CHILD MAT has 3 fields: PAR ID, CHILD ID, and QUANTITY as follows:

Table 3.3. PAR CHILD___MAT.

PAR ID	CHILD ID	QUANTITY

Table PERIOD has 2 fields: PERIOD ID and PERIOD as follows:

Table 3.4. PERIOD.

PERIOD ID	PERIOD
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
(Auto Number)	

Table RESULT has 5 fields: MATERIAL ID, LLC, DETAIL ID, PERIOD ID and QUANTITY as follows:

Table 3.5. RESULT.

MATERIAL ID	LLC	DETAIL ID	PERIOD_ID	QUANTITY

(3) Defining Data Types

Computers, and Microsoft Access, store different types of information in different formats. So when define the tables without the aid of a Wizard, it need to think about what type of information will be stored in each field.

To define the data type of a field, click in the Data Type column next to the name of the field, then click the drop-down list button. The list shown below will appear, and can select a data type by clicking.

Data type of each field is shown as follows:

Table 3.6. Data Type of Table DETAIL.

Field Name	Data Type	Description
DETAIL ID	Auto Number	
DETAIL NAME	Text	

Table 3.7. Data Type of Table MATERIAL.

Field Name	Data Type	Description
MA TERIAL ID	Auto Number	
ITEM	text	
LT	Number	
LOT SIZE	Number	
SCHEDULE PERIOD	Number	
SCHEDULE RECEIPTS	Number	
ON HAND	Number	

Table 3.8. Data Type of Table PAR CHILD MAT.

Field Name	Data Type	Description
PAR ID	Number	
CHILD ID	Number	
QUANTITY	Number	

Table 3.9. Data Type of Table PERIOD.

Field Name	Data Type	Description
PERIOD ID	Auto Number	
PERIOD	Number	

Table 3.10. Data Type of Table RESULT.

Field Name	Data Type	Description
MATERIAL ID	Number	
LLC	Number	
DETAIL ID	Number	
PERIOD ID	Number	
QUANTITY	Number	

(4) Setting a Primary Key

A primary key is a field in a table that uniquely identifies each record, much as a license plate uniquely identifies each car on the road. When you define a primary key, you tell Access to do three things:

(a) Ensure that no two records in the table have the same value in the field (or fields) that define the primary key.

(b) Keep records sorted (ordered) by the entries in the primary key field.

(c) Speed up processing.

You can use two or more fields to define a primary key. When you do, Access does not consider records to be duplicates unless the contents of all the fields, combined, are identical.

To set a primary key in your table design:

(a) Select the field you want to use as a primary key by clicking the row selector button the left of the field name. Or, if you want to select multiple fields, hold down the Ctrl Key and click the row selector for each field you want.

(b) Click the Set Primary Key button in the toolbar. Or, choose Edits Set Primary key from the menu.

(c) Set the Primary Key on fields:

(1) DETAIL ID in table DETAIL

(2) MATERIAL ID in table MATERIAL

(3) PAR ID and CHILD ID in table PAR CHILD MAT

(4) PERIOD ID in table PERIOD

(5) MATERIAL ID, DETAIL ID, and PERIOD ID in table RESULT

3.3.3 Creating a Form

Forms are Access objects that display information on the screen or the printer. Essentially, forms are designed to display the information contained in one record at a time, from a table or query dynaset. Forms, unlike such other Access objects as

table/query datasheets or reports, are fundamentally free form. Forms in Access are flexible objects that can have many special windows elements, such as drop down lists, check boxes, and command buttons. Although forms are often used for data entry and display, they are flexible enough to create forms that function as menus or user-defined dialog boxes.

To create a new form with Wizards:

(1) Start from any of the places listed below:

(a) If you know which table you want to base your form on, start from the database window, click the Table object button, and highlight the table name. Or open the table in datasheet or design view.

(b) If you know which query you want to base your form on, start from the database window, click the Query object button, and highlight the query name. Or open the query in datasheet or design view.

(c) If you're not sure which table or query you want to base the form on, start anywhere in Access (of course, a database must be open).

This step, it need Table MATERIAL for create MATERIAL INFORMATION, Table PAR CHILD MAT for create PRODUCT STRUCTURE form, and Query QPERIOD for ORDER form.

(2) Click the toolbar's New Foini button (at left) or choose File New Form.

(3) In the Select A Table/Query drop-down list, select the table or query as shown in (1).

(4) Click the Form Wizards button.

(5) When asked which Wizard you want, double-click o

record as a row of fields, with labels at the top of the cc

(6) In the dialog boxes that appear next, respond to the questions and click the Next button.

(7) In the last Form Wizard dialog box, accept the suggested title (or change it if you wish), select Open The Form With Data In It, verify that Open Cue Cards... is not selected, and click Finish.

(8) Access will create forms and display it in forms view. It can be arranged and adjusted in design view.

(9) Create Command buttons by using toolbox Wizard in design view on each form as follows:

(a) Create Add Record, Delete Record, Save Record, and Close Form buttons on MATERIAL INFORMATION form.

(b) Create Add Record, Delete Record, Save Record and Close Form buttons on PRODUCT STRUCTURE form.

(c) Create Save and Close Form buttons on ORDER form.

(10) Create the On Click Event Procedure in design view as follows:

(a) Create the On Click Event Procedure at Save Record button on MATERIAL INFORMATION form as shown in Appendix A.

(b) Create the On Click Even Procedure at Save button on ORDER form as shown in Appendix B.

3.3.4 Creating a Report

Report, to produce appealing, easy-to-read printouts of Microsoft Access data A report is like template or framework into which Microsoft Access plugs the data from a table or dynaset. The template can feature a wide array of special effects, including a variety of fonts (type styles), type sizes, text attributes such as italics, and even

graphics. Presenting data in a well-designed report is a great strategy for bolstering message or softening the blow of bad news.

The procedures for creating a report with Wizards depend on the type of report you choose, but these are the basic steps:

(1) Start from any of the places listed below:

(a) If you know which table you want to base your report on, start from the database window, click the Table object button, and highlight the table name. Or open the table in datasheet or design view.

(b) If you know which query you want to base your report on, start from the database window, click the Query object button, and highlight the query name. Or open the query in datasheet or design view.

(c) If you're not sure which table or query you want to base the report on, start anywhere in Access (of course, a database must be open).

This step, it need Query Q_REPORT for create PLANNED ORDER REPORT, and Query CROSSTAB1 for create CROSSTAB1 report.

(2) Click the toolbar's New Report button (at left) or choose File New) Form.

(3) In the Select A Table/Query drop-down list, select the query as shown in (1).

(4) Click the Form Wizards button.

(5) When asked which Wizard you want, double-click on Tabular (Shows each record as a row of fields, with labels at the top of the column).

(6) In the dialog boxes that appear next, respond to the questions and click the Next button.

(7) Most Wizards display a final dialog box. You can accept the suggested settings (or change them as needed); then select see the Report with data in it and click Finish.

(8) Access will create report and display it in print preview. The report can be arranged and adjusted in design view.

IV. SYSTEM EVALUATION

4.1 Verification and Validation

Verification is also intended to find errors. It is performed by executing a program in a simulated environment. Validation refers to the process of using software in a live environment in order to find errors.

When commercial systems are developed with the explicit intention of distributing them to dealers for sale or marketing them through company owned field offices, they first go through verification, sometimes called alpha testing. The feedback from the validation phase generally produces changes in the software to deal with errors and failures that are uncovered. Then a set of user sites is selected that put the system into use on a live basis. These beta test sites use the system in day-to-day activities; They process live transactions and produce normal system output. The system is live in every sense of the word, except that the users are aware they are using a system that can fail. But the transactions that are entered and the persons using the system are real.

Validation may continue for several months. During the course of validating the system, failure may occur and the software will be changed. Continued use may produce additional failures and the need for still more changes.

4.2 Testing Strategies

We have already indicated that the philosophy behind testing is to find errors. Test cases are devised with this purpose in mind. A test case is a set of data that the system will process as normal input. However, the data is created with the express intent of determining whether the system will process it correctly. For example, test cases for inventory handling should include situations where the quantities to be withdrawn from

inventory exceed, equal, and are less than the actual quantities on hand. Each test case is designed with the intent of finding errors in the way the system will process it.

There are two general strategies for testing software, the strategies of code testing and specification testing. This section we employ the specification testing.

To perform specification testing, the specifications stating what the program should do and how it should perform under various conditions. Then test cases are developed for each condition or combination of conditions and submitted for processing. By examining the results, it can determine whether the program performs according to its specified requirements.

Neither testing strategy is ideal. However, specification testing is a better strategy since it focuses on the way software is expected to be used. It also shows once again how important the specifications developed.

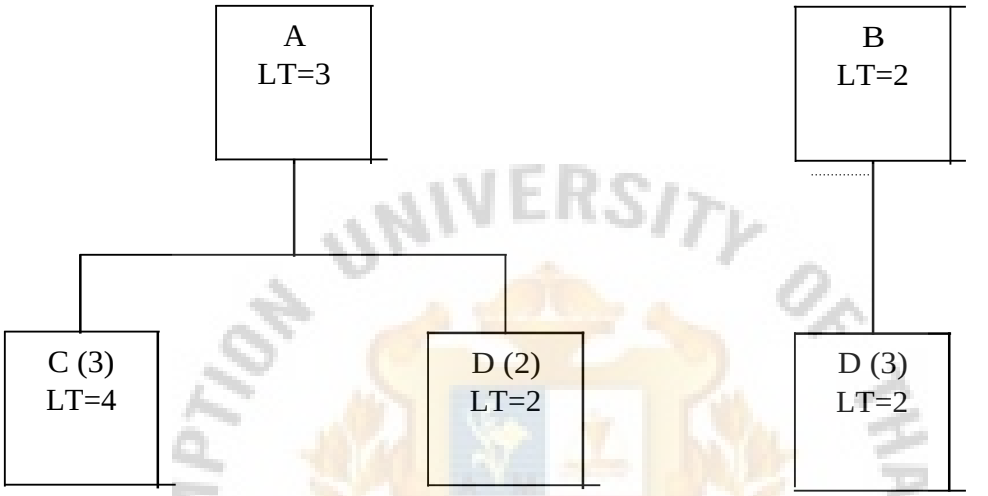
4.3 Software Evaluation

To evaluate the Material Requirements Planning (MRP) software, we must apply verification, validation, and testing strategy to make sure that the Material Requirements Planning (MRP) software meets the specifications and objectives of the software.

Therefore, the most interested approach to evaluate the Material Requirements Planning (MRP) software is the comparison of the results between using the MRP matrices and applying the software by using the same test case.

The test cases were taken from many textbooks and lecture sheet in Production and Operation Management class, because it is easy way to compare the results.

Test case **1:** AAA Co., Ltd. manufactures two products, namely Product A and Product B. Raw materials C and D are used for Product A whereas only raw material D is needed for Product B. The product structure, master scheduling requirements, and inventory information are provided as follows:



Product	On Hand	Scheduled Receipts	Lot Size	MPS
A	10	0	1	100, PERIOD 8
B	5	0	1	200, PERIOD 6
C	140	0	150	
D	200	250, PERIOD 2	250	

Solve the problem using the MRP matrices below:

Item A: First, we fill in the gross requirements for A, 100 units in period 8. Since A is an end item, we read this information from the master production schedule. In the projected on hand row, we begin with 10 units of A in inventory and continue with 10 units on hand until we need to use them. At the end of period 7, we havel0 units of A in inventory. We need 100 A's in period 8. We can use the 10 A's we have on hand and

make 90 more. The subtraction of the on hand quantity from the gross requirements is called netting. The net requirement of 90 A's is the gross requirement net of inventory. It appears in the same time period as the gross requirement. There is no lot-sizing requirement (A's are ordered in multiples of 1), so the planned order receipts are the same as the net requirements.

If we need to receive 90 A's by period 8 and it takes 3 periods to make A, we need to release an order for A in period 5. Thus, the quantity of 90 appears in period 5 of the planned order release row. This process of subtracting the lead time from the due date is called lead time offsetting, or time phasing, of requirements. The planned order release row is the result, or output, of the MRP calculations for item A. Only the entries in the final row of each matrix will be used in subsequent MRP calculations for component items.

Item: A	PD								
Lot Size: I I,T:3									
Gross requirements									100
Scheduled receipts									
Projected on hand	10	10	10	10	10	10	10	10	
Net requirements									90
Planned order receipts									90
Planned order releases						90			

Item B: Item B's matrix is completed in the same fashion as item A's. The gross requirement of 200 B's in period 6 is given in the master production schedule. Since there are 5 units of B on hand, the net requirement for B is 195 in period 5. There are no scheduled receipts for B and no lot-sizing requirements. If 195 B's are needed in period

5 and it takes 2 weeks to make B's, we need to release an order to begin production of B's in period 4.

Item: B LLC:0 Pb⁻							7	8
Lit "Size: 1 LT:2								
Gross requirements							200	
Scheduled receipts								
Projected on hand	5	5	5	5	5	5		
Net requirements							195	
Planned order receipts							195	
Planned order releases					195			

Item C: For all level 1 items, we need to calculate the gross requirements by multiplying the quantity per assembly given in parentheses on the product structure diagram times the planned order release (POR) of the parent item. This multiplication process is called explosion.

An order for 90 A's is set to be released in period 5. Three C's are needed for every A, so we place a gross requirement for 270 C's in period 5. We have 140 C's in inventory. They remain in inventory until period5, when we use them to satisfy partially the demand for C's. The net requirement for C is thus 130 units. But instead of ordering the net requirement of 130, we order the lot-sizing quantity of 150. If 130 C's need to be received by period 5 and it takes 4 weeks to make C's, we need to release the order for C in period 1. The 150 C's will arrive in period 5. We **will** use 130 of them to meet A's demand for C's. The remaining 20 units will be placed into inventory.

Item: C •1.1„;C: Lot Size: 150 LT 4	PD								
Gross requirements						270			
Scheduled receipts									
Projected on hand	140	140	140	140	140	20	20	20	20
Net requirements						130			
Planned order receipts						150			
Planned order releases		150							

Item D: Item D has two parents, A and B. We need to gather all the gross requirements for D first before completing the rest of the matrix. Item A has a planned order release of 90 units in period 5. Two D's are required for every A, so (90 * 2) = 180 D's need to be available by period 5. D's other parent, item B, has a planned order release of 195 units scheduled in period 4. Every B requires three D's, so (195 * 3) = 585 D's are also needed by period 4.

We have 200 D's on hand at the end of period 1. An order of 250 D's is scheduled to be received in period 2. By the end of period 2, we project that (200 + 250) = 450 D's will be on hand. We plan to use those 450 D's to fill partially the first gross requirement entry, leaving a net requirement of (585 — 450) = 135 D's in period 4. Since D's are ordered in lots of 250, even though we need only 135 D's, we will place an order for 250. It takes 2 weeks to make D's. Since they are needed in period 4, we will plan to release the order in period 2. When the order arrives, 135 D's will go toward making B's, and the remaining (250 — 135) = 115 will be placed into inventory.

The 115 D's projected to be on hand by the end of period 4 can be used to satisfy partially the gross requirement for 180 D's in period5, leaving a net requirement of (180 — 115) = 65 D's. Because of lot-sizing requirements, we will order 250 D's. Item D has a lead time of two periods. If we need to receive D's by period 5, we need to release an

order for D in period 3. We plan the order release for 250 and project that (250 — 65) = 185 units will be left over and placed into inventory at the end of period 5.

Item: I)	LLC:	PT)								
Lot Size: 250										
Gross requirements						585	180			
Scheduled receipts				250						
Projected on hand		200	200	450	450	115	185	185	185	185
Net requirements						135	65			
Planned order receipts						135	65			
Planned order releases				250	250					

Now we have completed the MRP calculations. To summarize the results, we construct a planned order report from the planned order release row of each matrix, as follows:

Period	**Item**	**uantity**
1	C	150
2	D	250
3	D	250
4	B	195
5	A	90

Solve the problem by applying the Material Requirements Planning (MRP) software below:

1. Start Microsoft Access.
2. Choose File **D** Open Database.
3. Choose AAMPS to open the Material Requirements Planning (MRP) software.
4. Click the Forms object button.

5. Select MATERIAL and click Open to open the MATERIAL INFORMATION form.

6. Enter material information; ITEM, LT, LOT SIZE, SCHEDULE PERIOD, SCHEDULE RECEIPTS, and ON HAND as follows:

   (6.1) ITEM: A, LT: 3, LOT ST7E: 1, SCHEDULE PERIOD: skip, SCHEDULE RECEIPTS: skip, and ON HAND: 10.

   (6.2) ITEM: B, LT: 2, LOT SIZE: 1, SCHEDULE PERIOD: skip, SCHEDULE RECEIPTS: skip, and ON HAND: 5.

   (6.3) ITEM: C, LT: 4, LOT SIZE: 150, SCHEDULE PERIOD: skip, SCHEDULE RECEIPTS: skip, and ON HAND: 140.

   (6.4) ITEM: D, LT: 2, LOT ST7E: 250, SCHEDULE PERIOD: 2, SCHEDULE RECEIPTS: 250, and ON HAND: 200.

7. Click save record button and then click close form.

8. Select PAR CHILD MAT and click Open to open the PRODUCT STRUCTURE form.

9. Enter product structure; PAR_ID and CHILD JD from combo box and QUANTITY as follows:

   (9.1) PAR ID: A, CHILD ID: C, and QUANTITY: 3.

   (9.2) PAR_ID: A, CHILD JD: D, and QUANTITY: 2.

   (9.3) B, D, and QUANTITY: 3.

10. Click save record button and then click close form.

11. Select ORDER and click Open to open ORDER form.

12. Enter order as the MPS:

    (12.1) ITEM: A, QUANTITY: 100, PERIOD: 8, and click save.

(12.2) ITEM: B, QUANTITY: 200, PERIOD: 6, click save and then click close form.

13. Click the Reports object button.

14. Select PLANNED ORDER REPORT and CROSSTAB1 to see the result.

By the comparison of the results from using the MRP matrices and applying Material Requirements Planning (MRP) software, the results are the same.

MATERIAL INFORMATION

ITEM	LT	LOT SIZE	SCHEDULE PERIOD	SCHEDULE RECEIPTS	ON HAND
A	3	1			10
B	2	1			5
C	4	150			140
D	2	250	2	250	200

Material Information Form of Test Case 1.

PRODUCT STRUCTURE

PAR_ID	CHILD_ID	QUANTITY
A	C	3
A	D	2
B	D	3

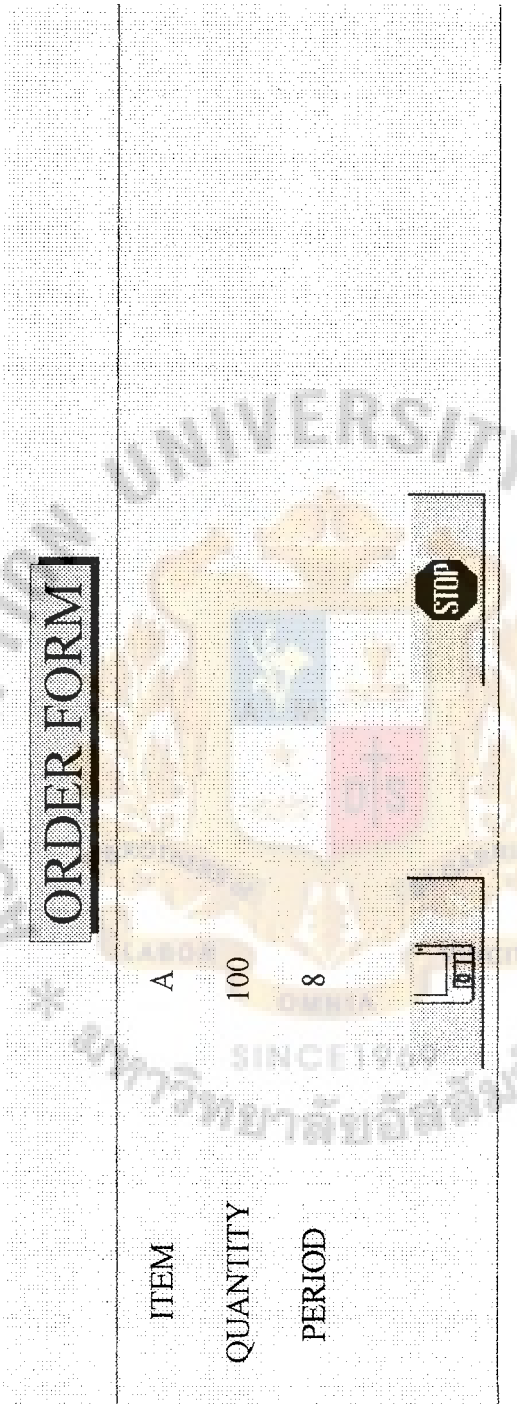
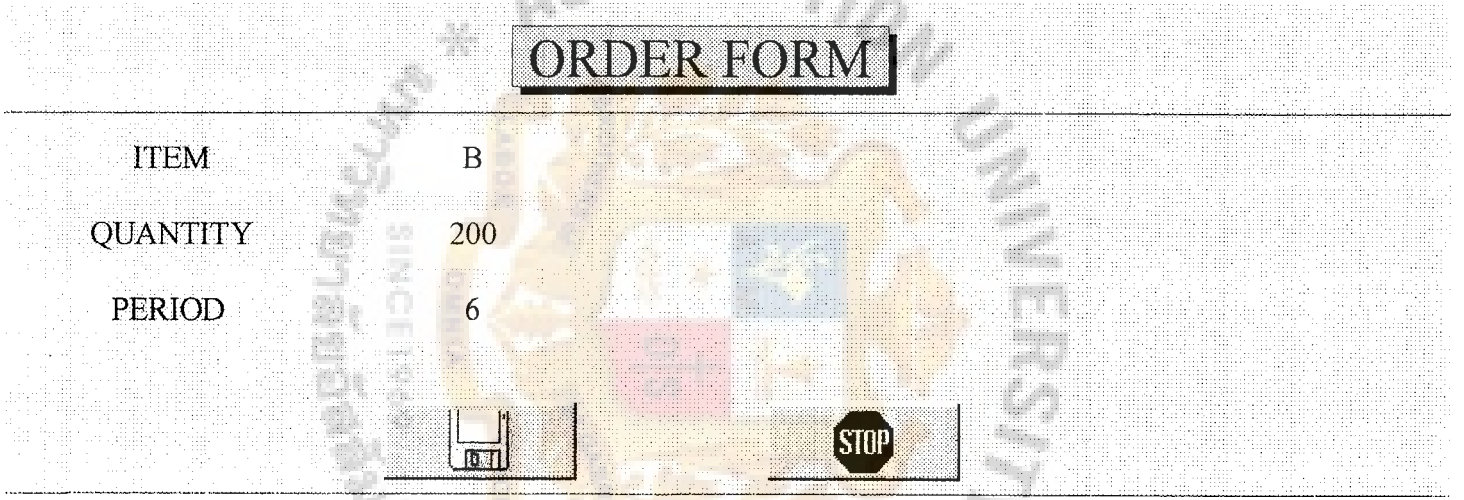


Figure 4.3. Order Form of Test Case 1.

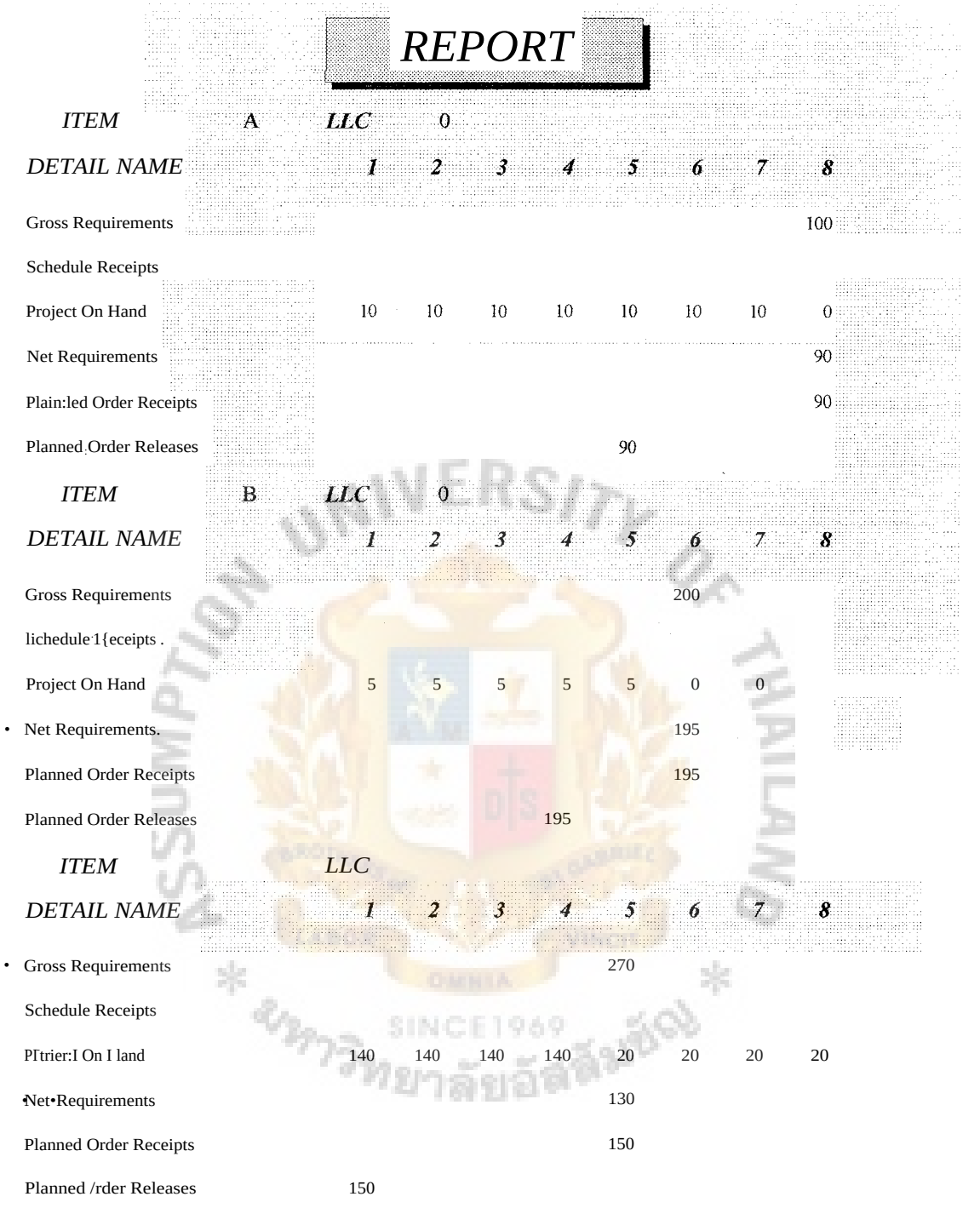


Order Form of Test Case 1.

PLANNED ORDER REPORT

PERIOD	ITEM	QUANTITY
1	C	150
2	D	250
3	D	250
4	B	195
5	A	90

Figure 4.5. Planned Order Report of Test Case 1.



REPORT

ITEM	A	LLC	0							
DETAIL NAME			1	2	3	4	5	6	7	8
Gross Requirements										100
Schedule Receipts										
Project On Hand			10	10	10	10	10	10	10	0
Net Requirements										90
Plain:led Order Receipts										90
Planned Order Releases							90			

ITEM	B	LLC	0							
DETAIL NAME			1	2	3	4	5	6	7	8
Gross Requirements								200		
lichedule 1{eceipts .										
Project On Hand			5	5	5	5	5	0	0	
• Net Requirements.								195		
Planned Order Receipts								195		
Planned Order Releases						195				

ITEM		LLC								
DETAIL NAME			1	2	3	4	5	6	7	8
• Gross Requirements							270			
Schedule Receipts										
PΓtrier:I On I land			140	140	140	140	20	20	20	20
•Net•Requirements							130			
Planned Order Receipts							150			
Planned /rder Releases			150							

Figure 4.6. Report of Test Case 1.

ITEM'	*LLC*	1						
DETAIL NAME	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
(;Toss Requirements				585	180			
Schedule Receipts.		250						
Pi eject On Hand	200	450	450	115	185	185	185	185
Net Requirements				135	65			
Planned Order Receipts				250	250			
Planned Order Releases		250	250					

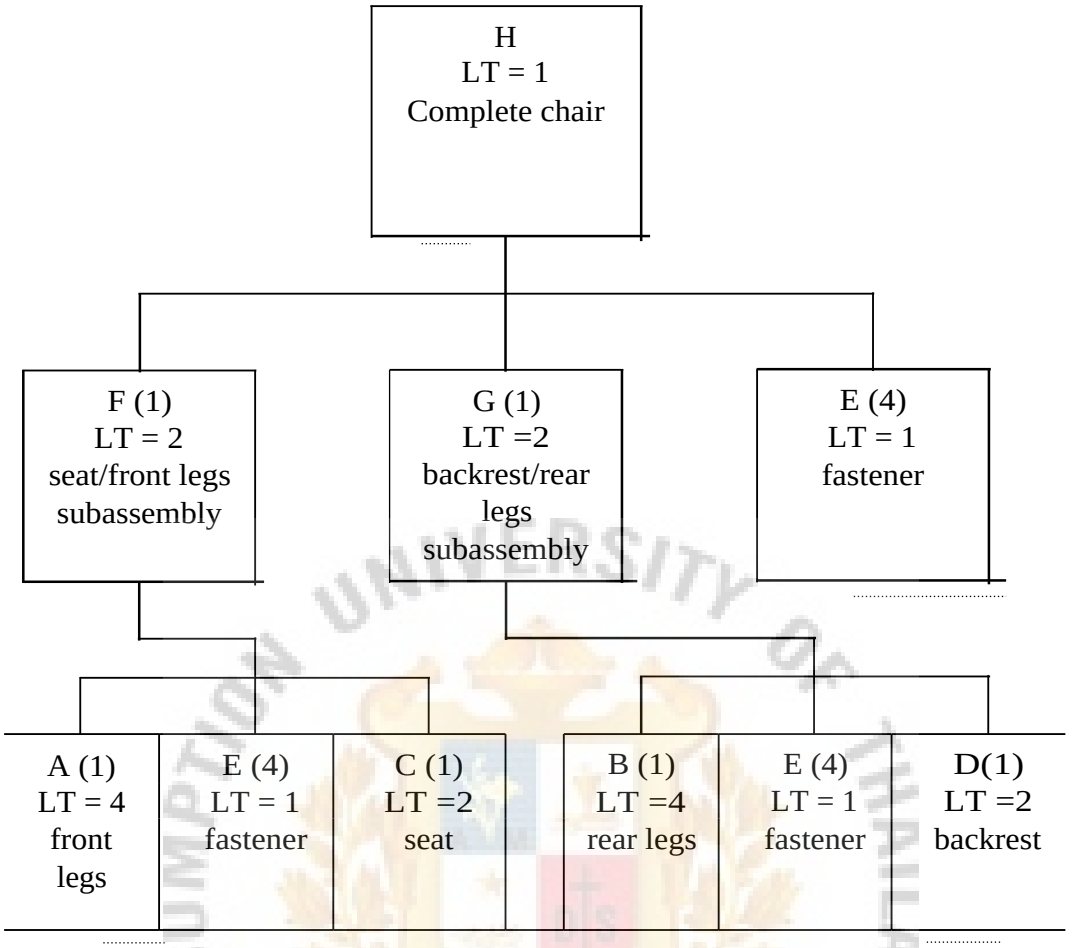
Figure 4.6. Report of Test Case 1. (Continued)

Test case 2: Consider a company that makes kitchen chairs. Their simplest chair, model H, requires two subassemblies F and G, one for the seat and the front legs and another for the backrest and rear legs. To assemble the seat to the front legs, a worker needs four fasteners. Similarly, to assemble the backrest to the rear legs, a worker needs four more fasteners. The two subassemblies are then attached to each other with four more fasteners. When the two subassemblies are combined, the chair is complete.

The product structure tree and component information including item identification, requirements for one parent item, lead time, and description. Each item in the product structure is categorized by a level code. The complete chair, item H, is the high-level item (level 0). Level 1 items are those whose parent is item H; these include items E, F, and G. Items A, B, C, D, and E are the individual components in level 2. Finally the lowest level (level 3) items are raw materials (RM) for the level 2 items.

The material requirements plan show the shipping 500 chairs in week 8, and shipping 50 units each of items A and D in week 3 for replacing and repairing chairs in the field (raw materials have been omitted from the table).

Without concerning ourselves with how this plan was developed, for the moment, let's concentrate on the information currently available for each item. We see that 100 units of H (finished chairs) are on hand prior to week 1. However, we need a safety stock of 50 units for unexpected demand. Thus, the net available for meeting the requirement of 500 units in week 8 is 50. Similarly, 200 units of G are on hand, but 30 units are for safety stock and 60 units were previously allocated to other job orders. Therefore, 110 units are currently available. For component A, there is a previous order (scheduled receipt) for 50 units that will be received in week 3 (Adam and Ebert 1992).



Item ID	Low level code	Lead time (weeks)	On hand	Safety stock	Allocated
H	0	1	100	50	0
G	1	2	200	30	60
F	1	2	52	30	20
A	2	4	50	20	30
C	2	2	60	20	30
B	2	4	150	20	30
D	2	2	52	200	30
E	2	1	500	300	150

Solve the problem using the MRP matrices, the way to calculate the results by using The MRP matrices of ***Test case 2*** is the same fashion as ***Test case 1***.

Item H: The gross requirement of 500 H's in period 8 is given in the master production schedule. Since there are 50 units of H on hand, the net requirement for B is 450 in period 5. There are no scheduled receipts for B and no lot-sizing requirements. If 450 H's are needed in period 8 and it takes 1 week to make H's, we need to release an order to begin production of B's in period7.

Item H	Week	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
Gross requirements								500
Scheduled receipts								
Available	50	50	50	50	50	50	50	0
Net requirements								450
Planned order receipts								450
Planned order releases							450	

Item G: An order for 450 H's is set to be released in period 7. One G's is needed for every H, so we place a gross requirement for 450 G's in period 7. We have 110 G's in inventory. They remain in inventory until period7, when we use them to satisfy partially the demand for G's. The net requirement for G is thus 340 units. Ordering the net requirement of 340. If 340 G's need to be received by period 7 and it takes 2 weeks to make G's, we need to release the order for G in period 5. The 340 G's will arrive in period 7. We will use all of them to meet H's demand for G's.

Item G	Week	Week 2	Week 3	4	Week 5	Week ... 6	Week 7	Week 8
Gross requirements							450	
Scheduled receipts								
Available	110	110	110	110	110	110	0	
Net requirements							340	
Planned order receipts							340	
Planned order releases					340			

Item F: An order for 450 H's is set to be released in period 7. One F's is needed for every H, so we place a gross requirement for 450 F's in period 7. We have 2 F's in inventory. They remain in inventory until period7, when we use them to satisfy partially the demand for H's. The net requirement for H is thus 448 units. Ordering the net requirement of 448. If 448 F's need to be received by period 7 and it takes 2 weeks to make F's, we need to release the order for F in period 5. The 448 F's will arrive in period 7. We will use all of them to meet H's demand for F's.

Item F	Week 1	Week	Week	4	Week	Week	Week 7	Week 8
Gross requirements							450	
Scheduled receipts								
Available	2	2	2	2	2	2	0	
Net requirements							448	
Planned order receipts							448	
Planned order releases					448			

Item A: An order for 50 A's is needed for replacing and repairing chairs in period 3 and an order for 448 F's is set to be released in period 5. One A's is needed for every F, so we place a gross requirement for 50 A's in period 3 and 448 A's in period 5. We have no A's in inventory. An order of 50 A's is scheduled to be received in period 3 and we

use them to satisfy the demand for replacing and repairing chairs. The net requirement for A is thus 448 units. Ordering the net requirement of 448. If 448 A's need to be received by period 5 and it takes 4 weeks to make A's, we need to release the order for A in period 1. The 448 A's will arrive in period 5. We will use all of them to meet F's demand for A's.

Item A	Week 1	Week 2	Week 3	Week 4	Week 5,	Week 6	Week 7	Week 8
Gross requirements			50		448			
Scheduled receipts			50					
Available	0	0	0	0	0			
Net requirements			0		448			
Planned order receipts					448			
Planned order releases	448							

Item C: An order for 448 F's is set to be released in period 5. One C's is needed for every F, so we place a gross requirement for 448 C's in period 5. We have 10 C's in inventory. They remain in inventory until period 5, when we use them to satisfy partially the demand for F's. The net requirement for C is thus 438 units. Ordering the net requirement of 438. If 438 C's need to be received by period 5 and it takes 2 weeks to make C's, we need to release the order for C in period 3. The 438 F's will arrive in period 5. We will use all of them to meet F's demand for C's.

Item C	Week 1	Week 2		Week 4	Week 5		Week 7	Week 8
Gross requirements					448			
Scheduled receipts								
Available	10	10	10	10	0			
Net requirements					438			
Planned order receipts					438			
Planned order releases			438					

Item B: An order for 340 G's is set to be released in period 5. One B's is needed for every G, so we place a gross requirement for 340 B's in period 5. We have 100 B's in inventory. They remain in inventory until period 5, when we use them to satisfy partially the demand for G's. The net requirement for B is thus 240 units. Ordering the net requirement of 240. If 240 B's need to be received by period 5 and it takes 4 weeks to make B's, we need to release the order for B in period 1. The 240 B's will arrive in period 5. We will use all of them to meet G's demand for B's.

Item B	Week. 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
Gross requirements				340			
Scheduled receipts							
Available	100	100	100	0			
Net requirements				240			
Planned order receipts				240			
Planned order releases	240						

Item D: An order for 50 D's is needed for replacing and repairing chairs in period 3 and an order for 340 G's is set to be released in period 5. One D's is needed for every G, so we place a gross requirement for 50 D's in period 3 and 340 D's in period 5. We have 2 D's in inventory. They remain in inventory until period 5, when we use them to satisfy

partially the demand for G's. The net requirement for D is thus 48 units in period 3 and 340 D's in period 5. Ordering the net requirement of 48 and 340 units. If 48 D's need to be received by period 3 and it takes 2 weeks to make D's, we need to release the order for D in period 1. The 48 D's will arrive in period 3, and 340 D's need to be received by period 5, we need to release the order for D in period 3. The 340 D's will arrive in period 5. We will use all of them to meet G's demand for D's.

Item D	Week 1	Week	Week	Week	Week	Week 6	Week 7	Week 8
Gross requirements			50		340			
Scheduled receipts								
Available	2	2	0		0			
Net requirements			48		340			
Planned order receipts			48		340			
Planned order releases	48		340					

Item E: Item E has three parents; H, F, and G. We need to gather all the gross requirements for E first before completing the rest of the matrix. Four E's are required for every H, F, and G, so (450 * 4) = 1800 E's need to be available by period 7 and [(340 * 4) + (448 * 4)] = 3152 E's need to be available by period 5.

We have 50 E's on hand. They remain in inventory until period 5, when we use them to satisfy partially the demand for G's and F's. The net requirement for E is thus 3102 units in period 5 and 1800 E's in period 7. Ordering the net requirement of 3102 and 1800 units. If 3102 E's need to be received by period 5 and it takes 1 week to make E's, we need to release the order for E in period 4. The 3102 E's will arrive in period 5, and 1800 E's need to be received by period 7, we need to release the order for E in period 6. The 1800 E's will arrive in period 7. We will use all of them to meet H's, F's, and G's demand for E's.

Item E	Week 1	Week 2	Week	Week 4i	Week 5	Week 6	Week 7	Week 8
Gross requirements					3152		1800	
Scheduled receipts								
Available	50	50	50	0	0	0	0	
Net requirements					3102		1800	
Planned order receipts					3102		1800	
Planned order releases				3102		1800		

Solve the problem by applying the Material Requirements Planning (MRP) software as the same fashion as *Test case I.*

1. Start Microsoft Access.
2. Choose File P Open Database.
3. Choose AAMPS to open the Material Requirements Planning (MRP) software.
4. Click the Forms object button.
5. Select MATERIAL and click Open to open the MATERIAL INFORMATION form.
6. Enter material information; ITEM, LT, LOT SIZE, SCHEDULE PERIOD, SCHEDULE RECEIPTS, and ON HAND as follows:

   (6.1) ITEM: H, LT: 1, LOT ST7E: 1, SCHEDULE PERIOD: skip, SCHEDULE RECEIPTS: skip, and ON HAND: 50.

   (6.2) ITEM: G, LT: 2, LOT SUE: 1, SCHEDULE PERIOD: skip, SCHEDULE RECEIPTS: skip, and ON HAND: 110.

   (6.3) ITEM: F, LT: 2, LOT SIZE: 1, SCHEDULE PERIOD: skip, SCHEDULE RECEIPTS: skip, and ON HAND: 2.

   (6.4) ITEM: A, LT: 4, LOT SIZE: 1, SCHEDULE PERIOD: 3, SCHEDULE RECEIPTS: 50, and ON HAND: 0.

(6.5) ITEM: C, LT: 2, LOT SIZE: 1, SCHEDULE PERIOD: skip, SCHEDULE RECEIPTS: skip, and ON HAND: 10.

(6.6) ITEM: B, LT: 4, LOT SIZE: 1, SCHEDULE PERIOD: skip, SCHEDULE RECEIPTS: skip, and ON HAND: 100.

(6.7) ITEM: D, LT: 2, LOT SIZE: 1, SCHEDULE PERIOD: 3, SCHEDULE RECEIPTS: 50, and ON HAND: 2.

(6.8) ITEM: E, LT: 1, LOT SIZE: 1, SCHEDULE PERIOD: skip, SCHEDULE RECEIPTS: skip, and ON HAND: 50.

7. Click save record button and then click close form.

8. Select PAR CHILD MAT and click Open to open the PRODUCT STRUCTURE form.

9. Enter product structure; PAR ID and CHILD ID from combo box and QUANTITY as follows:

(9.1) PAR ID: H, CHILD_ID: F, and QUANTITY: 1.

(9.2) PAR ID: H, CHILD_ID: G, and QUANTITY: 1.

(9.3) PAR ID: H, CHILD_ID: E, and QUANTITY: 4.

(9.4) PAR ID: F, CHILD_ID: A, and QUANTITY: 1.

(9.5) PAR_ID: F, CHILD_ID: E, and QUANTITY: 4.

(9.6) PAR_ID: F, CHILD_ID: C, and QUANTITY: 1.

(9.7) PAR_ID: G, CHILD_ID: B, and QUANTITY: 1.

(9.8) PAR_ID: G, CHILD_ID: E, and QUANTITY: 4.

(9.9) PAR_ID: G, CHILD_ID: D, and QUANTITY: 1.

10. Click save record button and then click close form.

11. Select ORDER and click Open to open ORDER form.

12. Enter order as the MPS:

(12.1) ITEM: H, QUANTITY: 500, PERIOD: 8, and click save.

(12.2) ITEM: A, QUANTITY: 50, PERIOD: 3, and click save.

(12.3) ITEM: D, QUANTITY: 50, PERIOD: 3, click save and then click close form.

13. Click the Reports object button.

14. Select PLANNED ORDER REPORT and CROSSTAB1 to see the result

By the comparison of the results from using the MRP matrices and applying Material Requirements Planning (MRP) software, the results are the same.

MATERIAL INFORMATION

ITEM	LT	LOT SIZE	SCHEDULE PERIOD	SCHEDULE RECEIPTS	ON HAND
A	4	1	3	50	0
B	4	1			100
C	2	1			10
D	2	1			2
E	1	1			50
F	2	1			2
G	2	1			110
H	1	1			50




Material Information Form of Test Case 2,

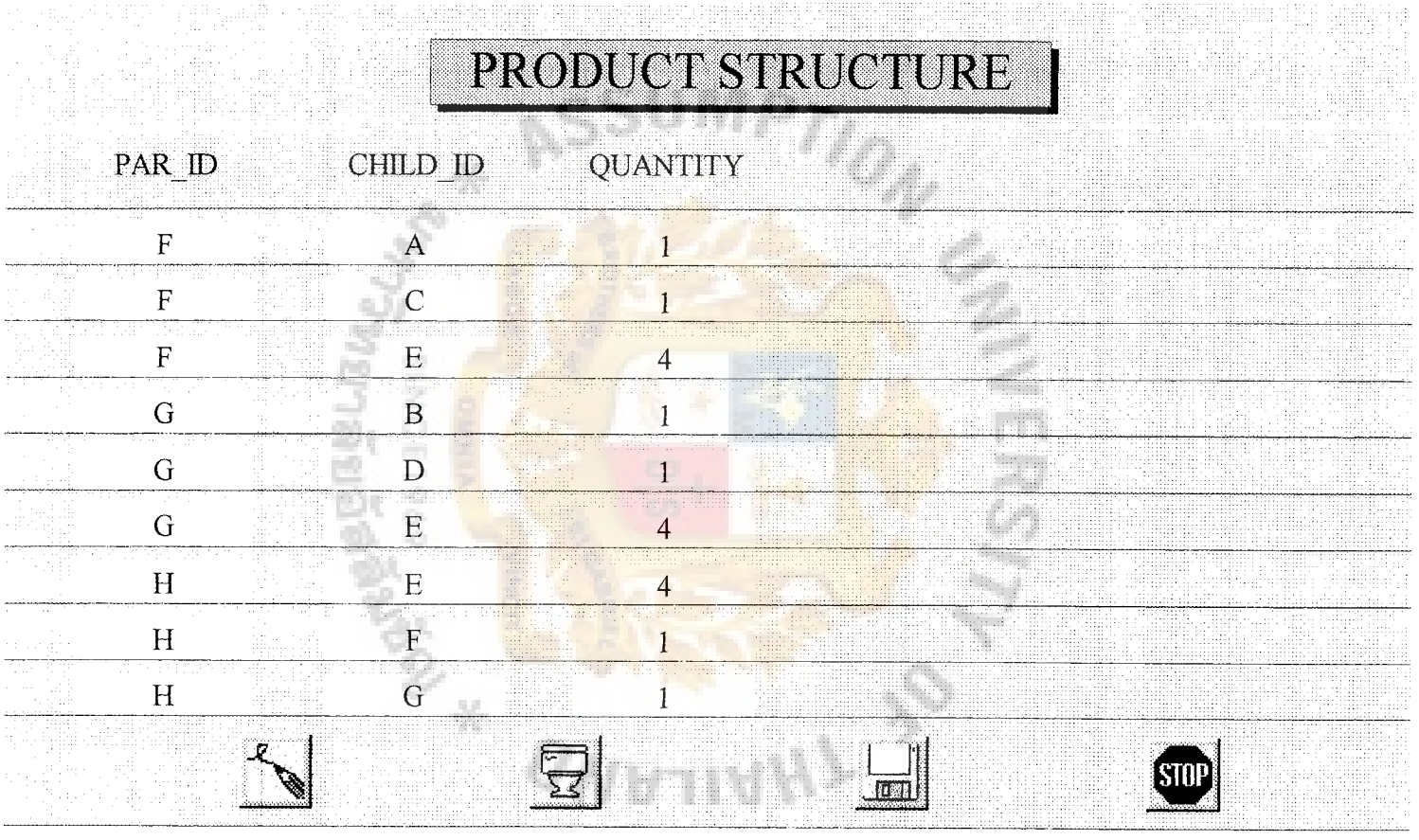
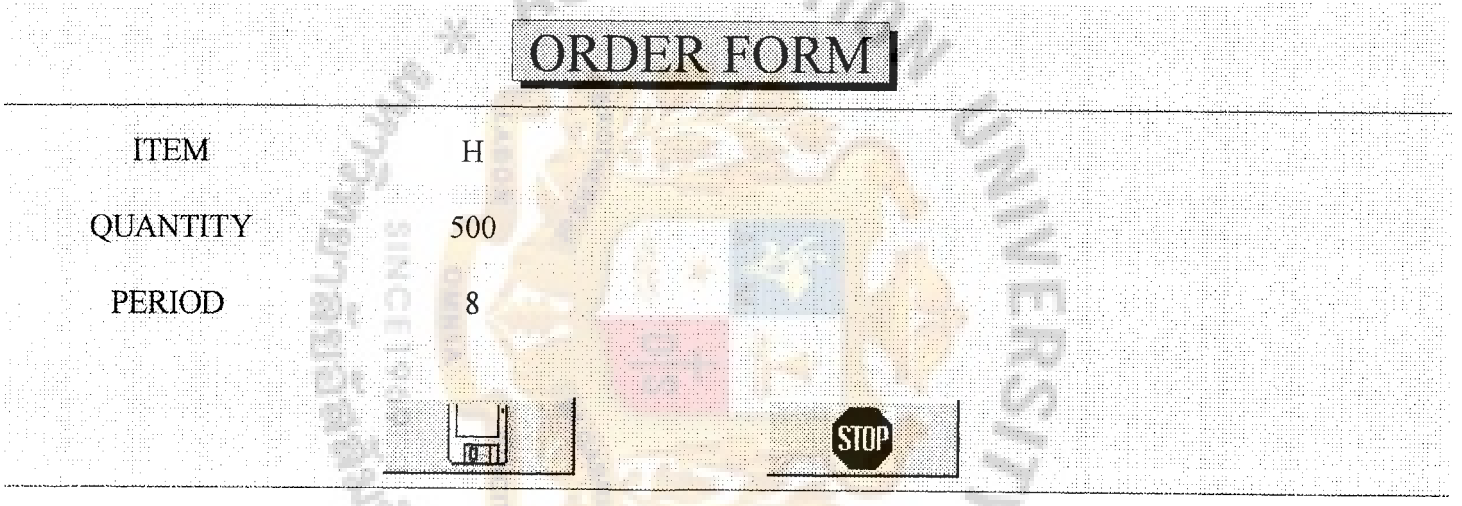


Figure 4.8. Product Structure Form of Test Case 2.



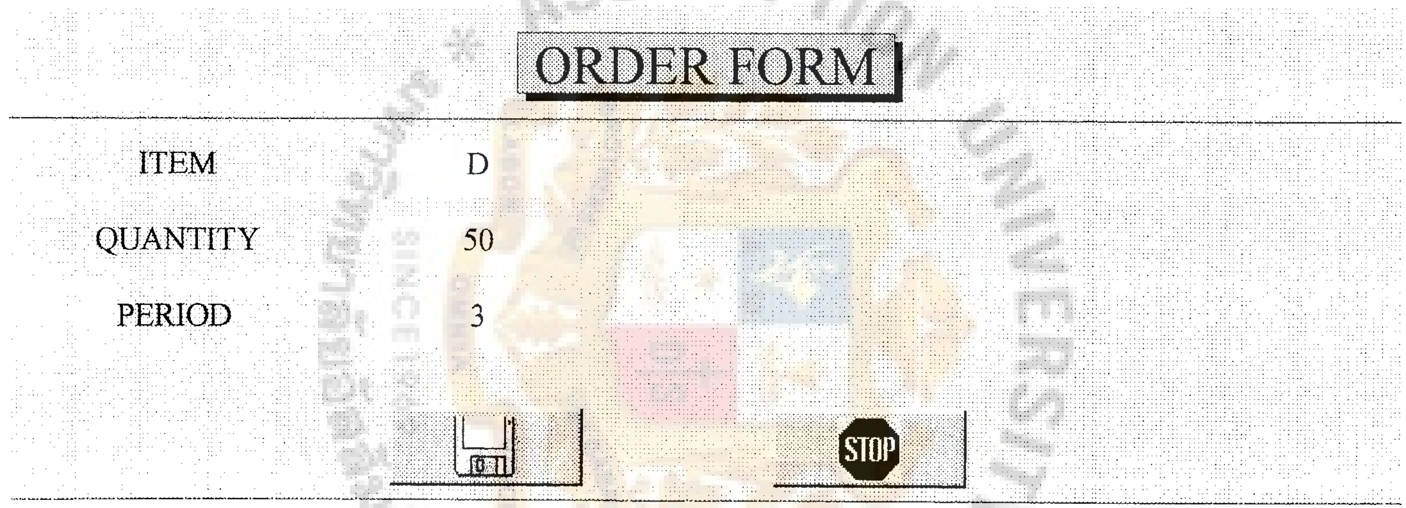
Order Form of Test Case 2.

ORDER FORM

ITEM	A
QUANTITY	50
PERIOD	3

STOP

2. Case t f Tes n r Fo der Or bn

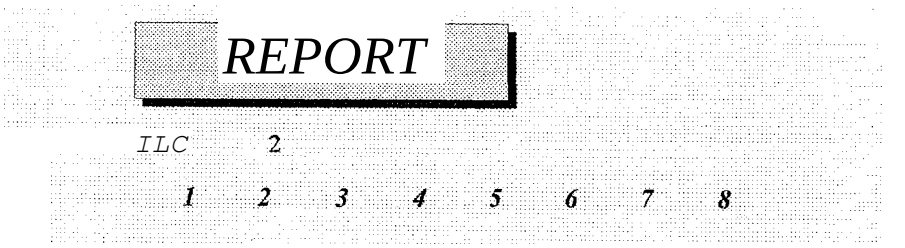


2. Case t f Tes n For de Or aA 4

PLANNED ORDER REPORT

PERIOD	ITEM	QUANTITY
1	D	48
1	B	240
1	A	448
3	D	340
3	C	438
4	E	3102
5	G	340
5	F	448
6	E	1800
7	H	450

Figure 4.12. Planned Order Report of Test Case 2.



REPORT

ITEM	ILC 2							
DETAIL NAME	1	2	3	4	5	6	7	8
Gross Requireinents					448			
Gross Requirements			50					
Schedule Receipts			50					
l'n•ject (I land		0				0	0	
Net Wquirmerits			0		448			
Planned Order Receipts					448			
Planned Order Releases	448							

ITEM	B LLC 2							
DETAIL NAME	1	2	3	4	5	6	7	8
Gross Requirements					340			
Schedule Receipts •								
Project On Hand	100	100	100	100	0	0	0	0
Net Requirements					240			
Planned Order Receipts					240			
PlannedOrderReleaks	240							

ITEM	. LLC 2							
DETAIL NAME		2	3	4	5	6	7	8
(gross Requirements					448			
Schedide Receipts								
Project On Hand	10	10	10	10	0	0	0	0
Net Requirements					438			
Planned Order Receipts					438			
• Planned Order Releases			438					

Figure 4.13. Report of Test Case 2.

ITEM	D i LLC	0							
DETAIL NAME		I	2	3	4	5	6	7	8
Gross Requirements				50					
Gross ReqUirements						340			
Schedule Receipts •									
Project On Hand		2	2	0	0	0	0	0	0
Net Requirements •				48		340			
Planned Order Receipts				48		340			
.Planned Order Releases .		48		340					

ITEM	E LLC	1							
DETAIL NAME		1	2	3	4	5	6	7	8
Gross Requirements								1800	
• Gross Requirements						3152			
. Schednle Receipts •									
.Project On Hand		50	50	50	50	0	0	0	0
Net Requirements						3102		1800	
Planned: Order' Receipts						3102		1800	
Planned Order Release's					3102		1800		

ITEM	LLC	1							
DETAIL NAME		1	2	3	4	5	6	7	8
• Gross Requiretnents								450	
Schedule Receipts									
Project On Ilan&		2	2	2	2	2	2	0	0
Net Requirements								448	
Planned Order Receipts								448	
Planned Order Releases						448			

Figure 4.13. Report of Test Case 2. (Continued)

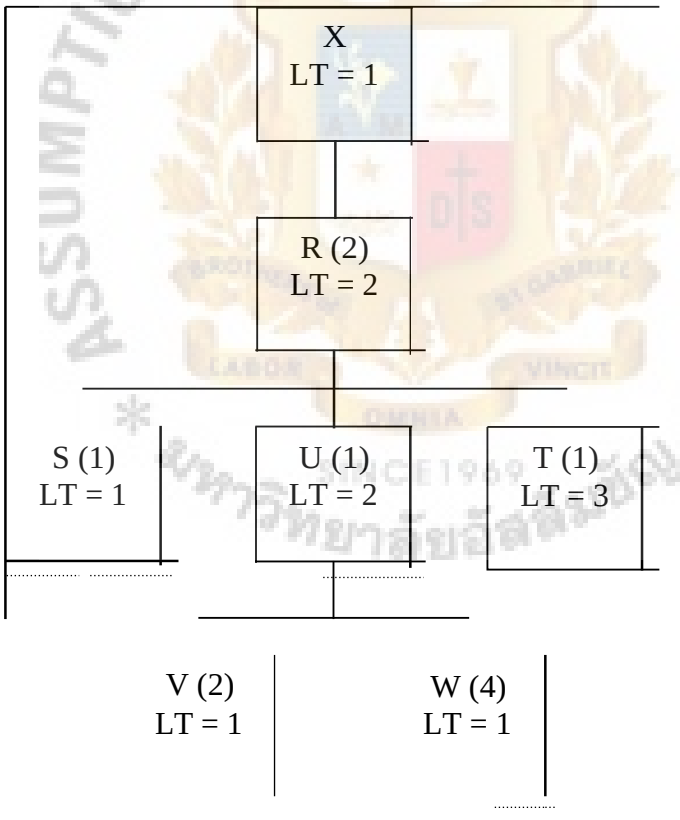
ITEM	*G.*	*LLC*	1						
DETAIL NAME		*1*	*2*	*3*	*A*	*S*	*6*	*7*	*8*
Gross Requirements								450	
Schedule Receipt; •									
Project On 'land		110	110	110	110	110	110	0	0
Net Requirements								340	
Planned Order Receipts								340	
PlannediOrder ReleaseS •						340			

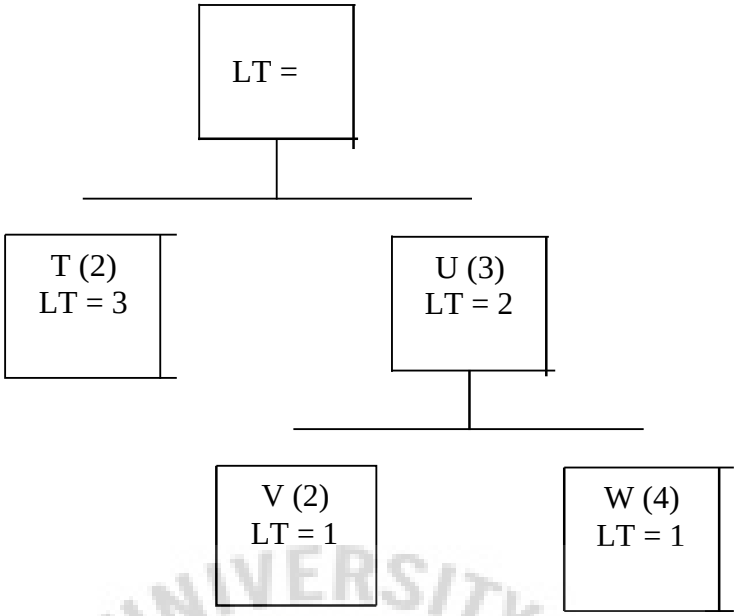
ITEM	*1,1„C* •	0						
DETAIL NAME	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Gross Requirements								500
Schedule Receipt;								
Project On Hand • •	50	50	50	50	50	50	50	0
Net. Requirements								450
Planned Order Receipts								450
l'Ianne4 Q.rder Release,;							450	

Figure 4.13. Report of Test Case 2. (Continued)

Test case 3: Camp's Inc. produce two products, X and Z, with product structures as shown. An order for 200 units of X, and 350 units of Z has been received for period 8. An inquiry of available stock reveals 25 units of X on hand, 40 of Z, 30 of R, 100 of S, 90 of T, 120 of U, 150 of V, and 160 of W. Of the T's on order, 250 are due in by period 2; 75 S's should arrive in period 1. For economy reasons, U is never made in quantities under 500. Similarly, V and W have multiple order quantities of 900 and 1,500, respectively (Russell and Taylor III 2000).

Determine when orders should be released for items V and W, and the size of those orders.





The way to calculate the results by using The MRP matrices of *Test case 3* is the same fashion as *Test case I.* Solve the problem using the MRP matrices below:

Item X: The gross requirement of 200 X's in period 8 is given in the master production schedule. Since there are 25 units of X on hand, the net requirement for X is 175 in period 8. There are no scheduled receipts for X and no lot-sizing requirements. If 175 X's are needed in period 8 and it takes 1 week to make X's, we need to release an order to begin production of X's in period 7.

Item: X	LLC: 0	1	2	3	4	5	6	7	8
Lot Size: 1	LT: 1								
Gross requirements									200
Scheduled receipts									
Projected on hand		25	25	25	25	25	25	25	0
Net requirements									175
Planned order receipts									175
Planned order releases								175	

Item Z: The gross requirement of 350 Z's in period 8 is given in the master production schedule. Since there are 40 units of Z on hand, the net requirement for Z is 310 in period 8. There are no scheduled receipts for X and no lot-sizing requirements. If 310 Z's are needed in period 8 and it takes 2 weeks to make Z's, we need to release an order to begin production of Z's in period 6.

Item: Z	L,LC· 0	1	2	3	4	5	6	7	8
Lot Size	LT: 2								
Gross requirements									350
Scheduled receipts									
Projected on hand		40	40	40	40	40	40	40	0
Net requirements									310
Planned order receipts									310
Planned order releases							310		

Item R: An order for 175 X's is set to be released in period 7.Two R's is needed for every X, so we place a gross requirement for 350 R's in period 7. We have 30 R's in inventory. They remain in inventory until period 7, when we use them to satisfy partially the demand for X's. The net requirement for R is thus 320 units. Ordering the net requirement of 320. If 320 R's need to be received by period 7 and it takes 2 weeks to make R's, we need to release the order for R in period 5. The 320 R's will arrive in period 7. We will use all of them to meet X's demand for R's.

Item: R	LLC: 1	1	2	3	4	5	6	7	8
I,cit Size· 1	LT: 2								
Gross requirements								350	
Scheduled receipts									
Projected on hand		30	30	30	30	30	30	0	0
Net requirements								320	
Planned order receipts								320	
Planned order releases						320			

Item S: An order for 320 R's is set to be released in period 5. One S's is needed for every R, so we place a gross requirement for 320 R's in period 5. We have 100 S's in inventory and an order of 75 S's is scheduled to be received in period 1. By the end of period 1, we project that (100 + 75) = 175 S's will be on hand. They remain in inventory until period 5, when we use them to satisfy partially the demand for R's. The net requirement for S is thus 145 units. Ordering the net requirement of 145. If 145 S's need to be received by period 5 and it takes 1 week to make S's, we need to release the order for S in period 4. The 145 S's will arrive in period 5. We will use all of them to meet R's demand for S's.

Item: S	LLC: 2								
Lot Size: 1	1,1": 1								
Gross requirements						320			
Scheduled receipts		75							
Projected on hand		100	175	175	175	0	0	0	0
Net requirements						145			
Planned order receipts						145			
Planned order releases					145				

Item T: Item T has two parents, Z and R. We need to gather all the gross requirements for T; two T's are required for every Z, so (310 * 2) = 620 T's need to be available by period 6 and one T's are required for every R, so 320 T's need to be available by period 5. We have 90 T's in inventory and an order of 250 T's is scheduled to be received in period 2. By the end of period 2, we project that (90 + 250) = 340 S's will be on hand. They remain in inventory until period 5, when we use them to satisfy partially the demand for R's. The inventory has 20 T's until period 6. The net requirement for T is thus 600 units. Ordering the net requirement of 600. If 600 T's need to be received by period 6 and it takes 3 weeks to make T's, we need to release the order for T in period 3. The 600 S's will arrive in period 6. We will use all of them to meet Z's demand for T's.

helm I L1._,C' 2 / Lot Size: 3 LT: 3	1	2	3	4	5	6	7	8
Gross requirements					320	620		
Scheduled receipts		250						
Projected on hand	90	1340	340	340	20	0	0	0
Net requirements						600		
Planned order receipts						600		
Planned order releases			600					

Item U: Item U has two parents, Z and R. We need to gather all the gross requirements for U; three U's are required for every Z, so (310 * 3) = 930 U's need to be available by period 6 and one U's are required for every R, so 320 U's need to be available by period 5. We have 120 U's in inventory. They remain in inventory until period 5, when we use them to satisfy partially the demand for R's. The net requirement for U is thus 200 units. But instead of ordering the net requirement of 200, we order the lot-sizing quantity of 500. If 200 U's need to be received by period 5 and it takes 2 weeks to make

U's, we need to release the order for U in period 3. The 500 U's will arrive in period 5. We will use 200 of them to meet R's demand for U's. The remaining 300 units will be placed into inventory. The inventory has 300 U's until period 6. The net requirement for U is thus 630 units. Ordering the lot-sizing quantity of 1000. If 630 U's need to be received by period 6 and it takes 2 weeks to make U's, we need to release the order for U in period 4. The 1000 S's will arrive in period 6. We will use all of them to meet Z's demand for U's. The remaining 370 units will be placed into inventory.

Item: U LLC: 2 Lot Size: 500 LT: 2	1	2	3	4	5	6	7	8
Gross requirements					320	930		
Scheduled receipts								
Projected on hand	120	120	120	120	300	370	370	370
Net requirements					200	630		
Planned order receipts					500	1000		
Planned order releases			500	1000				

Item V: Item V has one parent, U but U has two parents. So we need to gather all the gross requirements for V; two V's are required for every U, so (500 * 2) = 1000 V's need to be available by period 3 and (1000 * 2) = 2000 V's need to be available by period 4. We have 150 U's in inventory. They remain in inventory until period 3, when we use them to satisfy partially the demand for U's. The net requirement for V is thus 850 units. But instead of ordering the net requirement of 850, we order the lot-sizing quantity of 900. If 850 V's need to be received by period 4 and it takes 1 week to make V's, we need to release the order for V in period 2. The 900 V's will arrive in period 3. We will use 850 of them to meet U's demand for V's. The remaining 50 units will be placed into inventory. The inventory has 50 V's until period 5. The net requirement for

V is thus 1950 units. Ordering the lot-sizing quantity of 2700. If 1950 V's need to be received by period 4 and it takes 1 week to make V's, we need to release the order for V in period 3. The 2700 V's will arrive in period 4. We will use all of them to meet Z's demand for V's. The remaining 750 units will be placed into inventory.

Item: V LLC: 3 Lot Size: 900 LT: 1	1	2	3	4	5	6	7	8
Gross requirements			1000	2000				
Scheduled receipts								
Projected on hand	150	150	50	750	750	750	750	750
Net requirements			850	1950				
Planned order receipts			900	2700				
Planned order releases		900	2700					

Item W: Item W has one parent, U but U has two parents. So we need to gather all the gross requirements for W; Four W's are required for every U, so (500 * 4) = 2000 W's need to be available by period 3 and (1000 * 4) = 4000W's need to be available by period 4. We have 160 W's in inventory. They remain in inventory until period 3, when we use them to satisfy partially the demand for U's. The net requirement for V is thus 1840 units. But instead of ordering the net requirement of 1840, we order the lot-sizing quantity of 3000. If 1840 W's need to be received by period 4 and it takes 1 week to make W's, we need to release the order for W in period 2. The 3000 W's will arrive in period 3. We will use 1840 of them to meet U's demand for W's. The remaining 1160 units will be placed into inventory. The inventory has 1160 W's until period 5. The net requirement for W is thus 2840 units. Ordering the lot-sizing quantity of 3000. If 2840 W's need to be received by period 4 and it takes 1 week to make W's, we need to

release the order for W in period 3. The 3000 W's will arrive in period 4. We will use all of them to meet Z's demand for W's. The remaining 160 units will be placed into inventory.

Item. W	LLC: 3	1	2	3	4	5	6	7	8
Lot Size;.1500	LT: 1								
Gross requirements				2000	4000				
Scheduled receipts									
Projected on hand		160	160	1160	160	160	160	160	160
Net requirements				1840	2840				
Planned order receipts				3000	3000				
Planned order releases			3000	3000					

Now we have completed the MRP calculations. To summarize the results, we construct a planned order report from the planned order release row of each matrix, as follows:

Period	Item	aaatity.::
2	V	900
2	W	3000
3	V	2700
3	W	3000

Solve the problem by applying the Material Requirements Planning (MRP) software as the same fashion as *Test case 1.*

1. Start Microsoft Access.
2. Choose Files Open Database.
3. Choose A:\.MPS to open the Material Requirements Planning (MRP) software.
4. Click the Forms object button.

5. Select MATERIAL and click Open to open the MATERIAL INFORMATION form.

6. Enter material information; ITEM, LT, LOT SIZE, SCHEDULE PERIOD, SCHEDULE RECEIPTS, and ON HAND as follows:

(6.1) ITEM: X, LT: 1, LOT ST7E: 1, SCHEDULE PERIOD: skip, SCHEDULE RECEIPTS: skip, and ON HAND: 25.

(6.2) ITEM: *Z*, LT: 2, LOT SIZE: 1, SCHEDULE PERIOD: skip, SCHEDULE RECEIPTS: skip, and ON HAND: 40.

(6.3) ITEM: R, LT: 2, LOT SIZE: 1, SCHEDULE PERIOD: skip, SCHEDULE RECEIPTS: skip, and ON HAND: 30.

(6.4) ITEM: S, LT: 1, LOT SIZE: 1, SCHEDULE PERIOD: 1, SCHEDULE RECEIPTS: 75, and ON HAND: 100.

(6.5) ITEM: T, LT: 3, LOT SIZE: 1, SCHEDULE PERIOD: 2, SCHEDULE RECEIPTS: 250, and ON HAND: 90.

(6.6) ITEM: U, LT: 2, LOT SIZE: 500, SCHEDULE PERIOD: skip, SCHEDULE RECEIPTS: skip, and ON HAND: 120.

(6.7) ITEM: V, LT: 1, LOT ST7E: 900, SCHEDULE PERIOD: skip, SCHEDULE RECEIPTS: skip, and ON HAND: 150.

(6.8) ITEM: W, LT: 1, LOT SIZE: 1500, SCHEDULE PERIOD: skip, SCHEDULE RECEIPTS: skip, and ON HAND: 160.

7. Click save record button and then click close form.

8. Select PAR CHILD MAT and click Open to open the PRODUCT SIRUCTURE form.

9. Enter product structure; PAR JD and CHILD ID from combo box and QUANTITY as follows:

(9.1) PAR ID: X, CHILD ID: R, and QUANTITY: 2.

(9.2) PAR ID: R, CHILD ID: S, and QUANTITY: 1.

(9.3) PAR Ill: R, CHILD ID: U, and QUANTITY: 1.

(9.4) PAR ID: R, CHILD ID: T, and QUANTITY: 1.

(9.5) PAR ID: U, CHILD_ID: V, and QUANTITY: 2.

(9.6) PAR ID: U, CHILD_ID: W, and QUANTITY: 4.

(9.7) PAR ID: *Z,* CHILD ID: T, and QUANTITY: 2.

(9.8) PAR ID: Z, CHILD ID: U, and QUANTITY: 3.

10. Click save record button and then click close form.
11. Select ORDER and click Open to open ORDER form.
12. Enter order as the MPS:

    (12.1) ITEM: X, QUANTITY: 200, PERIOD: 8, and click save.

    (12.2) ITEM: Z, QUANTITY: 350, PERIOD: 8, click save and then click close form.

13. Click the Reports object button.
14. Select PLANNED ORDER REPORT and CROSSTABI to see the result.

By the comparison of the results from using the MRP matrices and applying Material Requirements Planning (MRP) software, the results are the same.

MATERIAL INFORMATION

ITEM	LT	LOT SIZE	SCHEDULE PERIOD	SCHEDULE RECEIPTS	ON HAND
R	2	1			30
S	1	1	1	75	100
T	3	1	2	250	90
U	2	500			120
V	1	900			150
W	1	1500			160
X	1	1			25
Z	2	1			40

Figure 4.14. Material Information Form of Test Case 3.

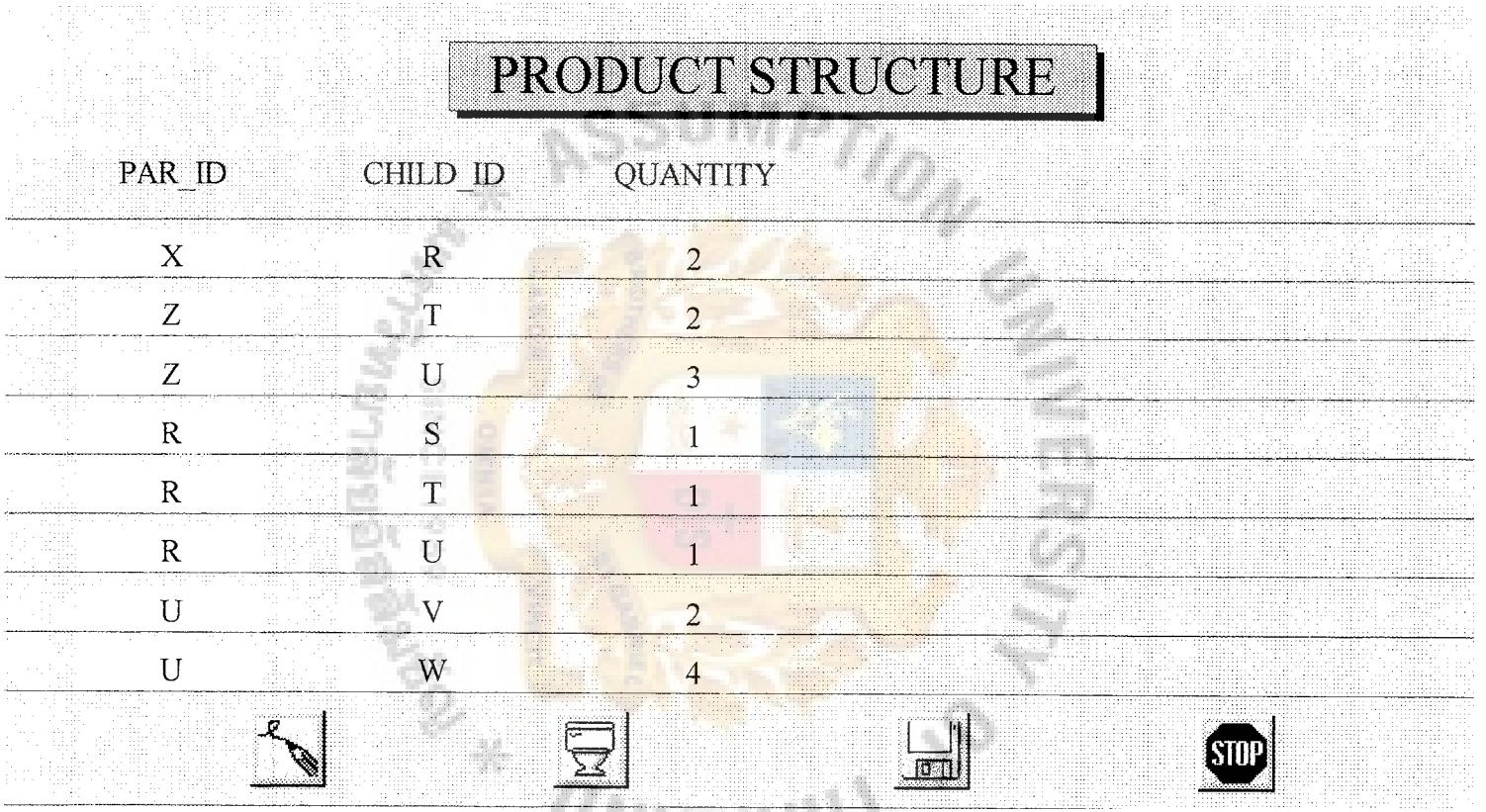
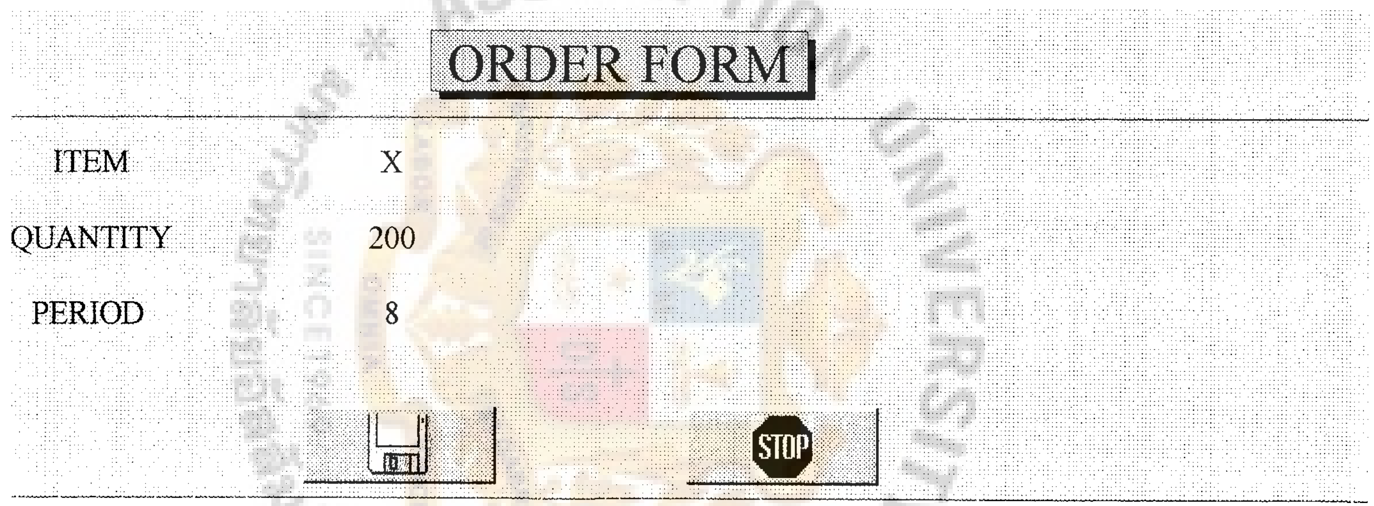


Figure 4.15. Product Structure Form of Test Case 3.



3. Case t f Tes o Form r de Or an

ORDER FORM

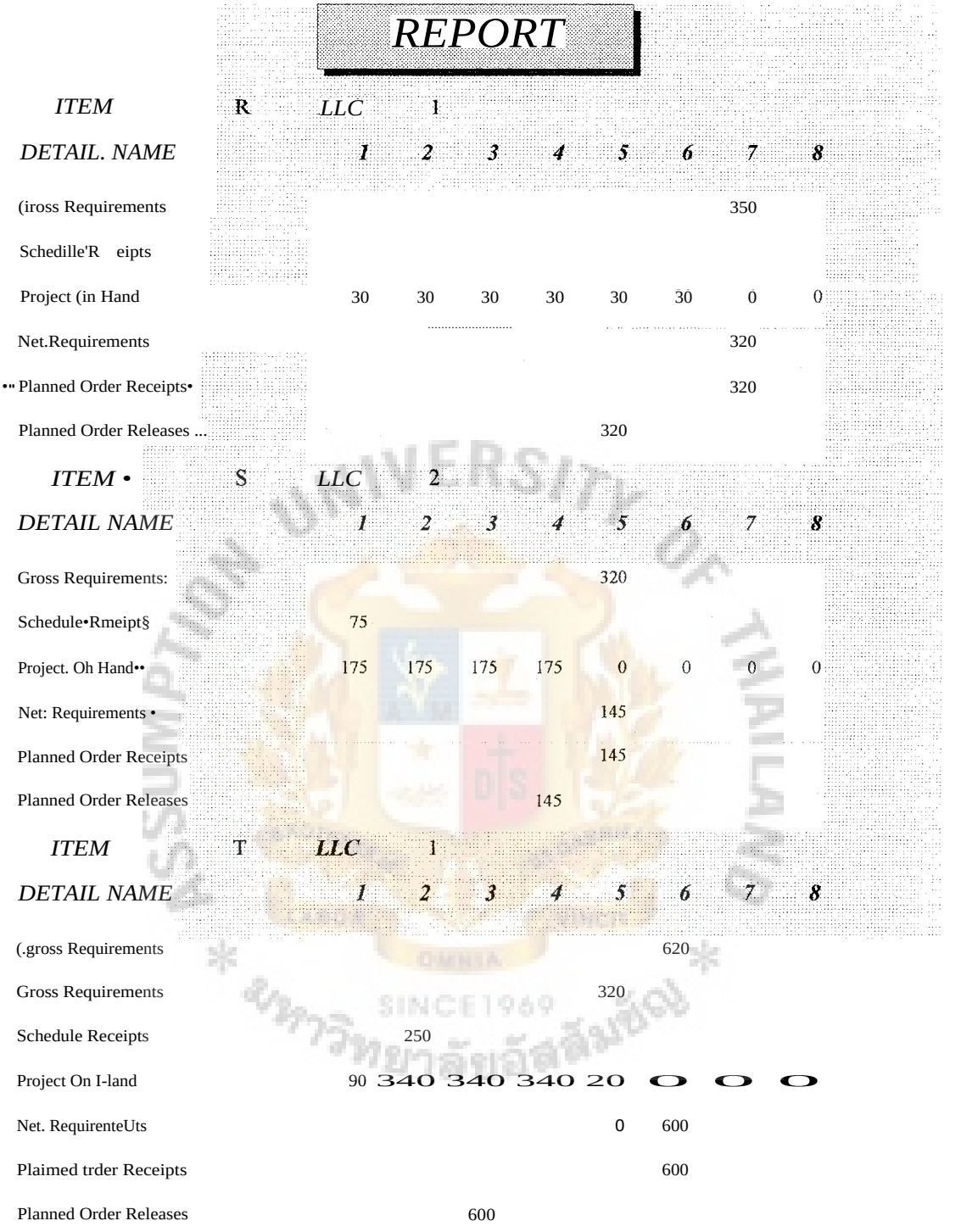
ITEM	Z
QUANTITY	350
PERIOD	8

3. Case t f Tes o Form der Or N

P ANNED ORDER REPORT

PERIOD •	ITEM	QUANTITY
1		
		3000
		900
		3000
		2700
		500
		600
		1000
		145
		320
		310
		175

Figure 4.18. Planned Order Report of Test Case 3.



REPORT

ITEM R LLC 1								
DETAIL. NAME	1	2	3	4	5	6	7	8
(iross Requirements							350	
Schedille'R eipts								
Project (in Hand	30	30	30	30	30	30	0	0
Net.Requirements							320	
•" Planned Order Receipts•							320	
Planned Order Releases ...					320			

ITEM • S LLC 2								
DETAIL NAME	1	2	3	4	5	6	7	8
Gross Requirements:					320			
Schedule•Rmeipt§	75							
Project. Oh Hand••	175	175	175	175	0	0	0	0
Net: Requirements •					145			
Planned Order Receipts					145			
Planned Order Releases				145				

ITEM T LLC 1								
DETAIL NAME	1	2	3	4	5	6	7	8
(.gross Requirements						620		
Gross Requirements					320			
Schedule Receipts		250						
Project On I-land	90	340	340	340	20	0	0	0
Net. RequirenteUts					0	600		
Plaimed trder Receipts						600		
Planned Order Releases			600					

Figure 4.19. Report of Test Case 3.

ITEM		LLC							
DETAIL NAME	1	2	3	4	5	6	7	8	
OrosS Requirements						930			
Gross.Requirements •					320				
Schedule. Receipts									
Project On Hand	120	120	120	120	300	370	370	370	
Net Requirements					200	630			
Planned Order Receipts					500	1000			
Planned Order Releases			500	1000					

•1TEM	V	LLC	3						
DETAIL NAME		1	2	3	4	5	6	7	8
OroSs Requirements				400					
•GrOSs:Regturemmts					1620				
Schedule•Receipts									
Project On Hand .		150	150	650	830	830	830	830	830
Net Requirements				250	970				
Planned Order Receipts				900	1800				
Planned Order Releases			900	2700					

ITEM	W	LLC	2						
DETAIL NAME		1	2	3	4	5	6	7	8
Gross Requirements					3240				
Gross Requirements				800					
Schedule Receipts									
Project On Hand		160	160	860	620	620	620	620	620
Net Requirements				640	2380				
Planned Ch'der Receipts				1500	3000				
Planned Order .Releases			3000	3000					

Figure 4.19. Report of Test Case 3. (Continued)

ITEM X ILC

DETAIL:NAME		*2*	*3*	*4*	*5*	*6*	*7*	*8*
Cirds's Requirements								200
Schedule Receipts								
Priiject On Ilafid	25	25	25	25	25	25	25	0
Net Requirements								175
Planned Order Receipts								175
Planned Order Releases							175	

ITEM: *LLC* 0

DETAIL NAME	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Gross Requirements								350
Schedule Receipts								
. Project: (hi I land •• •	40	40	40	40	40	40	40	0
Net Requirements								310
Planned•Order Receipts								310
Planned Order Releases						310		

Figure 4.19. Report of Test Case 3. (Continued)

V. CONCLUSIONS AND RECOMMENDATIONS

5.1 MRP Software Conclusions

Material Requirements Planning (MRP) can assist the users in managing production schedules and ordering purchased items so that materials will be available in cost-effective, timely manner. It is a valuable tool not only for manufacturing scheduling but also for maintenance operations. Microsoft Access is a full-featured database application development package that can be used by a wide range of people, so Microsoft Access would be interesting and considered to implement Material Requirements Planning (MRP) software.

Material Requirements Planning (MRP) software is designed to handle ordering and scheduling of dependent-demand inventories. A production plan for a specified number of finished products is translated into requirements for component parts and raw materials working backward form the date, using lead times and other information to determine when and how much to order. Hence, requirements for end items generate requirements for lower-level components, which are broken down by planning periods (e.g., weeks) so that ordering, fabrication, and assembly can be scheduled for timely completion of end items while inventory levels are kept reasonably low.

Microsoft Access elements are considerably more powerful than their rough equivalents in other applications and it does not need to use all of the elements to design and implement a database application. Material Requirements Planning (MRP) software was created by applying Microsoft Access for calculating the materials demand, monitoring the requirement dates, and developing work order or purchase order to make sure materials are available when needed and maintain the lowest possible level of inventory. It needs 4 elements to create Material Requirements Planning (MRP)

software; tables, queries, forms, and reports. The inputs of the MRP software are Material Information (Item, LT, Lot Size, Schedule Period, Schedule Receipts, and On Hand, Product Structure (Parent items, Children items and Quantity), and the Order (The Master Production Schedule; what, how much, and when finished products are needed). The output is the planned order report shows a schedule of how much is needed and when it is needed.

Evaluation the Material Requirements Planning (MRP) software, We must apply verification and validation (verification is also intended to find errors, validation refers to the process of using software in a live environment in order to find errors.) According to the Software Evaluation part as mentioned in previous topic, the planned order reports of test case 1, 2, and 3 that used the MRP matrices give the same results as applied Material Requirements Planning (MRP) software. Therefore, it can conclude that the MRP software performs accurately and satisfactorily.

5.2 MRP Software Recommendations

In operations planning in manufacturing, warehousing/distribution or purchasing, decisions need to be made about how much material, or what size of lots, to prepare. Lot-sizing is an important part of MRP planning and depending on the lot size. Methods for calculating the optimum lot size generally depend on balancing the set-up costs with holding costs. Thus, for lot-sizing calculation methods to be appropriate, it is necessary that these costs are known with some reliability. There are 4 quantitative methods for determining lot size.

(a) Lot-for-lot (LFL): The lot size manufactured or purchased is equal to the net requirements at that particular time period. Using this method minimizes inventory holding costs and avoids the risk of obsolescence.

(b) Economic ordering quantity (EOQ): This approach assumes that the demand is quite stable from period to period and also price discounts are not taken into account in the basic models.

(c) Period order quantity method (POQ): A certain quantity of material or parts is produced at a regular period. In this way planning is somewhat simplified.

(d) Part-Period Balancing (PPB): This approach balances the set-up costs with holding costs, with the exception that it is dynamic in that it reflects requirements for future demand requirements.

This Material Requirements Planning (MRP) software was applied with the lot-for-lot (LFL) approach by multiple order quantities. For the next developed MRP software version, the developer should consider the methods for determining lot size and applying 4 methods of lot size as the functions in the MRP software.

Forms are Access objects that display information on the screen or printer. It offers an alternative way of viewing and working with data in the table. The other important aspect of forms in the MRP software that should be developed are displays or user interfaces. Because this Material Requirements Planning (MRP) software use Form Wizards, it is easy way to create the data entry forms and use a few minutes then a form appears, but it is simply style. In the other hand working with good designed forms are attractive and often convenient alternative to manipulating data (view, enter, edit and calculate data) therefore, This MRP software should improved the display in the attractive way.

APPENDIX A

EVENT PROCEDURE ON MATERIAL INFORMATION FORM

```
Private Sub cmdClose_Click()
On Error GoTo Err cmdClose Click
   DoCmd.Close
Exit cmdClose Click:
   Exit Sub

Err_cmdClose Click:
   MsgBox Err.Description
   Resume Exit cmdClose Click
End Sub
Private Sub cmdDel Click()
On Error GoTo Err cmdDel Click

   DoCmd.DoMenuItem acFormBar, acEditMenu, 8, acMenuVer70
   DoCmd.DoMenuItem acFormBar, acEditMenu, 6, acMenuVer70
Exit cmciDel Click:
   Exit Sub

Err cmdDel Click:
   MsgBox Err.Description
   Resume Exit cmdDel Click
End Sub
Private Sub cmdAdd_Click()
On Error GoTo Err cmdAdd Click

   DoCmd.GoToRecord „ acNewRec

Exit cmdAdd_Click:
   Exit Sub

Err cmdAdd Click:
   MsgBox Err.Description
   Resume Exit cmdAdd Click
End Sub
Private Sub cmdSave_Click()
On Error GoTo Err cmdSave Click
   DoCmd.DoMenuItem acFormBar, acRecordsMenu, acSaveRecord, acMenuVer70

Exit cmdSave_Click:
   Exit Sub

Err cmdSave Click:
   MsgBox Err.Description
   Resume Exit cmdSave_Click
End Sub
Private Sub CmdCancel Click()
On Error GoTo Err cmdCancel Click

   DoCmd.DoMenuItem acFormBar, acEditMenu, acUndo, acMenuVer70
```

```
Exit_cmdCancel Click:
   Exit Sub

Err_cmdCancel Click:
   MsgBox Err.Description
   Resume Exit cmdCancel Click
End Sub

Private Sub Command24 Click()
Dim db As Database
Dim rsmat As Recordset
   cmdSave Click
   Set db = OpenDatabase("C: \MY DOCUMENTS \PACK\MPS.mdb")
   Set rsmat = db.OpenRecordset("SELECT * FROM MATERIAL WHERE
[SCHEDULE RECEIPTS] IS NOT NULL ORDER BY ITEM", dbOpenDynaset)
      db.Execute "DELETE FROM RESULT"
      db.Execute "INSERT INTO RESULT ( MATERIAL ID, LLC, DETIAL ID,
PERIOD ID, QUANTITY) SELECT MATERIAL ID, NULL ,3,PERIOD LD ," + "
[ON HAND] FROM PERIOD , MATERIAL"
   If rsmat.RecordCount > 0 Then
      Do
         db.Execute "INSERT INTO RESULT ( MATERIAL _ID, LLC, DETIAL _ID,
PERIODJD, QUANTITY) VALUES (" + CStr(rsmat(0)) + ", NULL , 2 ," + CStr
(rsmat(4)) + " , " + CStr(rsmat(5)) + ")"
         rsmat.MoveNext
      Loop Until rsmat.EOF
      db.Execute "UPDATE MA1ERIAL INNER JOIN RESULT ON
MATERIALMATERIAL = RESULT.MATERIAL ID SET RESULT. QUANTITY
= [QUANTITY]+[SCHEDULE RECEIPTS]"
                  + " WHERE (((RESULT.DETIAL ID)=3) AND
((RESULT.PERIOD_ID)>=[MA IERIAL]. [ SCHEDULE PERIOD]) AND
((MATERIAL.[SCHEDULE RECEIPTS]) Is Not Null))"
   End If
   Set rsmat = db.OpenRecordset("SELECT * FROM MA I ERIAL WHERE
[SCHEDULE RECEIPTS] IS NULL ORDER BY ITEM", dbOpenDynaset)
   Do
      db.Execute "INSERT INTO RESULT ( MATERIAL ID, LLC, DETIAL _ID,
PERIOD ID, QUANTITY ) VALUES (" + CStr(rsmat(0)) + ", NULL , 2 ,1 ,NULL)"
      rsmat. MoveNext
   Loop Until rsmat.EOF
End Sub
```

APPENDIX B

EVENT PROCEDURE ON ORDER FORM

```
Private Sub cmdSave Click()
   If Trim(Combol0) = "" Or IsNull(Combol0) Then
      MsgBox "nlitnVisDfictaii"„ "MPS"
      Combo 10. SetFocus
      Exit Sub
   ElseIf Trim(QUANTITY) = "" Or IsNull(QUANTITY) Then
      MsgBox "nlitnliri¯riinuFal"„ "MPS"
      QUANTITY. SetFocus
      Exit Sub
   ElseIf Trim(Combol2) = "" Or IsNull(Combol2) Then
      MsgBox "nvullalfal441"„ "MPS"
      Combo12.SetFocus
      Exit Sub
   End If
   Gross_Requirements CLng(CombolO.Value), CByte(Combo12.Value), 0, CInt
(QUANTITY)
   CalAll
   MsgBox " Your orders have been saved"
End Sub

Private Sub CmdCancel Click()
   DoCmd. Close
End Sub

Private Sub Combo10 NotInList(NewData As String, Response As Integer)
   MsgBox "npuitgonfrwilliniufmai¯rau"
End Sub

Private Sub Gross_Requirements(Material ID As Long, Periodl As Byte, Llc As Byte,
Quantityl As Integer)
Dim dbtmp As Database
Dim rstmp As Recordset
Dim rsmat As Recordset
Dim rstmp2 As Recordset
   Set dbtmp = OpenDatabase("C: \MY DOCUMENTS\PACK\MPS.mdb")
   Set rstmp = dbtmp.OpenRecordset("SELECT * FROM RESULT WHERE
MA.IERIAL ID = " + CStr(Material ID) + " AND DETIAL ID = 1 AND
PERIOD ID = " + CStr(Periodl), dbOpenDynaset)
   If rstmp.RecordCount > 0 Then
      rstmp.Edit
      rstmp("QUANTITY") = rstmp!QUANTITY + Quantityl
      rstmp!Llc = Llc
      rstmp.Update
   Else
      rstmp.AddNew
      rstmp!Material_ID = Material ID
      rstmp!Llc = Llc
```

```
        If rsresultl(4) <= rsresult2(4) Then
           NR = 0
           PRC = 0
           PRL = 0
        Else
           NR = rsresult 1 (4) - rsresult2(4)
           PRC = rsmat! [LOT SIZE]
           Do While PRC < NR
              PRC = PRC + rsmat! [LOT SIZE]
           Loop
           PRL = PRC
        End If
        If NR = 0 Then
           dbAll.Execute "UPDATE RESULT SET QUANTITY = " + CStr(rsresult2(4)
- rsresultl(4)) + " WHERE MATERIAL ID = " + CStr(rsmat(0)) + " AND
DETIAL ID = 3 AND PERIOD ID >= " + CStr(rsresultl!PERIOD_ID)
           dbAll.Execute "INSERT INTO RESULT ( MA IERIAL_ID, DETIAL ID,
PERIOD ID, QUANTITY ) VALUES (" + CStr(rsmat(0)) + ",4," + CStr
(rsresultl !PERIOD ID) + "," + CStr(NR) + ")"
           dbAll.Execute "INSERT INTO RESULT ( MATERIAL ID, DETIAL _ID,
PERIOD ID, QUANTITY ) VALUES (" + CStr(rsmat(0)) + ",5,1,NULL)"
           dbAll.Execute "INSERT INTO RESULT ( MATERIAL ID, DETIAL _ID,
PERIOD ID, QUANTITY ) VALUES (" + CStr(rsmat(0)) + ",6,1,NULL)"
        Else
           dbAll.Execute "UPDATE RESULT SET QUANTITY = 0 WHERE
MA I ERIAL JD = " + CStr(rsmat(0)) + " AND DETIAL ID = 3 AND PERIOD ID >=-
" + CStr(rsresultl!PERIOD_ID)
           dbAll.Execute "INSERT INTO RESULT ( MATERIAL ID, DETIAL JD,
PERIOD JD, QUANTITY) VALUES (" + CStr(rsmat(0)) + ",4," + CStr
(rsresultl !PERIOD ID) + "," + CStr(NR) + ")"
           dbAll.Execute "INSERT INTO RESULT ( MATERIAL _ID, DETIAL _ID,
PERIOD ID, QUANTITY ) VALUES (" + CStr(rsmat(0)) + ",5," + CStr
(rsresultl !PERIOD ID) + "," + CStr(PRC) + ")"
           dbAll.Execute "INSERT INTO RESULT ( MATERIALJD, DETIAL _ID,
PERIOD ID, QUANTITY) VALUES (" + CStr(rsmat(0)) + ",6," + CStr
(rsresult1!PERIODJD - rsmat![LT]) + "," + CStr(PRL) + ")"
           dbAll.Execute "UPDATE RESULT SET QUANTITY = " CStr(PRC - NR)
+ " WHERE MATERIAL ID = " + CStr(rsmat(0)) + " AND DETIAL ID = 3 AND
PERIOD ID >= " + CStr(rsresultl !PERIOD ID)
        End If
        rsre sult 1 .MoveNext
      Loop
      rsmat.MoveNext
   Loop
End Sub

            dbAll.Execute "UPDATE RESULT SET "
Public Sub resetall()
Dim db As Database
```

```
Dim rsmat As Recordset
   Set db = OpenDatabase("C: \MY DOCUMENTS \PACK\MPS.mdb")
   Set rsmat = db.OpenRecordset("SELECT * FROM MATERIAL WHERE
[SCHEDULE RECEIPTS] IS NOT NULL ORDER BY ITEM", dbOpenDynaset)
      db.Execute "DELETE FROM RESULT WHERE DETIAL JED <> 1"
      db.Execute "INSERT INTO RESULT ( MATERIAL ID, LLC, DETIAL _ID,
PERIOD_ID, QUANTITY) SELECT MATERIAL ID, NULL ,3,PERIOD ID ," + "
[ON HAND] FROM PERIOD , MATERIAL"

   If rsmat.RecordCount > 0 Then
      Do
         db.Execute "INSERT INTO RESULT ( MATERIAL ID, LLC, DETIAL _ID,
PERIOD ID, QUANTITY ) VALUES (" + CStr(rsmat(0)) + ", NULL , 2 ," + CStr
(rsmat(4)) + " , " + CStr(rsmat(5)) + ")"
         rsmat.MoveNext
      Loop Until rsmat.EOF
      db.Execute "UPDATE MATERIAL INNER JOIN RESULT ON
MATERIALMATERIAL = RESULT.MATERIAL _ID SET RESULT.QUANTITY
= [QUANTITY]+[SCHEDULE RECEIPTS]" _
                  + " WHERE (((RESULT.DETIAL _ID)=3) AND
((RESULT. PERIOD ID)>=[MATERIAL].[SCHEDULE PERIOD]) AND
((MATERIAL. [SCHEDULE RECEIPTS]) Is Not Null))"
   End If
   Set rsmat = db.OpenRecordset("SELECT * FROM MATERIAL WHERE
[SCHEDULE RECEIPTS] IS NULL ORDER BY ITEM", dbOpenDynaset)
   Do
      db.Execute "INSERT INTO RESULT ( MATERIAL ID, LLC, DETIAL ID,
PERIOD ID, QUANTITY) VALUES (" + CStr(rsmat(0)) + ", NULL , 2 ,l ,NULL)"
      rsmat.MoveNext
   Loop Until rsmat.EOF

End Sub
```

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