MATERIAL REQUIREMENTS PLANNING FOR V.C.K. INDUSTRIAL LINES CO., LTD.

by

Ms. Orawan Limchaiyawat

A Final Report of the Six-Credit Course
CE 6998 - CE 6999 Project

Submitted in Partial Fulfillment
of the Requirements for the Degree of
Master of Science
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Project Title	Material Requirements Planning for V. C. K. Industrial Lines Co., Ltd.
Name	Ms. Orawan Limchaiyawat
Project Advisor	Dr Chamnong Jungthirapanich
Academic Year	November 2002

The Graduate School of Assumption University has approved this final report of the six-credit course, CE 6998 — CE 6999 PROJECT, submitted in partial fulfillment of the requirements for the degree of Master of Science in Computer and Engineering Management.

Approval Committee:

(Dr. Chamnong J ngthirapanich)
Dean and Advisor

(Prof.Dr. Srisakdi Charmonman)
Chairman

(Assoc.Prof. Somchai Thayarnyong)
MUA Representative

November 2002

ABSTRACT

To manage production systems effectively, one must pay special attention to materials management, including materials procurement, coordination of materials availability, inventory control, and control of material utilization. A diverse production line and the complexities of individual products can cause confusion, inefficiencies, and inferior customer service for any organization. Management will be better able to control in such an environment if there is the timely and accurate information. Material Requirements Planning (MRP) system can provide this vital information.

V.C.K Industrial Line Co., Ltd., the lighting fixture manufacturer, is faced with problem of material planning as the current system is operated manually and just an informal replenishment system. The computerized MRP System is proposed since the existing system does not provide timely and accurate information for the planner. The planner cannot reschedule the plan when the plan was changed. Besides, the current system requires a lot of time for preparing the monthly report.

According to the limitations, the proposed system is designed to solve or minimize the current problems. The data is recorded and updated with the program called Delphi. The database file is created so it can be shared among the users. So, data redundancy and time in searching required data are reduced. The interfaces, forms and reports are generated to be easy to use and understand. The result from system evaluation concludes that the system responds to the user requirements and minimize the current problems of the existing system.

ACKNOWLEDGEMENTS

It is a great pleasure to acknowledge the assistance and guidance of numbers of people who have been very helpful for providing all the related information for Application of Material Requirements Planning (MRP) for V.C.K Industrial Line Co., Ltd. and resulting in present report.

Most importantly, I would like to express my gratitude to Dr. Chamnong Jungthirapanich, the project advisor, for his suggestion, instruction and correction.

I wish to thank the staff in Production Department, Ms. Vilawan Sumran, Production Manager, who has provided a great deal of information, support and comments. Thanks are also given to Mr. Pornthep Dejarkom who advised in application of system software program. I wish that this report would be the guideline for similar applications.

Moreover, I wish to thank the other project committee members of the Graduate School of Assumption University for their advocating, understanding and support throughout my graduate study.

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I. INTRODUCTION

1.1 Background of the Project

Today's business environment is constantly changing, and companies are looking for ways to cut costs while at the same time increasing quality and thereby increasing profit. Few manufacturing organizations will survive in a competitive environment without Material Requirements Planning. In manufacturing, the best inventory position must be found, where the potential for material shortages is well-balanced with the need to minimize on-hand inventories and minimize the lead times. The Material Requirements Planning (MRP) is the one of the alternatives to control these activities. It has been officially around since the 1960's, with the advent of the use of computers in the manufacturing environment. However, by defining what MRP is, companies and software vendors are able to adapt a standardized set of methods by which they can schedule delivery of raw materials against the manufacturing schedule, thus keeping their assembly lines moving while at the same time minimizing the amount of inventory on hand.

In the past, the ideal adaptation of MRP process has been considered to be A 'just in time' scenario, when raw materials arrive just as they are required on the assembly line. Obviously, a system like this has the potential of being thrown 'out of balance' by even the slightest problem; therefore, manufacturers build in 'safety stock' or 'lead time' factors to prevent material shortages from ever causing a 'line stop'. But safety stock and long lead times increase on-hand inventory, requiring larger Warehouses space to store raw materials , or even work in process, with no immediate benefit. In addition, it ties up the company's liquid capital in non-liquid inventory, which typically depreciates, gets damaged, and/or becomes obsolete within a relatively short period of time.

V.C.K Industrial Lines Co., Ltd. also be the one among many companies that require tool in solving problems about material requirements planning. The nature demand of lighting products is randomly fluctuated and the changing in customers' need also be occurred oftenly. Besides, the diverse product lines and the complexities of products can cause difficulties and inefficiencies when the planner performs the material planning. To have large amount of raw material on hand does not satisfy the accounting department. On the other hand, the shortage of raw materials does not support the production line. The planning currently is done manually. It is just informal system, it does not provide the accurate and timely information for the planner. So, the RP system is proposed to solve or minimize the current problems. It will help the company to manage and control the materials more effectively and efficiently.

1.2 Objectives of the Project

The objectives of the project on the Material Requirements Planning for V.C.K. Industrial Lines Co., Ltd. are as follows:

(1) To study and analyze the existing system of materials planning in order to propose a new system.

(2) To design the new system for managing and controlling the materials in the way that can solve or, at least, minimize the current problems.

(3) To provide the real time information so that the planner can manage the production materials more effectively and efficiently.

(4) To generate the required reports.

(5) To better serve the company's customers.

(6) To reduce the loss of business opportunities.

1.3 Company Background

V.C.K. Industrial Lines Co ., Ltd. was established on June 19, 1985 with a registered capital of twenty millions baht. The plant is located at 3/1 Moot Taladjinda, Samphan, Nakhonpathom, on 16,800 square metres. Over 150 staff are employed here. The company is the manufacturer and distributor of high quality lighting fixtures and luminaires. Under "VCK" brandname, the product is well accepted by its customers over a decade. The company's product includes louver covered luminaire, acrylic covered luminaire, batten type luminaire, downlight, and streetlight. All products is certified by TIS 902-2532 and TIS 903-2532 which are the logo of standard from Thai Industrial Standards Institute for the manufacturer of lighting fixtures. Company's mission is to satisfy the customers with best quality and cost effective products at the optimal services. Company's policy includes concentration in the continuous development and improvement of the quality standards of its operational system to internationally recognized standards. Therefore, V.C.K. Industrial Lines Co., Ltd. implemented the quality management system standard ISO 9001:2000 as a corporate practice. And the implementation plan of this standard has the step of providing training course to all employees, setting up of the ISO documentation system as a guidance to operate the system, internal auditing making a review, and assessment for the award of ISO 9001:2000 certification. And this policy is communicated to all employees of the company. The company also promote a corporate culture that encourage a rapid and continuous flow of cost effective innovations in order to improve the quality and value of products and services and to become one of the low cost producers. It is committed to invest at all section for the development and to organize the activities for the benefit of the company but never neglect to conduct business ethically and legally at all times.

V.C.K Industrial Lines Co., Ltd. also contributes to the economy of the local communities where it operates by hiring local employees and improving their quality of life. All staff are provided comprehensive program that is geared specifically to encourage their long-term employment with the company. With a strong belief in the contribution of its human resources to the company's success, both in-house and off-site training for the introduction and update of new technologies also be provided to its human resource. V.C.K Industrial Lines Co., Ltd. is very conscious of its duty to environment protection, conservation and development by using a production process that is environment-friendly and compatible with the surrounding community and the company's own human resource. The company has been invested considerably in installing dust control machine, a waste matter and a waste water treatment system which enables water to be recycled. In term of production, V.C.K. Industrial Lines Co., Ltd. currently has the capacity to produce approximately 45,500 units of the luminaires per month. The entire product range is manufactured under strict quality control supervision throughout each stage of production. The electrical and physical laboratory are available to test the performance of the products. The efficiency of its operation is important factors in maintaining its successful operation. The company has sought ways to improve the productions machinery and technology input and to be integrated with the company's expertise and resources to ensure quality consistency in production of quality lighting fixtures to fulfill customer's requirements. For the future business plan, the company will remain focus on this lighting fixtures industry, and providing a broad line of quality products and services to diverse group of customers in all market segment.

1.4 Company's Business Functions and Organization Chart

(1) Finance and Accounting department

This department is responsible for the preparation of fmancial and cost accounting information, providing the cost estimation, assessing the cash flow, forecasting the budgets, and developing plans to finance the cash flows.

(2) Marketing and Sales department

The marketing department's functions involve providing the sale forecasts and information on competition and customer service that are used for medium and long-range plans, determining prices, designing and executing the product advertising campaigns, creating the demand and keep the operations function focused on satisfying customers' needs.

(3) Production department

The main duty of this department is to design and operate production systems to give the firm a sustainable competitive advantage. The planner has the responsible to develop plans that are the best compromise among cost, customer service, inventory investment, stable work-force levels, and facility utilization.

(4) Purchasing department

This department is responsible for providing information on supplier capabilities and coordinating the inbound flow of materials to meet the requirements of every departments. The planner is responsible to select the suppliers with the best offers.

(5) Personnel department

The functions of personnel department are recruiting qualified personnel, training employees, organizing team efforts, develop welfare programs and devising appropriate incentive systems.

The organization chart of V.C. K. Industrial Lines Co., Ltd. is illustrated in Figure 1.1.

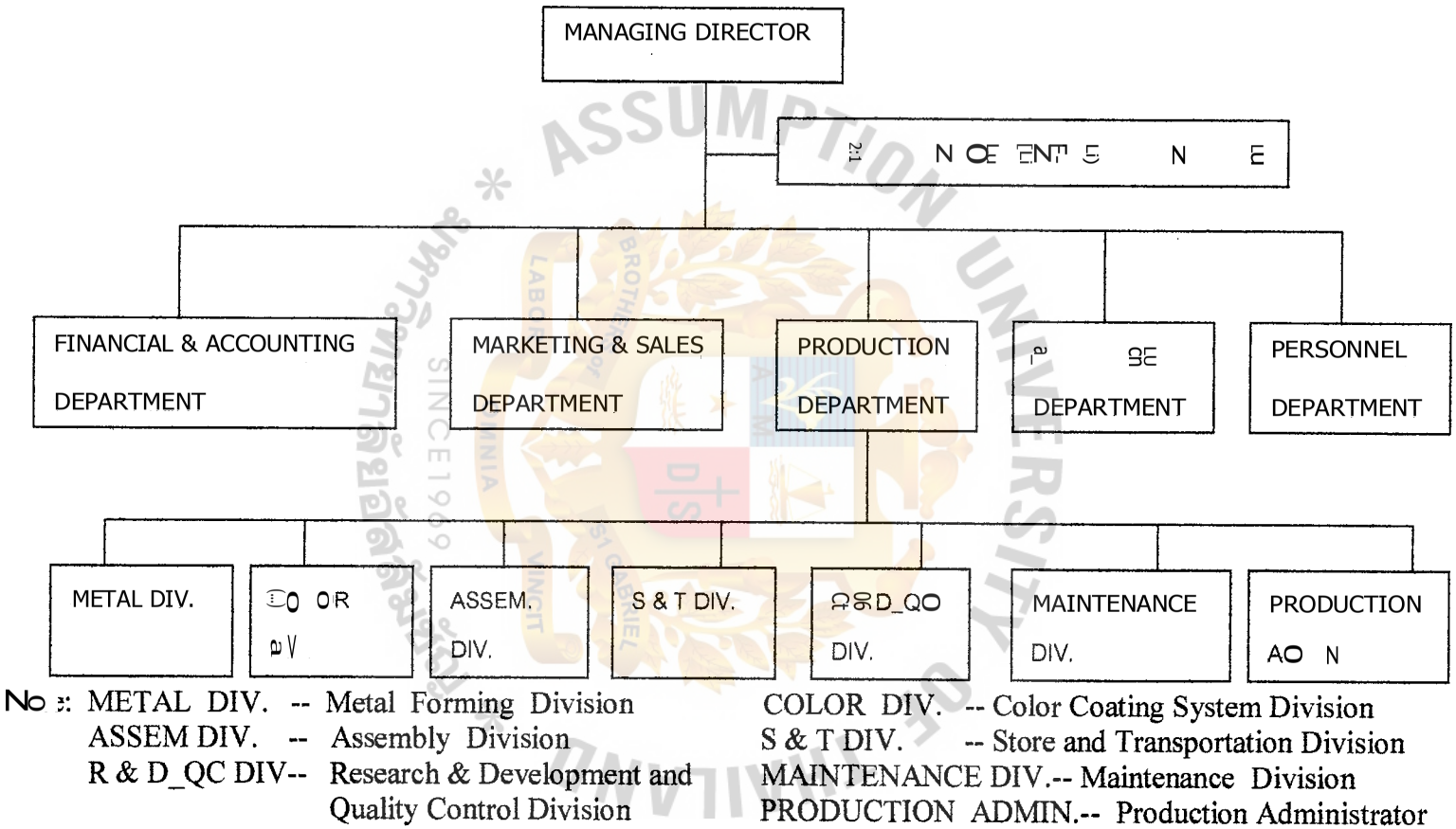


Figure 1.1. V.C.K Industrial Line Co., Ltd. Organization Chart.

1.5 Scope of the Project

The scope of the project of Material Requirement Planning For V.C.K. Industrial Lines Co., Ltd. will cover the analysis of the existing system and the design of the proposed system for the planner in the material requirement planning. The analysis of existing system involves gathering information on the study area ,developing the structure of existing system, identifying the current problems, and defining the user requirements. The design of the proposed MRP system involves structuring the requirement model, the process modeling of the system which includes the development of context diagram and data flow diagram of the proposed system, and the conceptual data modeling which is about the representation of entity-relationship diagram. Some physical design such as report design also be included. In order to show how the MRP works, a model of company's product is chosen to be applied to the schedule. At the end part of the project, the system evaluation and some recommendation are concluded. The explanation of how the project can be related to the future research is also provided in this project.

II. LITERATURE REVIEW

2.1 Overview of MRP

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). MRP begins with a schedule for finished goods that is converted into a schedule of requirements for the subassemblies, component parts, and raw materials that will be 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 needed.

MRP is an approach to stocks and scheduling that is widely employed in situations where demand can be planned or predicted on the basis of a known program of future activity. The MRP works through logic. The overview of the system is shown in Figure 2.1. It explodes master production schedule into the required amount of raw materials, parts, subassemblies, and assemblies needed in each week of the planning horizon; reduces these material requirements to account for materials that are in inventory or on order; and develops a schedule of orders for purchased materials and produced parts over the planning horizon.

Basically, MRP is most suited to a manufacturing organization which produces some components in-house, buys other components from suppliers and ultimately assembles them all into a fairly complicated finished product. Example are the manufacture of automobile or electrical appliances.

The concept of the system is that production control and inventory management are integrated. This is done in such a way as to ensure that raw materials and components are only made available when they are actually required, and not before.

So, there is no excess in-process stock of any of the components as well as inadequate supplies of the other components that will lead to delays. At the same time, a similar principle is also applied to work in progress in the production areas. Each operation on a component is managed so that when completed, the next part of the production line will be ready to receive it and put it through the next operation with out delay, and also without accumulating large quantities of work in progress between operations. Like these, the amount of capital required to finance stocks of raw materials and work in progress will be minimized.

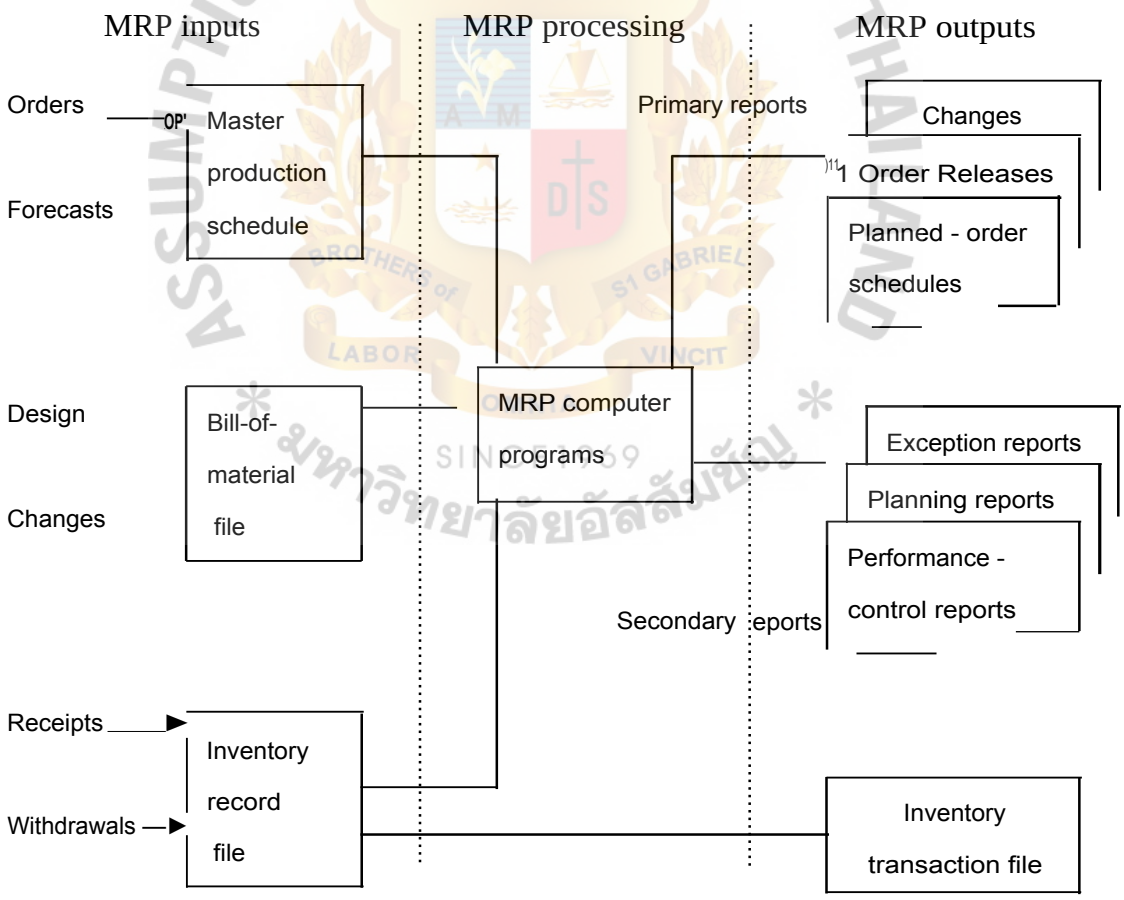


Figure 2.1. Overview of MRP.

It is possible to operate a system manually, but this is only practicable if the product has a simple structure, without too many individual components or production operations involved. Even with a small number of parts and a very shallow bill of materials, the calculations are quite extensive. The computerized MRP provides timely, correct and reliable performance information. Generally, MRP system relies on the use of computers as there are large amounts of data which must be stored, retrieved and manipulated.

2.2 Nature of Demand

The first major concept in the MRP approach is the distinction between dependent and independent demand items. Some item requirements are determined by the needs of other items while the others are specified by customers. When demand for items is derived from plans to make certain products, as it is in the case of raw materials, parts, and subassemblies used in producing a finished product, those items are said to have dependent demand. It is directly related to or derived from the bill of material structure for other items or end products. Such demands are calculated and need not to be forecasted. Independent demand is the demand for an item that is unrelated to the demand for other items. The demand for finished goods, parts required for destructive testing, and service part requirements are examples of independent demand.

The way inventories are managed relates to the nature of demand. The independent demand is fairly stable and tends to be relatively continuous and steady over a period of time. While the dependent demand tends to be lumpy and discontinuous. Because of these tendencies, independent-demand items must be carried on a continual basis, but dependent-demand items need only to be stocked just prior to the time they will be needed in the production process. The reorder point

system works best for independent -demand items. But using reorder points to manage the dependant-demand items results in higher level of stock outs and a higher level of inventory overall. Manufacturing companies often have hundreds or thousands of dependent-demand components, but only a small number of independent-demand items, usually end items. With MRP application, the planners can compute the schedules for the mass of dependent-demand items. Each independent-demand item is planned, and requirements are defined for lower level components. Demand is accumulated for any components used by more than one top-level part. Once all the demand is calculated for the component part, then the replenishments are planned based on what is already in inventory and on order.

2.3 Objectives of MRP

Material requirements planning has two major objectives: determine requirements and keep priorities current.

(1) Determine requirements

The MRP's objective is to determine what components are needed in order to meet the master production schedule on the basis of lead time. It must then determine what to order, how much to order, when to order, and when to schedule delivery.

(2) Keep priorities current.

In this ever-changing world, MRP must be able to reorganize priorities to keep plans current. It must be able to add, delete, delay, expedite, and change orders. MRP is particularly helpful in establishing and adjusting order priorities for both in-house production and outside procurement. Rescheduling helps reflect the reality.

2.4 Basic Terms in MRP

The followings are term often used in MRP.

Allocated inventory - Materials that are in inventory or on order but have been assigned to specific production orders in the future.

Available inventory - Materials that are in inventory or on order that are not safety stock or allocated to other uses.

Bills of material file - A file containing the bills of material for all end items, a listing of all raw materials, parts, subassemblies, and assemblies. The amount of each component that is required to produce one end item is included. The product structure is also included.

Bucket - The term refers to a particular period of time in the planning horizon.

Changes to planned orders -The reports show how planned order schedules for material should be changed adapted to a changed MPS.

Component - A term used to describe a subordinate relationship in product structure. A component goes into a parent.

Dependent demand - Demand for a raw material, part, or other lower- level component that is dependent on the demand for the end item.

End item - A product, service part, or any other output that has a demand from customers or other departments.

Frozen MPS - The early periods of the MPS that can be assumed to not be subjected to change. These periods allow operation managers to order materials, allocate budgets, and make other plans with the confidence that such plans will not need to be subsequently changed.

Gross requirements - The quantity and timing of the total requirements planning for a particular material, not considering any availability of the material in inventory or scheduled receipts.

Independent demand- Demand for a material that is independent of the demands for other materials.

Inventory status file - Material on hand or on order, planned orders, planned order release, materials allocated, lot sizes, safety stock levels, lead times, costs, and suppliers are among the information included in this file about each material.

Lot size decisions - Given a net requirements schedule, decisions on how to group these requirements into production lots or purchase lots.

Low-level coding - Each material is coded at the lowest level that is appears in any product structure. Because MRP programs process net requirements calculations for all products level by level from end items down to raw materials, low-level coding avoids redundant net requirements calculations.

Lumpy demand - The demand for a material that exhibits an irregular period-to-period pattern.

Master production schedule (MPS) - A schedule of the number and timing of all end items to be produced in a manufacturing plant over a specific planning horizon.

Material requirements planning (MRP) - A POM computer information system that determines how much of each material, any inventory item with a unique part number, should be purchased or produced in each future time period to support the MPS.

Net change MRP - MRP systems that generate outputs emphasizing only the changes to the last MRP outputs. Planned order schedule in these systems would indicate only the changes to the previous report and not a completely new schedule.

Net requirement - The amount and timing of the needed for a material that must be satisfied from production or purchasing. It is calculated by subtracting material available from gross requirements.

Offsetting for lead time - A term used to describe the need to account for the require to produce a production lot in-house or to receive a lot purchased from a supplier. The number of periods between the requirement and the release is the offset and is equal to the lead time.

On-hand inventory - The amount of a material actually in inventory. It may include safety stock and materials allocated to other uses.

Parent - A term used to describe a superior relationship in a product structure.

Planned order receipt-The quantity of each material to be received in each time period of the planning horizon.

Planned order release-The quantity of each material to be ordered in each time period of the planning horizon. This schedule is determined by offsetting the planned order receipts schedule to allow for lead times.

Planning horizon - The number of periods included in the MPS, MRP, and all other production planning.

Product structure levels - Strata of the hierarchy of the product structure.

Regenerative MRP - MRP systems that periodically generate one complete set of MRP outputs. In these systems, a planned order schedule would be a complete report and not be comprised solely of changes to an earlier report.

Safety stock - A given quantity of each material held in inventory that is dedicated to emergency shortages arising out of uncertain demand or lead times.

Scheduled receipts - Materials that are on order from a supplier and scheduled to be received in a specific period of the planning horizon.

Service parts - Materials that are demanded as end items when ordered by service centers to be used in repairing other end items. These materials usually also have dependent demands as they are assembled into other, higher-level components.

2.4 MRP Inputs

There are three major categories of information that mandatory in MRP system: a master production schedule, an inventory status file, and a bill of material file.

(1) Master Production Schedule

MPS is initially developed before the MRP system begins to operate. It identifies the quantity and timing of each end product to be produced during each future period in the production planning horizon. It is created by disaggregating the overall production plan into specific end products. It drives the entire MRP system by providing the initial input as to what components are required so the MRP system can plan to produce orders for manufactured and purchased parts and raw materials. The quantities in a master schedule can come from a number of different sources, including

customer orders, forecasts, orders from warehouses to build up seasonal inventories, and external demand. The schedule separates the planning horizon into a series of time periods or time buckets. These are often in weeks.

The initial schedule may or may not be feasible given the constraints of the production system. MRP assumes that the MPS can be produced within the capacity constraints. If it turns out that the current master schedule is not feasible, MPS will need to be modified or revised. Material orders are speeded up or slowed down or canceled. When the MPS is frozen, the plan for inflow of materials emanating from MRP is also frozen.

(2) Bill of Materials

A bill of materials (BOM) contains a listing of all the assemblies, subassemblies, parts, raw materials, and their quantities required to produce one unit of a finished product. Each product has it own bill of materials. It is a very complicated document. The listing in the bill of materials file is hierarchical. The bill of material can be more conveniently shown as a product structure tree, such as the one illustrated in Figure 2.2.

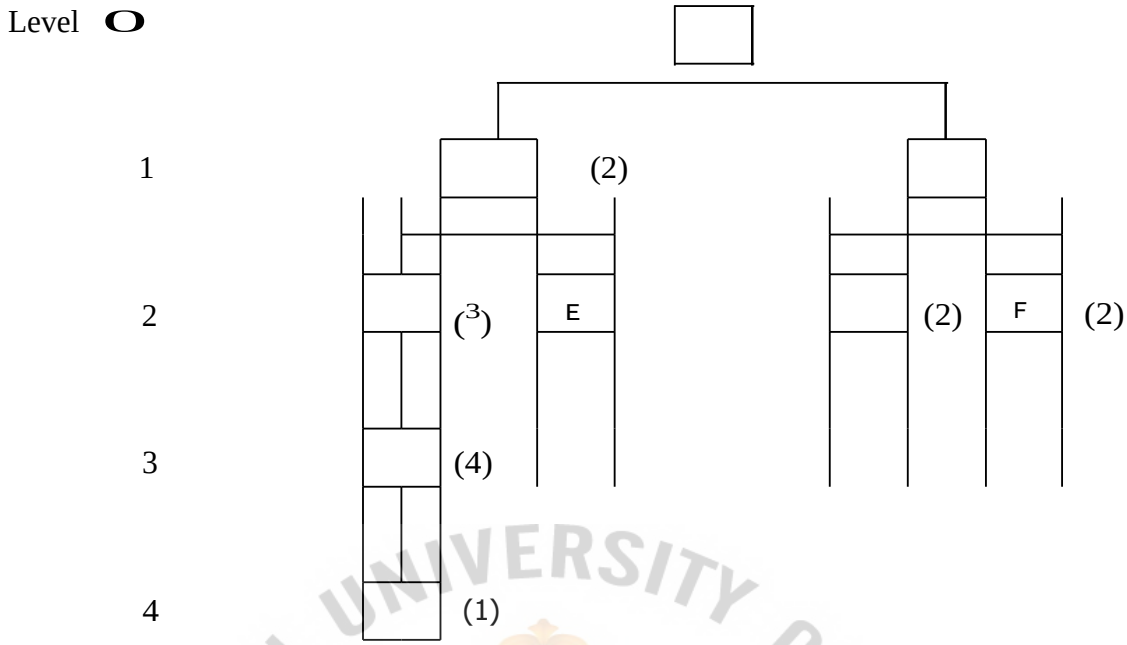


Figure 2.2. A Product Structure Tree for An End Item X.

A product structure tree is useful in illustrating how the bill of materials is used to determine the quantities of each of the ingredients (requirements) needed to obtain a desired number of end items. These requirements are listed by level, beginning with level 0 for the end item, then level 1 for the next level, and so on. If the same part is used in two different bill of material or twice in the same bill of material, in this case, the concept of low level coding is used to ensure that each part is run only once with all requirement being considered. Each item in the product structure tree is given a unique identification number.

The bill of materials file is an up-to-date computerized file that must be revised as products are redesigned. Maintaining its accuracy is extremely important. Here are some of the common BOM displays.

(a) Single-level BOM

A single-level bill of material contains only the parent and its immediate components. This display is most valuable during the engineering change process.

(b) Multilevel BOM

This BOM reflects the way in which the product will be manufactured. It shows the grouping of parts into subassemblies and components.

(c) Parts list

It lists all the parts that are needed to make one of the assemblies. The parts lists is produced by the product design engineer and does not necessarily reflect the way the parts go together.

(d) Indented BOM

A multilevel bill of material can also be shown as an indented bill of material. It is the listing in which the parent is in the margin and its components are indented to show structure.

(e) Where-used and Pegging report

Where-used report is the listing of all the parents in which a component is used. This has several uses, such as in implementing an engineering change or in costing a product.

Pegging report is similar to a where-used report except that it shows only hose parents for which there is an existing requirements. The report shows the parents creating the demand for the components.

(3) Inventory status file

The inventory status file is a computerized file with a complete record of each material held in inventory. Each material has only one material record. The information included in the record are about the inventory on hand, the 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. This type of information is dynamic and changed every time each transaction takes place. Another part of file includes planning data that are used by the MRP system. These factors include such information as lot sizing rule, lead times, safety stock levels, and scrap rates. The inventory status file not only provides the MRP system with a complete status record for each material, but also helps to plan the delivery date, quantities to order, and when to place orders.

2.5 MRP Process

MRP processing involves taking the end- item requirements specified by the master schedule and exploding them into time-phased requirements for assemblies, parts, and raw materials using the bill of materials offset by lead times. MRP processing logic is very straightforward, and requires only simple calculations. After netting the on-hand and on-order inventory, and offsetting the lead time, the production schedule of the end products, MPS, is determined And this is the net material requirements. The quantities that are generated by exploding the bill of material are gross requirement. They do not take into account any inventory that is currently on hand or due to be received. The determination of the net requirements is the core of MRP processing. It is accomplished by subtracting the gross

requirements with the on-hand inventory and any scheduled receipts in each time bucket. Then, the safety stock is added.

Net requirements = Gross requirements - Projected inventory + Safety stock

To make the explanation more simpler, the quantities will be recorded in the table illustrated in Figure 2.3.

Week number:	1	2	3	4	5	6	7	8	9
Item:									
Gross requirements									
Scheduled receipts									
Projected on hand									
Net requirements									
Planned-order receipts									
Planned-order releases									

Figure 2.3. A time-phased MRP.

After the consideration of lot size, the net requirements are transformed into the planned order receipts. Under lot for lot ordering policy, the quantity expected to be received will equal to the net requirements. Under the lot size ordering policy, this quantity may exceed the net requirements. Lead time offsetting shifts the planned order receipts backward and derives the planned order releases. The MRP procedure continues to explode the planned order releases to obtain the gross requirements of its components. The MRP repeats the procedure until the planned order release of all the items are determined. These planned orders are automatically changed as requirements for the item change. This in turn causes the gross requirements for the component items and raw materials to be updated to reflect the changes.

2.6 MRP Outputs

MRP systems have the ability to provide management with a fairly broad range of outputs. These are often classified as primary reports, which are the main reports, and secondary reports, which are optional outputs. The wide range of outputs generally permits users to adapts MRP to their particular needs.

Primary reports concern production and inventory planning and control. These reports normally include the following:

(1) A schedule of planned orders, which indicates the amount and timing of future orders.

(2) Order releases, which authorize the execution of planned orders.

(3) Changes to planned orders, which can include revisions of due dates or order quantities as will as cancellations of orders.

Secondary reports concern such things as performance control, planning, and exceptions:

(1) Performance-control reports are used to evaluate system operation. They aids managers by measuring deviations from plans, including missed deliveries and stock-outs, and by providing information that can be used to assess cost performance.

(2) Planning reports are useful in forecasting future inventory requirements. They include purchase commitments and other data that can be used to assess future material requirements.

(3) Exception reports call attention to major discrepancies such as late and overdue orders, excessive scraps rates, reporting errors, and requirements for non existent parts.

2.7 Other Considerations in MRP

Safety Stock

The use of safety stock for end items in MRP systems can be justified on the same basis as in any other inventory system which is the presence of uncertain demand and uncertain lead times. For example, the bottleneck process or one with varying scrap rates can cause shortages in downstream operations. For higher-level items such as end items, the uncertainty of lead times for these items seems more controllable if these items are produced in-house. However, the safety stock is carried for the end items as these items are subject to random demand. For lower-level items such as raw materials and parts, the uncertainty of demand is more controlled because the demand is a dependent demand. The MPS sets the weekly demand for these items. The only major uncertainties present during lead times are scrap, the uncertainty of lead time and demand that occurs because changes in the MPS.

Lot-sizing

The quantity of materials ordered is rarely equal to the requirements. Usually extra quantities are purchased to take advantage of price breaks, minimum order sizes, or packaging conventions. In MRP systems, economic considerations often result in order quantities that are larger than a single period's net requirements. This recognizes the trade-off in cost between carrying, ordering cost, and cost to set up a machine. Economies can be realized by grouping order or run sizes. There are variety of techniques used for determining lot sizes, mainly because no one plan has a clear advantage over the others. The tendency in practice is to use lot-for-lot (LFL)at all levels for product-to-order firms. It is the simplest lot-sizing rule. he inventory level can be kept low, but the setup cost and ordering cost will be high. Economic order quantity is sometimes used in the case for lower-level items that are common to

different parents and for raw material. The other techniques like fixed-period ordering, part-period method or the Wagner-whiting algorithm can also be used based on characteristics of the parts and the goals of the companies.

Net Change versus Regenerative MRP Systems

The two types of MRP systems differ updating frequency. These systems update the existing plan when there are changes in the master production schedule of the inventory status file. Net change only recalculates the requirements for items that are directly affected by the unexpected changes. It updates the production plan each time a change is posted and exploded throughout the system. The updated outputs would indicate only changes to previous plans, that have changed. The regenerative approach, on the other hand, completely reprocesses the entire set of information and recreates the requirements plan from beginning to end. It updates the production plan at regular intervals, often weekly or monthly, and produces a complete, updated plan.

Each method has its advantages and disadvantages. The net advantages of a net change system include shorter run time that allow more frequent replanning. This can also be a disadvantage to the planner who cannot respond to all the massages before the next run is completed. The main advantage of a regenerative system is that it is easier to implement and manage. The disadvantage is that processing the entire database can take an extremely long time and it is slightly more costly to prepare and process. The selection is based on the business environment. If the business is very dynamic with frequent schedule changes, net change MRP runs daily should be implemented. Conversely, if the business is static with few changes, a weekly regenerative run can be used.

2.8 Benefits of MRP

As a manufacturing becomes more and more efficient in their MRP implementation, the following benefits will continuously improve.

(1) Reduction in inventory levels: MRP can reduce overall inventory costs by providing complete information .

(2) Reduction in production lead times: By coordinating inventories procure- and production decisions, it helps avoid delays in production. It prioritizes activities by putting dates on production activities.

(3) Improved plant operating efficiency.

(4) Improved productivity.

(5) Reduced overtime.

(6) Reduced incidence of scrap and rework.

(7) Reduced component shortages.

(8) Simplified and accurate scheduling

(9) Reduced purchasing cost.

(10) Reduced manufacturing cost.

(11) Realistic delivery date.

(12) Improved customer service

(13) Improved company's competitive position.

(14) Improve communication between departments.

IL THE EXISTING SYSTEM

3.1 Raw materials and Materials used

V.C.K. Industrial Lines Co.,Ltd. is committed to maintain high production standard and product quality. And this commitment is applied at each stage of production process, starting from the selection of raw materials. This is very important. Only qualified raw materials and materials are eligible to be used. In producing the fluorescent luminaires, the major raw materials and materials used are:

(1) Cold rolled metal sheet: This raw material is used to produce the luminaire's housing. The typical thickness used is ranged from 0.6-0.8 mm which can be classified as mild steel. The product origin is Argentina or Mexico. The company buys this raw material from supplier in the country.

(2) Pre-anodized aluminum: To produce a reflector, a solid aluminum alloy flat sheet with a tough, adherent, non-flaking, anodized surface is selected to offer properties that enhance total luminous efficacy of the luminaire. Its bright polished surface provides about 86% reflectance. The surface is covered by PVC film during production process in order to protect against abrasion. This raw material must be imported from the abroad. The product origin is Italy or Germany, and IS09002 certified.

(3) Acrylic sheet: Methyl methacrylate monomer virgin grade of acrylic sheet provides the finest quality. The sheet has about 88°c temperature resistance and 10,300 per square inch tensile strength. This material is the product of Thailand. There are four kinds of sheet which suit the applications; no color, opal color, prismatic texture, stipple texture.

(4) Lamp holder: Spring load type and rotary locked type are two kinds of lamp holder used in fluorescent luminaires. Both types has temperature rating at 110°c, and high-quality imported voltage rating at 250V. Complied to several Western quality standard, lamp holder is also certified by TIS no. 344-2530.

(5) Copper wire: Stranded annealed copper conductor, sizes 0.5 square mm. THW type of wire is used. The classification is maximum conductor temperature 70°c. The insulator is polyvinyl chloride. It is certified by TIS no.11-2531.

(6) Color powder: The company uses only white color. This raw material can be reused.

(7) Hardware kits

These raw materials are different in their purchasing lead times and lot-sizing rule and be shown in Table 3.1.

Table 3.1. Lead Times and Lot-size Rule.

Raw Materials	Purchasing lead time	Lot-sizing Rule
Cold Rolled Steel Sheet	5 days	10000 kgs.
Pre-anodized Aluminum	6 weeks	5000 kgs.
Acrylic Sheet	5 days	50 sheets.
Lamp holder	5 days	800 units.
Copper Wire	5 days	5000 metres.
Color Powder	1 weeks	1000 kgs.
Hardware Kits	3 days	144 dozens

3.2 Production Processes

Full equipped with high-performance machinery and tools, the production line is controlled by engineering specialists. The usage of computer control is the standard of production requirements. The machinery technology the firm used is from Japan and Portugal. The company's advanced technology equipment has increased the efficiency of its production processes and enable it to compete more effectively in this business segment.

In producing a fluorescent luminaire, there are about seven main stages of production. These production processes are shearing, hole punching, bending and pressing, welding, color coating, assembly, and packaging. The details of each process are listed below.

(1) Shearing process: In the first process, the metal sheet is fed into the machine and be cut according to the predetermined size. Here, the precision and consistency of the machine performance is very important. The machine must be able to produce accurate straight cut output. Figure 3.1 shows the shearing process.

(2) Punching process: In the second process, the metal sheet is brought to the punching machine. Then, the machine punches on the sheet to make the holes. The machine can be programmed to produce different forms of holes. Moreover, it can produce many holes at one running time and this can reduce much time spent in manufacturing. Figure 3.2 shows the punching process.

(3) Bending and Press process: In this process the metal sheet is bend into the form that has been designed. The information of the form of

each model is stored in the machine's memory unit so that it can be retrieved when used. Figure 3.3 shows bending and press process.

(4) Welding process: In this process the small work pieces, like head and end part, are attached to the larger work piece. The welding head is operated by the workers manually. The adjustment of pulse control is the main factor to achieve smooth output. Then, the work piece will be ground so that the welded points is in neatly condition before it will be going to the next process. The welding process is shown in Figure 3.4.

(5) Color coating process: Dust, dirt, and grease will be removed from the surface of the work piece. And, then it will be coated with phosphate through the iron phosphate pretreatment system for antirust purpose. The type of powder used is epoxy polyester powder which is durable against scratches and any chemical substances. The process is operated through the robot with electrostatic spray gun. Figure 3.5 exhibits the color coating system.

(6) Assembly: In this process, plastic cover, aluminum louver, fluorescent lamp holder and the other fmished assembly will be attached to the housing. The process in shown in Figure 3.6.

(7) Packaging process: Figure 3.7 shows the workers put the finished product into the plastic bag and then in the paper box.

The visual inspection will be made at the end of each process. The quality control staff will choose a sample size and compare to the standard level. Only qualified work piece can pass to the next process. There are two laboratory located inside the factory. The first is the electrical laboratory. This laboratory provides the testing about resistance of the product to excessive voltage

and leakage current. The second laboratory is the photometric laborartory which provides the testing about luminous intensity, luminous efficacy, and total luminaire efficiency. The devices used are shown in Figure 3.8.

Figure 3.1. Shearing Process.

Figure 3.2. Punching Process.

Figure 3.3. Bending and Press Process.

Figure 3.4. Welding Process.

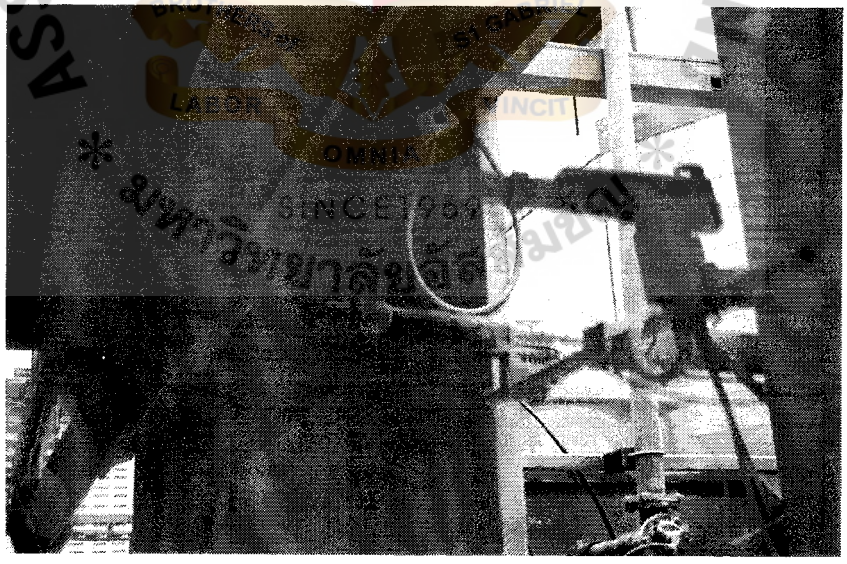


Figure 3.5. Color Coating Process.

Figure 3.6. Assembly.

Figure 3.7. Packaging Process.

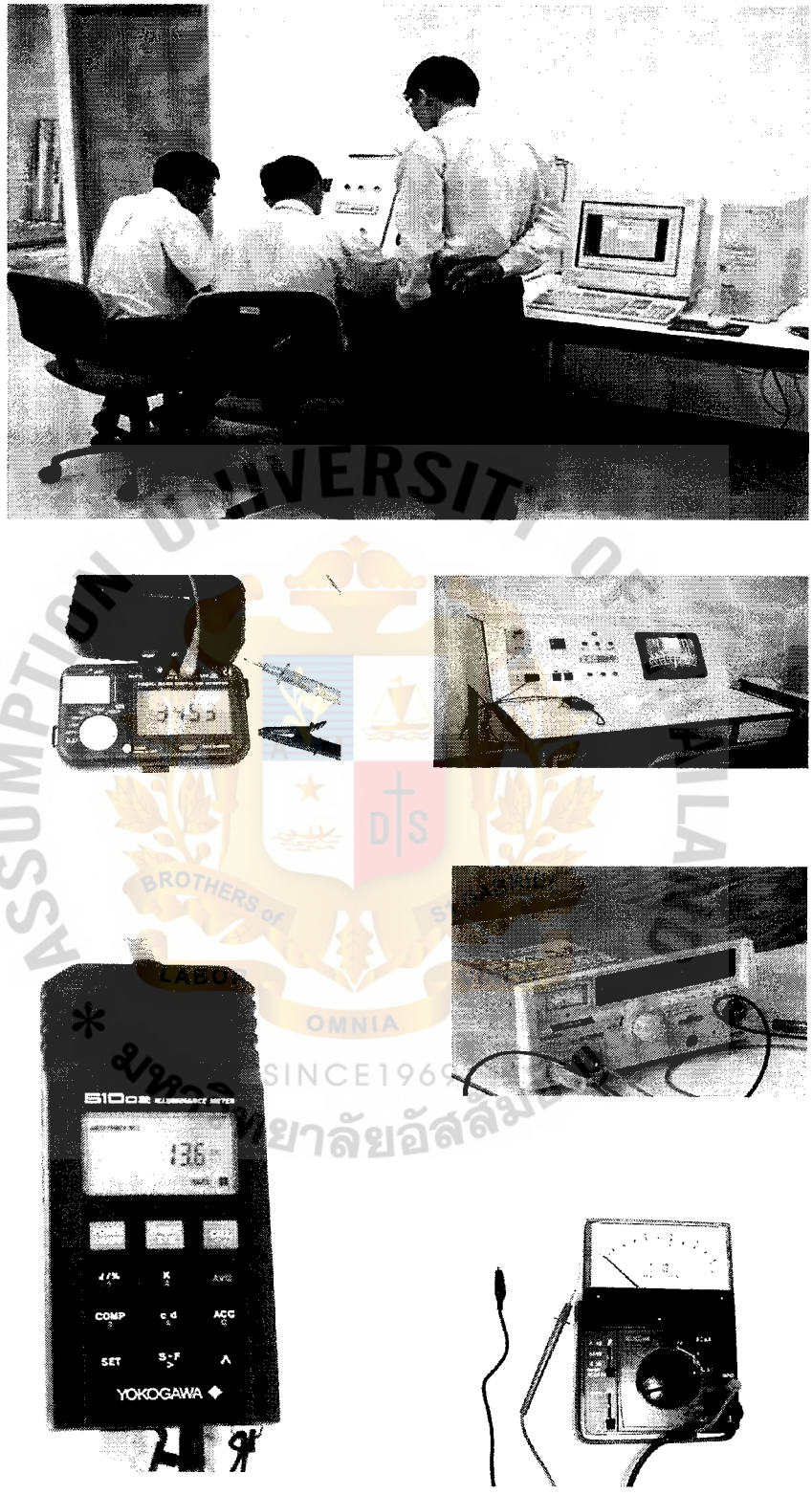


Figure 3.8. Laboratory and Devices.

3.3 Existing MRP System

The existing MRP system used in V.C.K Industrial Lines Co., Ltd. is operated in a traditional replenishment system which is not effective. The flow of materials can be divided into two routes which are inward route and outward route. The inward route is about the receipt of the materials into the company's warehouse. The forecasting of how much to order is done by purchasing officer based on historical data and guessing. The outward route can be separated into internal and external. Material requisition can be considered as a internal outward movement, while delivery order are considered as external outward movement of finished product. Actually, there is no material planning in advance. Usually, deliveries of the products are already scheduled, but overtime, things change and some are needed earlier than originally scheduled. When any demand or any changes are requested, the planner goes to the storeroom with the bills of material for those products. The planner checks whether the materials required are available for use or not. After that, she recalculates projected on hand balance and notes what the changes will have to be made to meet the additional demand. To finish this procedure takes quite a long time as the calculation of all materials and components required is done manually. The existing system cannot effectively keep up with often changes request. If there is the shortage of any material or any components the planner must inform the purchasing department what is needed and when it must arrive. The shortages lead to production delay which is the main reason of order cancellation. So, the company's material planner choose to set up the high level of safety stock in order to avoid the shortage problem. This is not effective and efficient way of operation.

3.4 Current Problems of Existing MRP System

The problems of the existing system can be defined in terms as the following:

(1) It is difficult for the planner to reschedule the plan quickly as the calculation of materials is done manually.

(2) The monthly plan of material planning does not correspond with the actual use of materials.

(3) Searching of needed information requires a lot of time because it was kept in the different place.

(4) The accuracy of the information can not be guaranteed. So, the subjective judgement is involved when the planner making the decisions.

(5) A lot of time is required in preparation of monthly report.

3.5 User Requirements

After gathering information on what the proposed system should do from interviewing, observation, and from report, forms and procedures, the user requirements are summarized as the following:

(1) The new system must have the capability to predict shortages so that the planner can take actions to prevent them.

(2) The system must automatically determine whether and when a new order should be placed.

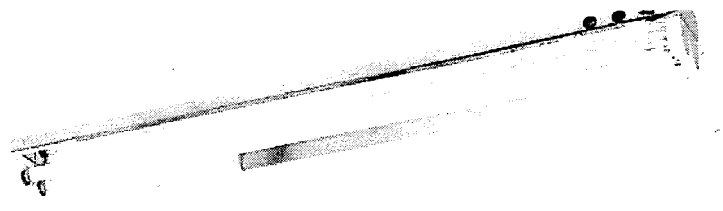
(3) The new system should help the planner to keeps priorities properly updated which can lead to reduction in inventories.

(4) The inventory balance of the materials and components as well as finished products should be automatically updated.

II. THE PROPOSED SYSTEM

4.1 Application of the Company Product to MRP Schedule

A model of product is chosen to be applied to MRP system in order to demonstrate how it really works. A model of 2x4OW industrial type of luminaire with profile mirror aluminum reflector wing is used as an example here. The MRP system is applied first to the high-level items (end products) in the product structure, proceeding to the next lower-level items until it has determined the requirements or all items at that level. The processing continues through successively lower levels until it has determined the requirements for all items in the product structure that will be needed to meet the master production schedule. The bill of material and product structure are used to illustrate the materials and components used to produce this product model. The product picture, its product structure and bill of material are illustrated in Figure 4.1, Figure 4.2 and Table 4.1 respectively. The MRP schedule is prepared based on the company's most recent MPS, VCK111SC/240 bill of material, and the inventory record of the product model and its components. The MPS is shown in Table 4.2. The inventory record file is shown in Table 4.3.



VCK111SC/240

Figure 4.1. VCK111SC/240 Industrial Type Luminaire.

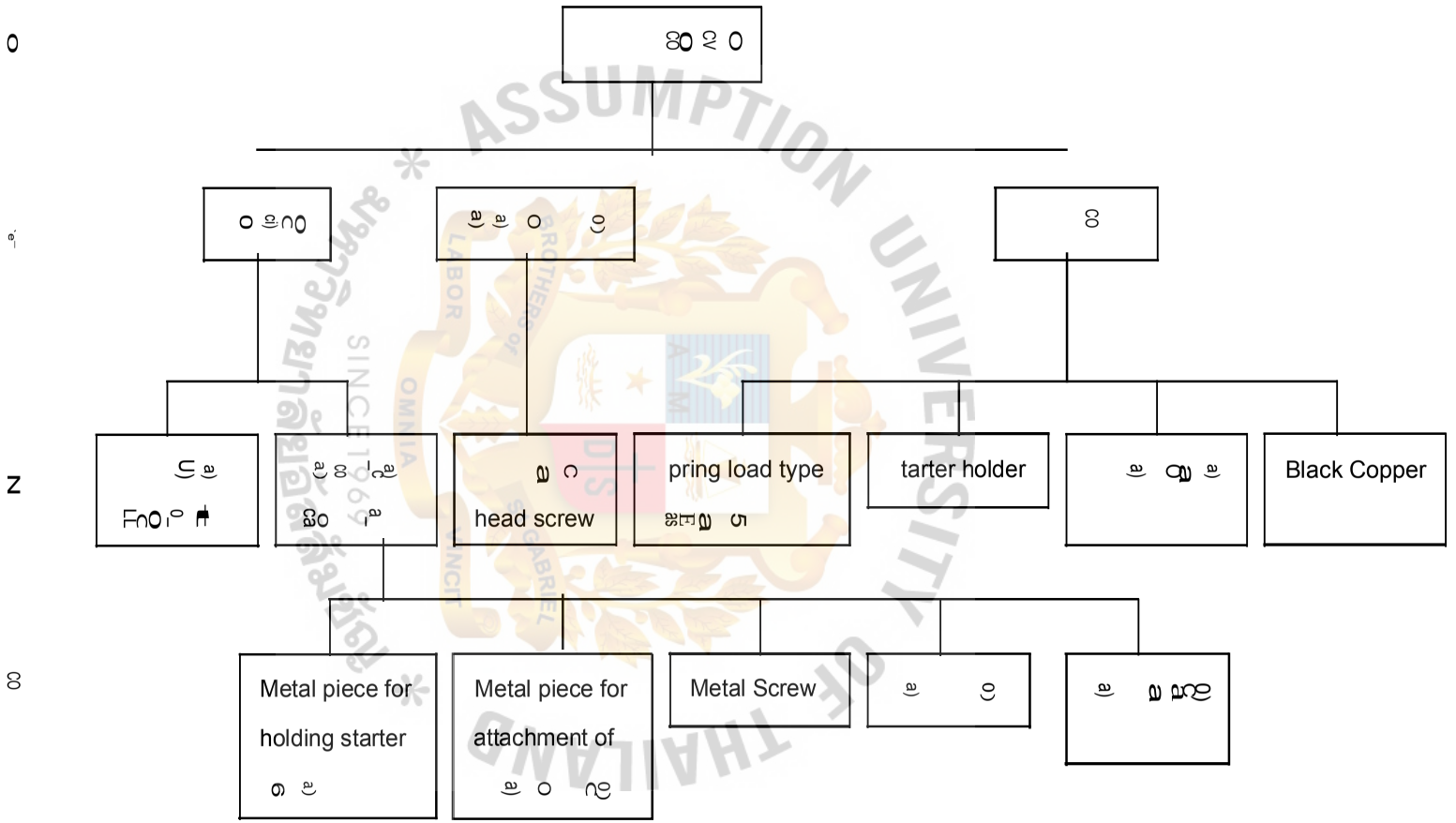


Figure 4.2. The Product Structure Chart of VCK111SC/240.

Table 4.1. Bill of Material of VCK111 SC/240.

Parent Code	Component Code	Level Code	Description	Qty. Required per Parents
	111SC/240	0	2x40w fluorescent industrial type with reflector wing	
111SC/240	H	1	Housing	1
	WS	1	Wiring set	2
	RF	1	86% profile mirror reflector wing	1
H	MB	2	Metal sheet-body part	1
	ME	2	Metal sheet-end part	2
WR	SLH	2	Spring load type lamp holder-G13	2
	SH	2	Starter holder	1
	WCW	2	0.5sq.mm-THW white copper wire	1
	BCW	2	0.5sq.mm-THW black copper wire	1
RW	PPHS	2	Philip pan head screw 5/32"x3/4"	2
MB	MFSH	3	Metal piece for holding the starter holder	1
	MFA	3	Metal piece for attachment of reflector wing	2
	STS	3	Self tapping screw 4"x$^{3}/_{8}$"	4
	MS	3	Metal screw 4"x8"	1
	MR	3	Metal ring 4mm.	2

Table 4.2. Master Production Schedule of VCK111SC/240.

Week	1	2	3	4	5	6	7	8
Gross Requirement						1900		700

Table 4.3. Inventory Record Report of VCK111SC/240.

Item Code	On Hand	Safety Stock	Lot Size	Unit of measure	Lead times (weeks)	Scheduled Receipts	
						Qty.	Week
111SC/240	136	300	500	unit	2		
HS	525	600	500	unit	2		
WS	2800	2000	LFL	unit	1		
RW	150	100	500	unit	1		
MB	200		500	unit	1		
ME	400		1000	unit	1		
SLH	120		5000	unit	1	5000	3
SH	480		3000	unit	1	3000	3
WCW	400		2000	unit	1	2000	1
BCW	640		2000	unit	1	2000	1
PPHS	5000		15000	unit	1		
MFSH	1150		5000	unit	1	5000	3
MFA	340		2000	unit	1	3000	1
MS	3854		20000	unit	1		
MR	5634		100000	unit	1		
STS	8858		300000	unit	1		

It starts with the master production schedule. The demand of 1900 units of VCK111SC/240 is required at the week 5, and 700 units at the week 8. This time phased MRP covers period of eight weeks or 2 months. The schedules of this product model as well as its materials and components at all level are shown below from Table 4.4 to Table 4.19.

Table 4.4. The Time Phased MRP Record for 111SC/240.

Item code: 111SC/240					LT: 2			Lot size: 50(
Week	1	2	3	4	5	6	7	8
Gross Requirement				1000				1000
Scheduled Receipts								
Projected on hand	-164	-164	-164	-164	300	300	300	300
Net Requirement				1164				700
Planned Order Receipts				1164				700
Planned Order Release		1164				700		

Table 4.5. The Time Phased MRP Record for HS.

Item code: HS					LT: 2	Lot size: 500		
Week	1	2	3	4	5	6	7	8
Gross Requirement				1164				700
Scheduled Receipts								
Projected on hand	-75	-75	-75	-75	600	600	600	600
Net Requirement				1239				100
Planned Order Receipts				1239				500
Planned Order Release		1239				500		

Table 4.6. The Time Phased MRP Record for WS.

Item code: WS				LT. 1			Lot size: LFL	
Week	1	2	3	4	5	6	7	8
Gross Requirement				2328				1400
Scheduled Receipts								
Projected on hand	800	800	800	800	2000	2000	2000	2000
Net Requirement				1528				0
Planned Order Receipts				1528				0
Planned Order Release			1528				0	

Table 4.7. The Time Phased MRP Record for RW.

Item code: RW					LT: 1		Lot size: 50€	
Week	1	2	3	4	5	6	7	8
Gross Requirement				1164				700
Scheduled Receipts								
Projected on hand	50	50	50	50	100	100	100	100
Net Requirement				1114				600
Planned Order Receipts				1114				600
Planned Order Release			1114				600	

Now system can explode the requirements for all components through the bill of material. The gross requirements for parent item, VCK111SC/240 are 1000 units in period 4 and 8 respectively. The beginning inventory is 136 units and safety stock is 300 units. After the calculation, it is found that 1164 units and 1000 units are required. When this order is offset with the lead time,

it is planned to release in period 3 and 6. For all level 1 items, the gross requirements are calculated by multiplying the quantity per assembly given above in the table 4.1. The matrix for item HS is completed in the same fashion as the end item's. Since the safety stock is required to be kept at 600 units and there is only 525 units on hand, the net requirement is 1239 units in week 2 and 100 units in week 6. The production lot size of this item is units per lot. Therefore, 300 units is planned to be receipts in week 6 instead of 100 units. For item WS, only 364 units is planned to be release in week 3 as the on hand is adequate to cover the second order which is required in week 8. The item RW has the planned orde release of 1114 units in week 3 and 500 units week 7. The model VCK111SC/240, item HS, WS, and RW, which are higher-level items, require in-house production. All other items are purchased from suppliers. The lower-level items require the same way to calculate the requirement and plan the schedule. All lower-level item's matrix are shown below.

Table 4.8. The Time Phased MRP Record for MB.

Item code: MB					LT: 1	Lot size: 500		
Week	1	2	3	4	5	6	7	8
Gross Requirement		1239				500		
Scheduled Receipts								
Projected on hand	200	200				0	0	0
Net Requirement		1039				500		
Planned Order Receipts		1039				500		
Planned Order Release	1039				500			

Table 4.9. The Time Phased MRP Record for ME.

Item code: ME					LT: 1		Lot size: 1000	
Week	1	2	3	4	5	6	7	8
Gross Requirement		1239				300		
Scheduled Receipts								
Projected on hand	400	400	161	161	161	161	861	861
Net Requirement		839				139		
Planned Order Receipts		1000				1000		
Planned Order Release	1000				1000			

Table 4.10. The Time Phased MRP Record for SLH.

Item code: SLH					LT: 1		Lot size: 5000	
Week	1	2	3	4	5	6	7	8
Gross Requirement			1528				0	
Scheduled Receipts			5000					
Projected on hand	120	120	5120	3592	3592	3592	3592	3592
Net Requirement			0					
Planned Order Receipts								
Planned Order Release								

Table 4.11. The Time Phased MRP Record for SH.

Item code: SH				LT: 1		Lot size: 3000		
Week	1	2	3	4	5	6	7	8
Gross Requirement			1528				0	
Scheduled Receipts			3000					
Projected on hand	480	480	3480	1952	1952	1952	1952	1952
Net Requirement			0					
Planned Order Receipts			0				0	
Planned Order Release		0				0		

Table 4.12. The Time Phased MRP Record for WCW.

Item code: WCW				LT: 1		Lot size: 2000		
Week	1	2	3	4	5	6	7	8
Gross Requirement			3056				0	
Scheduled Receipts	2000							
Projected on hand	400	2400	2400	1344	1344	1344	1344	1344
Net Requirement			656				0	
Planned Order Receipts			2000				0	
Planned Order Release		2000				0		

Table 4.13. The Time Phased MRP Record for BCW.

Item code: BCW				LT: 1		Lot size: 2000		
Week	1	2	3	4	5	6	7	8
Gross Requirement			3056				0	
Scheduled Receipts	2000							
Projected on hand	640	2640	2640	1584	1584	1584	1584	1584
Net Requirement			416				0	
Planned Order Receipts			2000				0	
Planned Order Release		2000				0		

Table 4.14. The Time Phased MRP Record for PPHS.

Item code: PPHS				LT: 1		Lot size: 15000		
Week	1	2	3	4	5	6	7	8
Gross Requirement			2228				1200	
Scheduled Receipts								
Projected on hand	5000	5000	5000	2772	2772	2772	2772	1572
Net Requirement			0				0	
Planned Order Receipts			0				0	
Planned Order Release		0				0		

Table 4.15. The Time Phased MRP Record for MFSH_

Item code: MFSH				LT: 1	Lot size: 5000			
Week	1	2	3	4	5	6	7	8
Gross Requirement	1039				500			
Scheduled Receipts			5000					
Projected on hand	1150	11	11	5011	5011	4511	4511	4511
Net Requirement	0				0			
Planned Order Receipts	0				0			
Planned Order Release				0				

Table 4.16. The Time Phased MRP Record for MFA.

Item code: MFA				LT: 1	Lot size: 2000			
Week	1	2	3	4	5	6	7	8
Gross Requirement	2078				1000			
Scheduled Receipts	2000							
Projected on hand	340	262	262	262	262	1262	1262	1262
Net Requirement	0				738			
Planned Order Receipts	0				2000			
Planned Order Release				2000				

Table 4.17. The Time Phased MRP Record for MS.

Item code: MS				LT: 1		Lot size: 20000		
Week	1	2	3	4	5	6	7	8
Gross Requirement	1039				500			
Scheduled Receipts								
Projected on hand	3854	2815	2815	2815	2815	2315	2315	2315
Net Requirement	0				0			
Planned Order Receipts	0				0			
Planned Order Release				0				

Table 4.18. The Time Phased MRP Record for MR

Item code: MR				LT: 1		Lot size: 100000		
Week	1	2	3	4	5	6	7	8
Gross Requirement	2078				1000			
Scheduled Receipts								
Projected on hand	5634	3556	3556	3556	3556	2556	2556	2556
Net Requirement	0				0			
Planned Order Receipts	0				0			
Planned Order Release				0				

Table 4.19. The Time Phased MRP Record for STS.

Item code: STS				LT: 1		Lot size: 300000		
Week	1	2	3	4	5	6	7	8
Gross Requirement	4156				2000			
Scheduled Receipts								
Projected on hand	8858	4702	4702	4702	4702	2702	2702	2702
Net Requirement	0				0			
Planned Order Receipts	0				0			
Planned Order Release				0				

By its very nature, MRP must reflects the latest information in its planned order releases. In the updating procedures of the MPS, one week is added to the back end of the schedule and one week is taken off from the front end, and all the weekly demands are again estimated. This updating of the MPS is aimed at making the MRP system adaptive to changes in demands for the end items. As the MPS is updated weekly, the MRP schedules are also updated weekly.

4.2 Process Modeling of Proposed System

The process modeling involves graphically representing the functions, or processes which capture, manipulate, store and distribute data between a system and its environment and between components within a system. It is the structuring of analysis and design of the new system requirements. The primary deliverables from process modeling are a set of coherent, interrelated data flow diagrams. The Gane & Sarson symbol is used to represented the data flow diagram conventions in this project. The highest level view, a context diagram, of the proposed system is shown in Figure 4.2. As illustrated in Figure 4.3, the level-0 data flow diagram represents

the proposed system's major processes, data flows, and data stores at a high level of detail. Next, each process in level-0 diagram is explained in greater detail as the sub-processes. The decomposition of all processes are shown in level-1 diagram respectively from Figure4.4 toFigure4.7. Some processes are singular logical function, neither of these processes needed to be decomposed further like the process of updating the data in process. The MRP system for V.C.K. Industrial Lines Co., Ltd. composes of four main processes which are aggregate of MRP input data, process MRP data, generate MRP output, and prepare the management report. The detail of each process in level-0 data flow diagram is described below.

4.2.1 Process 1.0: Aggregate MRP input data

In the first process, the system receives data from many sources. MPS is derived from production scheduler. Bill of material is retrieved from bill of material file. On-hand amount of materials, scheduled receipts, lot size and lead time information are retrieved from inventory record file. These data is filled into the MRP matrix.

4.2.2 Process 2.0: Process MRP data

This process begins with turning MPS into gross requirement. Then, it is adjusted to the scheduled receipts, safety stock and on hand material. Net requirement, now, is calculated and compared with lot size to get the planned order receipt. The on-hand material amount has been changed and automatically updated. The order will be offset with lead time to get the planned order release. The order receipts and releases are two main outputs of this process.

4.2.3 Process 3.0: Generate MRP output

The output of the previous process will be translated into MRP output which are purchase orders, material availability notification, material requisition and the rescheduling notices. The purchase order is launched to the purchase department.

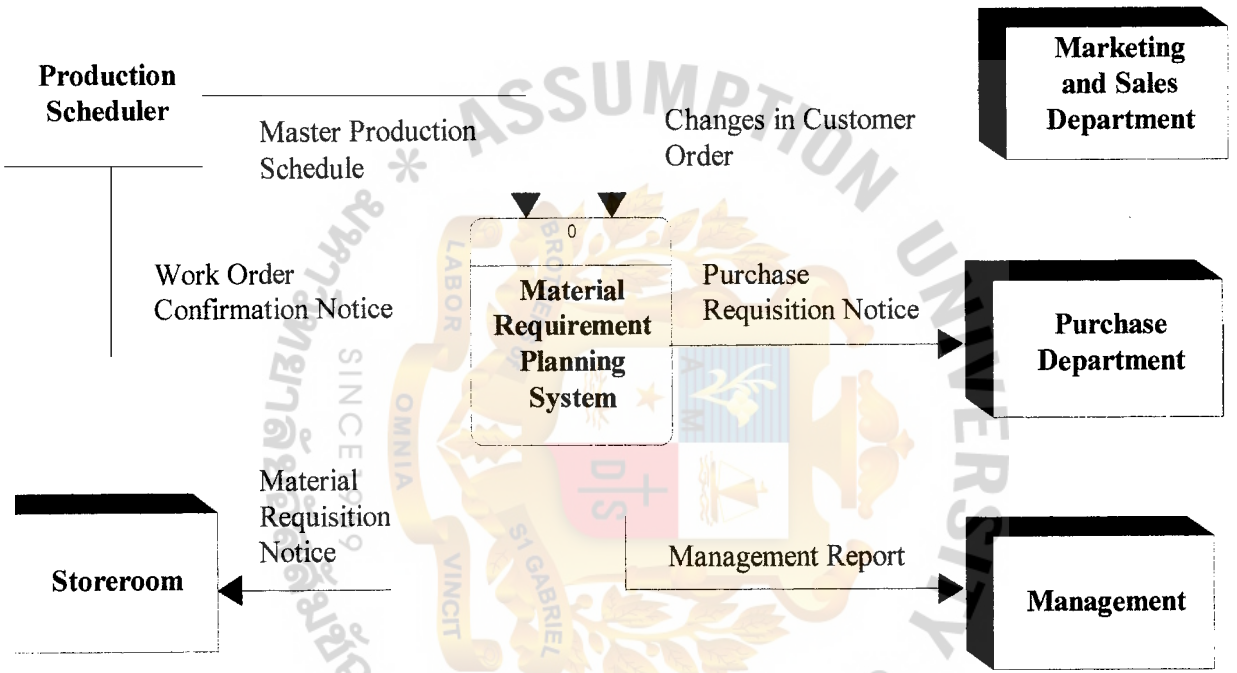
The material availability notification is sent to the production scheduler The material requisition is sent to storeroom so that the officer can prepare the material for use in advance. The possible adjustments which are expedite, delay and cancellation of orders will be informed in the rescheduling notice.

4.2.4 Process 4.0: Prepare management report

Besides the planned order receipts and the planned order releases, the other data is required to be included in the report. The latest on-hand amount is retrieved from inventory record file. All purchase order launched information is retrieved from purchase order file. The information about movement of all materials and supplier must also be included. The management report must be completed with needed data to support the management's decisions.

There are six information files involved in running the system as shown in Figure 4.3. The related data stores are alphabetically listed below. The content of each file will be shown from Table 4.20 to Table 4.25.

BOM	: Bill of Material File
FORECAST	: Forecast File
INV REC	: Inventory Record File
MAT USED	: Material Used File
POFILE	: Purchase Order File
SUPPLIER	: Supplier Master File



Context Diagram of MRP System.

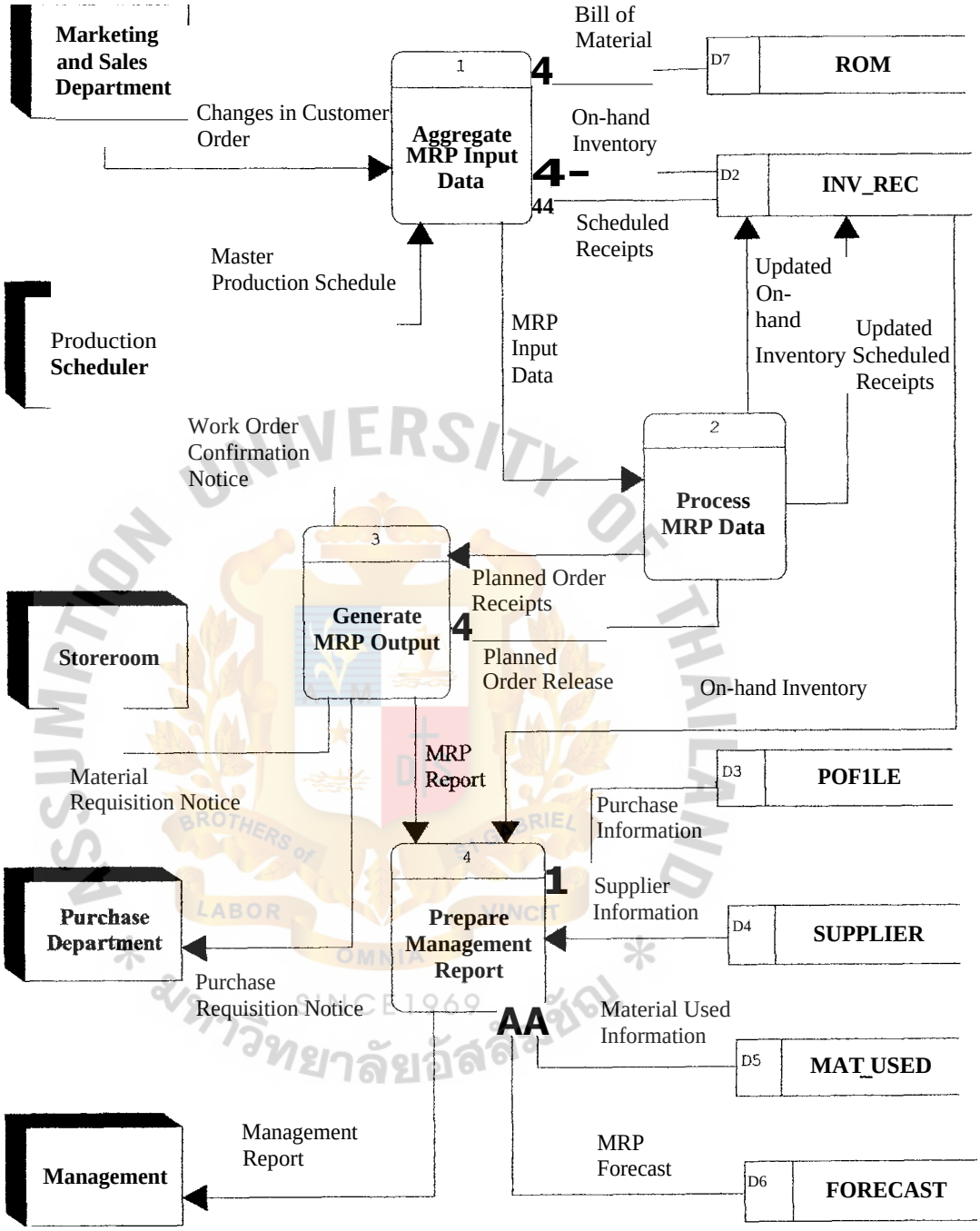
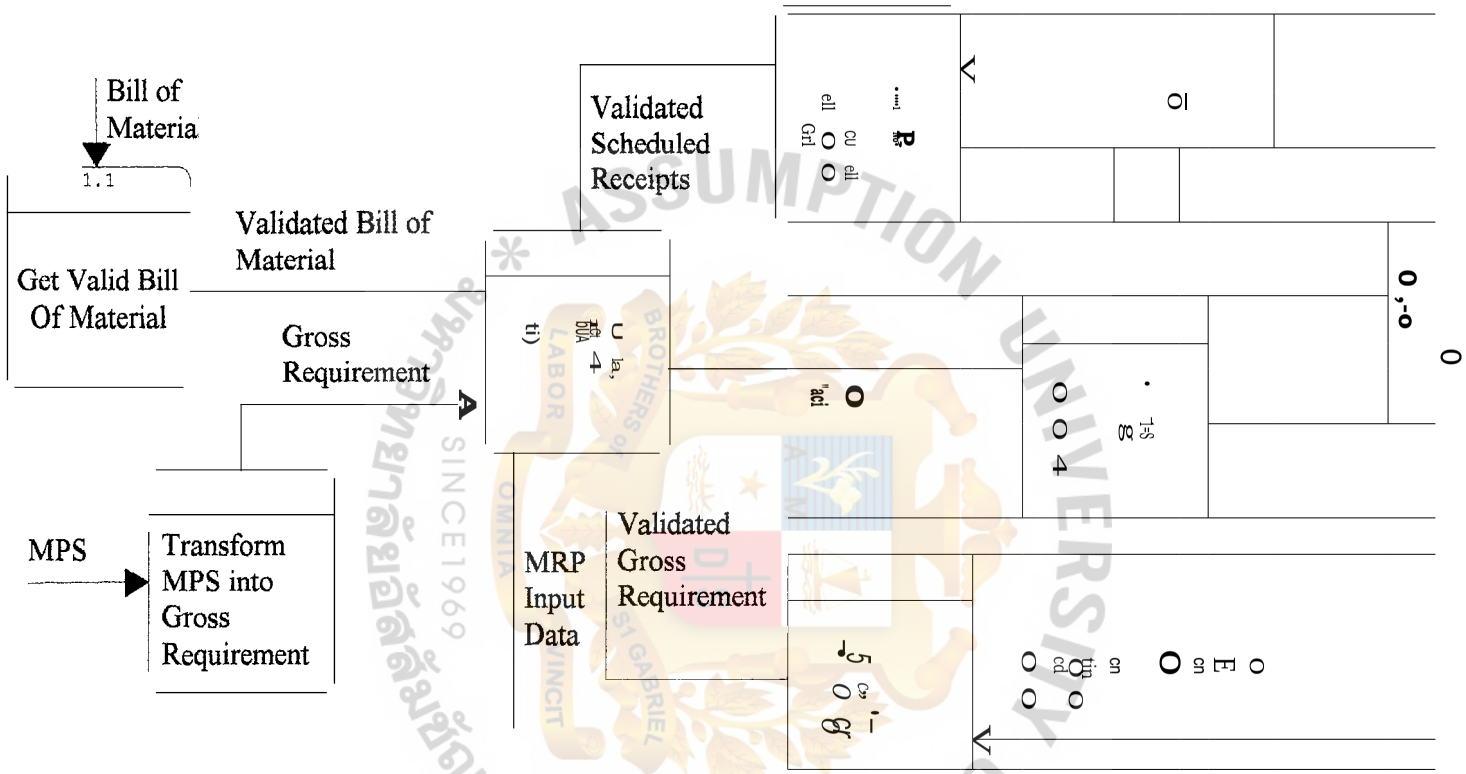


Figure 4.4. Level-0 Data flow Diagram of **MRP** System.



Level-1 Data Flow Diagram of Process 1.0

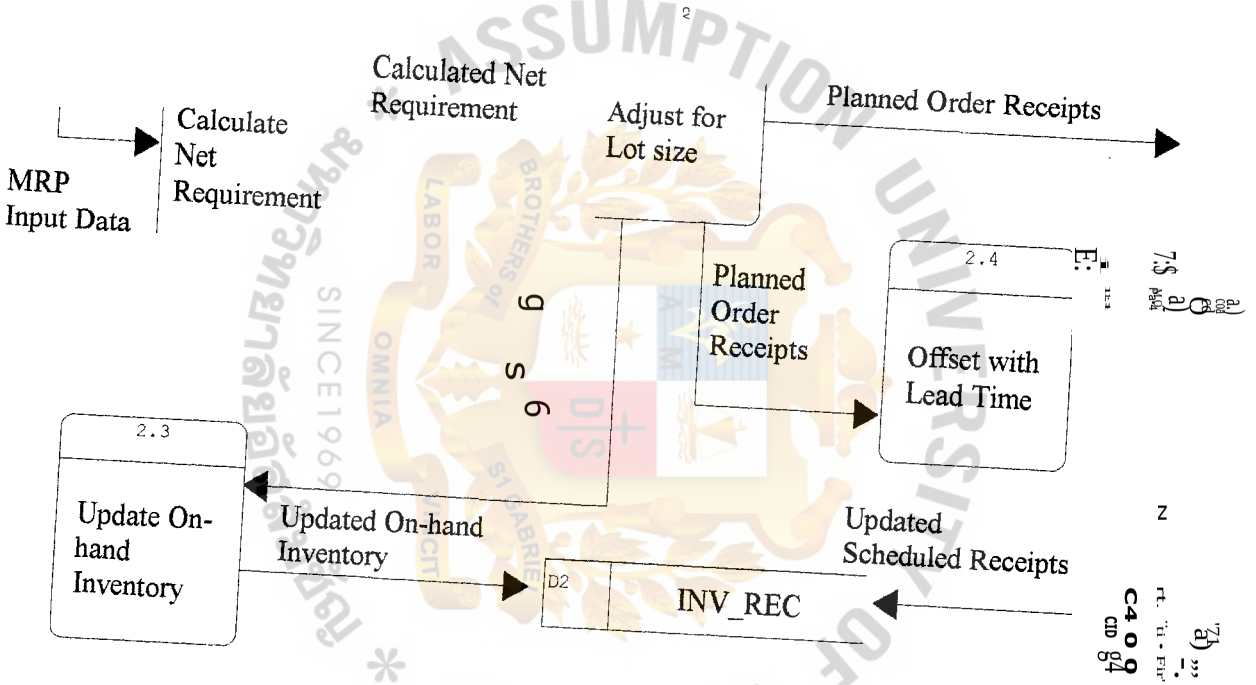
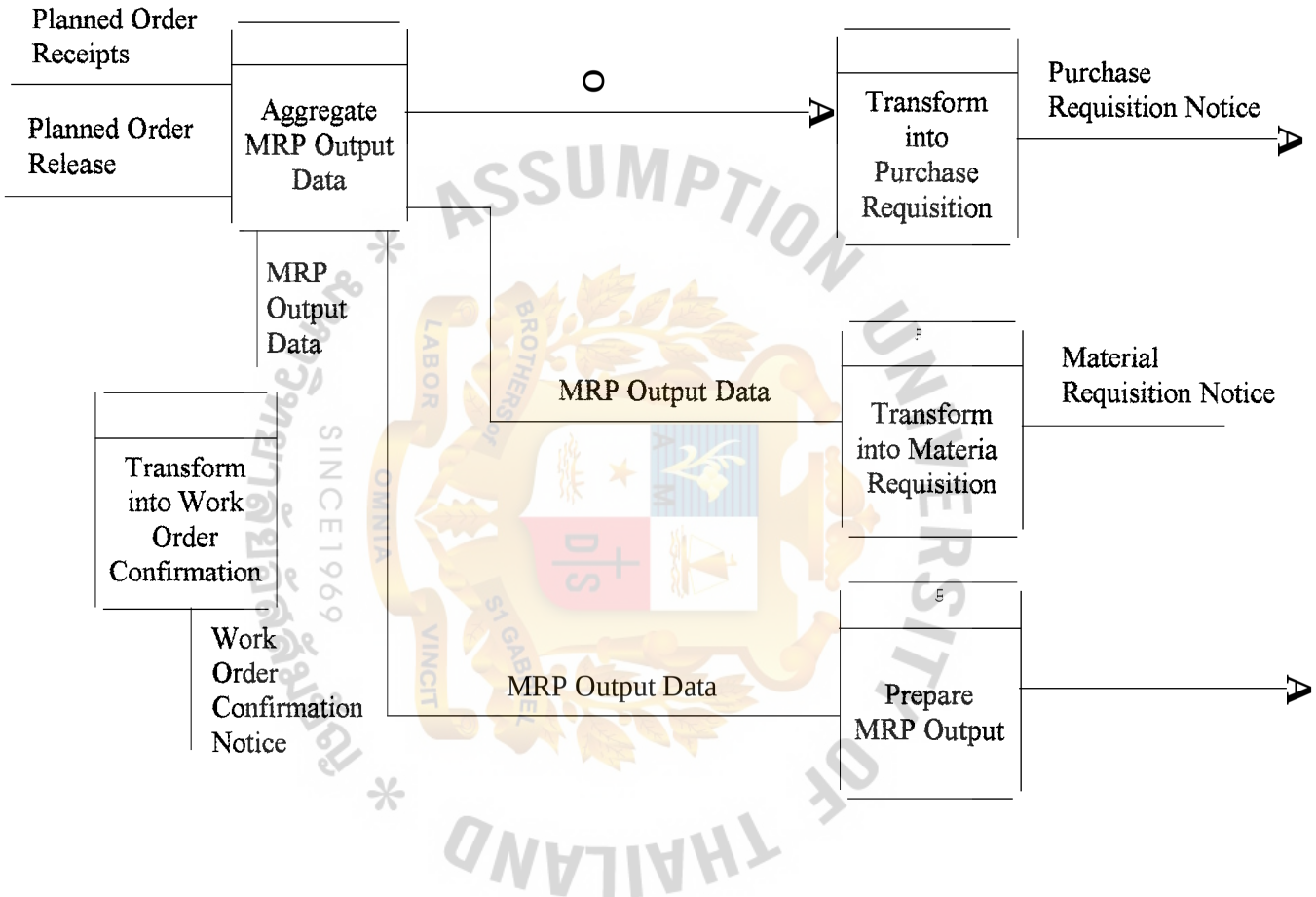


Figure 4.6. Level-1 Data Flow Diagram of Process 2.0.



Z Level-1 Data Flow Diagram of Process 3.0.

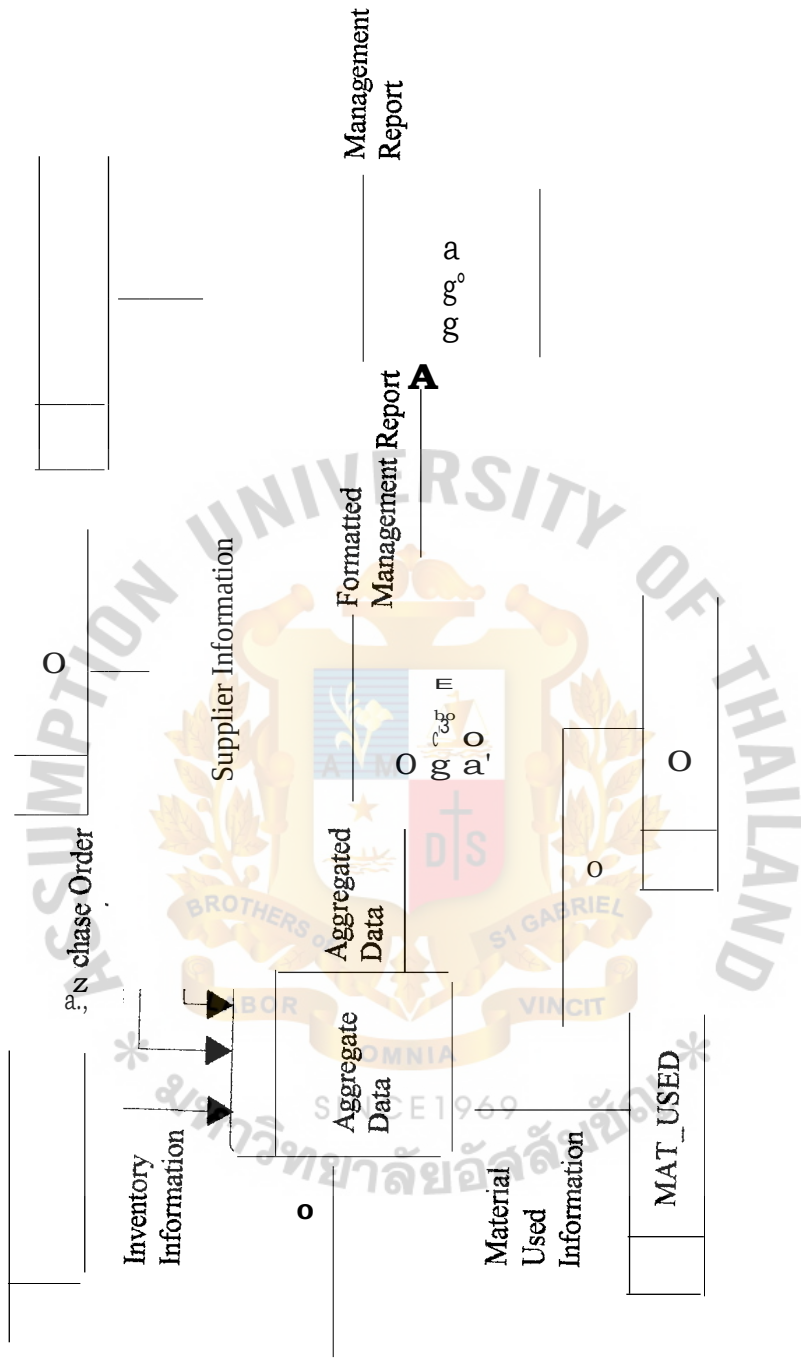


Table 4.20. Data Element of Bill of Material File.

DATA STORE: BOM <Bill of Material File>	
DATA STORE	DATA ELEMENT
Name Of Data Store	Name of Data Element
BOM	End Item Code + End Item Name + Component Code + Component Name + Description +Qty. Required + Unit of Measure + Level Code

Table 4.21. Data Element of Forecast File.

DATA STORE: FORECAST <Forecast File>	
DATA STORE	DATA ELEMENT
Name of Data Store	Name of Data Element
FORECAST	Week No.+ Item Code + Description + Forecast Formula + Forecasted Qty. + Unit of Measure +Unit Cost + Sum. Amt.

Table 4.22. Data Element of Inventory Record File.

DATA STORE: INV REC <Inventory Record File>	
DATA STORE	DATA ELEMENT
Name of Data Store	Name of Data Element
Name of Data Store	Name of Data Element
INV REC	Item Code +Item Type + Beginning Stock + Reciept Amt. + Issue Amt. +Ending Stock +Safety Stock + On Order Amt. +On Hand Amt. + Last Count Date + Location +Lead Time + Lot Size +Last Reciept Date + Last Issue Date + Unit Cost

Table 4.23. Data Element of Material Used File.

DATA STORE: MAT USED <Material Used File>	
DATA STORE	DATA ELEMENT
Name of Data Store	Name of Data Element
MAT USED	Production Date + Production Code +Production Name +Production Rate + Lot No. + Item Code +Descritption +Unit Of Measure +Qty.Used + Unit Cost + Sum. Amt. + Scrapped Remark

Table 4.24. Data Element of Purchase Order File.

DATA STORE: PO <Purchase Order File>	
DATA STORE	DATA ELEMENT
Name of Data Store	Name of Data Element
PO	Requisition No. + Requisitioner +Po. Date + Po. No.+ Item Code +Description +Unit of Measure +Po. Qty.+ Unit Cost + Sum Amt. + Vat Amt. + Total Cost + Release Date + Required Date + Supplier Code

Table 4.25. Data Element of Supplier Master File.

DATA STORE: SUPPLIER <Supplier Master File>	
DATA STORE	DATA ELEMENT
Name of Data Store	Name of Data Element
SUPPLIER	Supplier Code +Supplier Name +Address +Postal Code + Province + Contact Name + Contact Title + Phone No. + Fax No. + Credit Term

4.3 Logical Modeling of the Proposed System

Logical modeling involves representing the internal and functionality of the processes represented on data flow diagrams. The logic of the proposed system is represented through decision tables. The table is composed of three parts which are condition stubs, action stubs and rules. The condition stubs contains the various conditions that apply in the situation the table is modeling. The action stubs list the action that result for a given set of conditions. The rule specifies which actions are to be followed for a given set of conditions. The table is shown in Table 4.26.

Table 4.26. Decision Table of Proposed System.

	Condition / Course of Actions	Rules 1	2	3	4
Condition Stubs	Material Availability	Y	N	Y	N
	Lot size > Net requirement	Y	Y	N	N
Action Stubs	Confirm work orders	X		X	
	Release PO at lot size		X		
	Release PO at net requirement				X

In Table 4.26, there are two condition stubs for material availability and comparison between lot size and net requirement amount. The action stubs contain all the possible courses of action that result form combining values of the condition stubs. There are three possible courses of action in this table: confirm work orders, release purchase order at lot size, and release purchase order at net requirement. The part of table that links the conditions to action is the section that contains the rule. The rule "Y" and "Y" in the first column means the material is adequate for the requirement and lot size amount is greater than net requirement.

In this case that the result of the first condition is rule "Y", the system will confirms the work order and ignores the result of the second condition. In the next column, the "N" and "Y" mean the requirement amount is exceed the on hand amount and the lot size amount is greater than the net requirement amount. So, the system releases the purchase order at lot size. The third column's rule indicates that the material is adequate for use. The system automatically confirms work orders. The inadequate for use and purchase order must be released. For the last column, it implies that purchase order must be released at net requirement amount. The decision tree can also be used to present the logic in the system. It has two main components: decision points, which are represented by nodes, and actions, which are represented by ovals. Each node represents choice. Each path leaving a node corresponds to one of the options for that choice. From each node, there are at least two paths that lead to the next step which is either another decision point of an action. Figure 4.8 exhibits the decision tree of the proposed system.

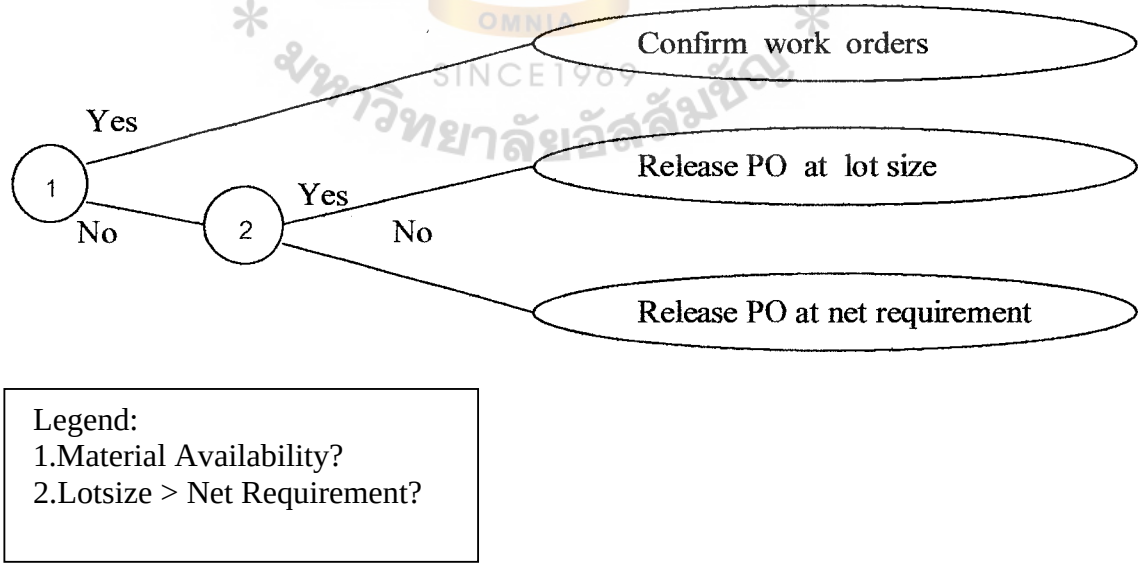


Figure 4.9. Decision Tree of Proposed System.

4.4 Process Specification

The process specification provides further description of element-level processes. It describes the transformation occurring within the lowest level of the data flow diagrams and explains the inputs, outputs and attached elements for each process. The process specification of the proposed system is exhibited from Table 4.27 to Table 4.46.

Table 4.27. Process Specification of Process 1.1.

ITEM	DESCRIPTION
PROCESS NAME:	Get valid bill of material
DATA IN;	Bill of material
DATA OUT:	Validated bill of material.
PROCESSS:	(1) Enter item code. (2) Retrieve bill of material data of that item. (3) Check bill of material data
ATTACHMENT:	BOM file. (Data Store 1)

Table 4.28. Process Specification of Process 1.2.

ITEM	DESCRIPTION
PROCESS NAME:	Transform Master Production Schedule into Gross Requirement.
DATA IN:	Master Production Schedule.
DATA OUT:	Gross Requirement.
PROCESS:	(1) Enter gross requirement amount. (2) Enter required date.
ATTACHMENT:	

Table 4.29. Process Specification of Process 1.3.

ITEM	DESCRIPTION
PROCESS NAME:	Get valid scheduled receipt.
DATA IN:	Scheduled Receipt.
DATA OUT:	Validated scheduled receipt.
PROCESS:	(1) Retrieve scheduled receipt for the item. (2) Check data with purchase department.
ATTACHMENT:	Inventory record file(Data Store 2)

Table 4.30. Process Specification of Process 1.4.

I1EM	DESCRIPTION
PROCESS NAME:	Get valid on-hand inventory.
DATA IN:	On-hand Inventory.
DATA OUT:	Validated on-hand inventory.
PROCESS:	(1) Retrieve on-hand data for the item. (2) Check data with storeroom.
ATTACHMENT:	Inventory record file (Data store 2)

Table 4.31. Process Specification of Process 1.5.

I fEM	DESCRIPTION
PROCESS NAME:	Update gross requirement.
DATA IN:	Changes in customer order.
DATA OUT:	Updated gross requirement.
PROCESS:	(1) Check data with sale and marketing department. (2) Add or deduct from gross requirement. (3) Enter new gross requirement.
ATTACHMENT	

Table 4.32. Process Specification of Process 1.6.

IILM	DESCRIPTION
PROCESS NAME:	Aggregate TARP input data.
DATA IN:	Validated BOM, validated inventory data, gross
DATA OUT:	MRP input data.
PROCESS:	(1) Enter item code. (2) Retrieve data for that item from each file. (3) Enter gross requirement.
ATTACHMENT:	

Table 4.33. Process Specification of Process 2.1.

ITEM	DESCRIPTION
PROCESS NAME:	Calculate net requirement.
DATA IN:	MRP input data.
DATA OUT:	Calculated net requirement
PROCESS:	(1) Plus gross requirement with scheduled receipt. (2) Deduct gross requirement with on-hand amount.
ATTACHMENT:	

Table 4.34. Process Specification of Process 2.2.

I IBM	DESCRIPTION
PROCESS NAME:	Adjust for lot size.
DATA IN:	Calculated net requirement.
DATA OUT:	Planned order receipt and change in schedule
PROCESS:	(1) Compare net requirement with lot size. (2) Order at lot size, if lot size more than net requirement. (3) Order at net requirement, if it more than lot size.
ATTACHMENT:	

Table 4.35. Process Specification of Process 2.3.

ITEM	DESCRIPTION
PROCESS NAME:	Update on-hand inventory.
DATA IN:	Change in on-hand amount.
DATA OUT:	Updated on-hand amount.
PROCESS:	(1) Confirm new on-hand amount. (2) Send data into the inventory record file.
ATTACHMENT:	Inventory record file (Data store 2)

Table 4.36. Process Specification of Process 2.4.

I1EM	DESCRIPTION
PROCESS NAME:	Offset with lead time
DATA IN:	Planned order receipt.
DATA OUT:	Planned order release.
PROCESS:	Offset the receipt date with lead time.
ATTACHMENT:	

Table 4.37. Process Specification of Process 2.5.

IFEM	DESCRIPTION
PROCESS NAME:	Update scheduled receipt.
DATA IN:	Change in scheduled receipt.
DATA OUT:	Updated scheduled receipt.
PROCESS:	(1) Confirm new scheduled receipt. (2) Send data into inventory record file.
ATTACHMENT:	Inventory record file (Data store2)

Table 4.38. Process Specification of Process 3.1.

ITEM	DESCRIPTION
PROCESS NAME:	Aggregate MRP output data.
DATA IN:	Planned order receipt and planned order release.
DATA OUT:	MRP output data.
PROCESS:	Aggregate order receipt with order release
ATTACHMENT:	

Table 4.39. Process Specification of Process 3.2.

I1EM	DESCRIPTION
PROCESS NAME:	Transform into work order confirmation.
DATA IN:	MRP output data.
DATA OUT;	Work order confirmation notice.
PROCESS	Format data into work order confirmation notice.
ATTACHMENT:	

Table 4.40. Process Specification of Process 3.3.

ITEM	DESCRIPTION
PROCESS NAME:	Transform into purchase requisition.
DATA IN:	MRP output data.
DATA OUT:	Purchase requisition notice.
PROCESS:	Format data into purchase requisition notice.
ATTACHMENT:	

Table 4.41. Process Specification of Process 3.4.

I1EM	DESCRIPTION
PROCESS NAME:	Transform into material requisition
DATA IN:	MRP output data
DATA OUT:	Material requisition notice.
PROCESS:	Format data in to material requisition notice.
ATTACHMENT:	

Table 4.42. Process Specification of Process 3.5.

I 1 EM	DESCRIPTION
PROCESS NAME:	Prepare MRP Report
DATA IN:	MRP output data
DATA OUT:	MRP report
PROCESS:	Format MRP output data into report form.
ATTACHMENT:	

Table 4.43. Process Specification of Process 4.1.

ITEM	DESCRIPTION
PROCESS NAME:	Aggregate data
DATA IN:	(1) MRP report. (2) Inventory data. (3) Purchase data. (4) Supplier data. (5) Material used data
DATA OUT:	Aggregated data.

Table 4.43. Process Specification of Process 4.1. (Continued)

PROCESS:	(1) Retrieve inventory data from file (2) Retrieve purchase order data from file (3) Retrieve supplier data from file (4) Retrieve material used data from file (5) Retrieve material forecast from file (6) Aggregate with MRP report.
ATTACHMENT:	(1) Inventory record file (Data store 2) (2) Purchase order file (Data store 3) (3) Supplier master file (Data store 4) (4) Material used file(Data store 5) (5) Forecast file (Data store 6)

Table 4.44. Process Specification of Process 4.2.

ITEM	DESCRIPTION
PROCESS NAME;	Format management report.
DATA IN:	Aggregated data.
DATA OUT:	Formatted management report.
PROCESS:	Format the aggregated data into management report form.
ATTACHMENT:	

Table 4.45. Process Specification of Process 4.3.

ITEM	DESCRIPTION
PROCESS NAME:	Print management report.
DATA IN:	Formatted management report.
DATA OUT:	Management report
PROCESS:	Print management report.
ATTACHMENT:	

4.5 Conceptual Data Modeling of the Proposed System

The conceptual data model is a representation of organizational data. The purpose of a conceptual data model is to show as many rules about the meaning and interrelationship among data as are possible. The most common format used for data modeling is entity-relationship diagramming. E-R notation explains the characteristics and structure of data independent of how the data may be stored in computer memories. The basic entity-relationship modeling notation uses three main constructs: data entities, relationships, and their associated attributes. An entity is a person, place, object, event, or concept in the user environment about which the organization wishes to maintain data. An entity has its own identity which distinguishes it from each other entity. Each entity type has a set of attributes associated with it. An attribute is a property or characteristics of an entity that is of interest to the organization. Relationships are the glue that hold together the various components of an E-R model. A relationship is an association between the instances of one or more entity types that is of interest to the organization. Three common relationship types are unary, binary and ternary. The binary relationship is the most common type of relationship encountered in data modeling. The E-R diagram of the propose system is illustrated in Figure 4.10. In the diagram, the entities are suppliers, customers , production planner, materials, product, component item, inventory item, bill of material, master production schedule, and material requirement planning. The relationship, for example, between suppliers and materials are binary many-to-many relationship. It indicates that many supplier supply many kinds of material and each kind of material can be supplied by many suppliers. The others with binary relationships include customers and product, material and component, production planner and master production schedule, and master production schedule and material requirement planning. The ternary relationship

is a simultaneous relationship. In the diagram of the proposed system, the example of ternary relationship is the relationship between material requirement planning, master production schedule, and inventory item.

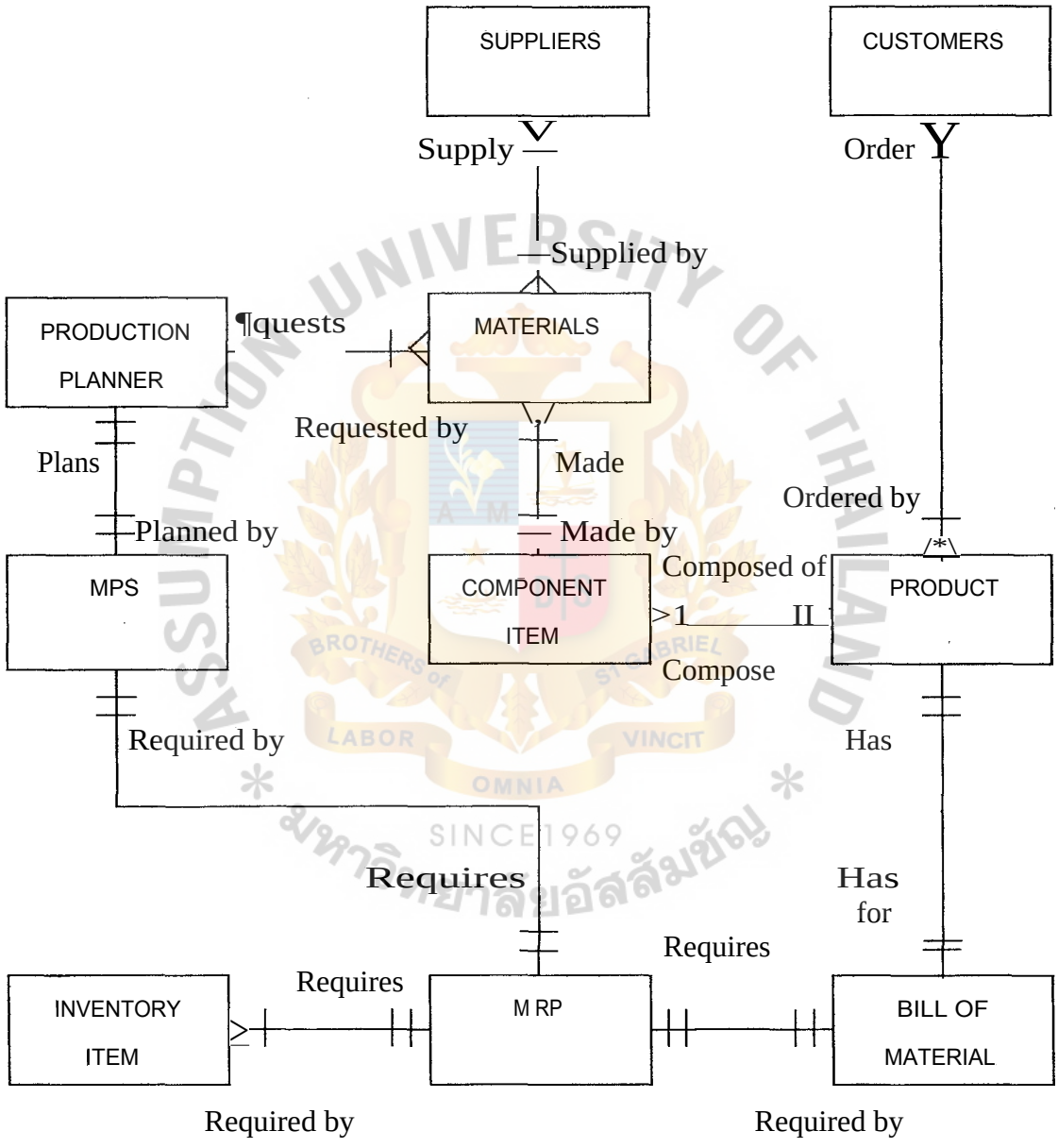


Figure 4.10. Entity Relationship Diagram of Proposed System.

4.6 Form and Report Design

Forms and reports are integrally related to various diagrams developed during requirements structuring. This means that the contents of a form or report correspond to the data elements contained in the associated data flow. Forms are used for data display and data entry. Reports are used solely for reading and viewing. Designing forms and reports is a user-focused activity. Gaining the understanding about who will use the form or report, what is the purpose of the form or report, when is the form or report needed and used, where does the form or report need to be delivered and used, and how many people need to use or view the form or report. Form and report design of the MRP system are exhibited in from Figure 4.11 to Figure 4.19. Figure 4.11 shows the form of master production schedule. It is used for entering the gross requirements for each product. Work order confirmation notice, purchase requisition notice, and material requisition notice are shown in Figure 4.12, Figure 4.13, and Figure 4.14 respectively. For the management report, it is divided into inventory status report, purchase order commitment report, material movement report, and material planning forecast report. Figure 4.15 shows the inventory status report. Figure 4.16 shows the purchase order commitment report. Figure 4.17 shows the material movement report. Figure 4.18 shows the material planning forecast report. Figure 4.19 shows the planned order schedule report.

Master Production Schedule

Date: 2/9/02 Prepared by: Wilawan

Approved by: Thanongsak

No:	Job no.	Item Code:	Week 1	Qty.	Week 2	Qty.	Week 3	Qty.	Week 4	Qty.
1	J01209	1007R/220B	3/9/02	500						
2	J01309	114SC/120			13/9/02	1000			25/9/02	825
3	J01409	114SC/140			14/9/02	2000				
4	J01509	1019C/240A					18/9/02	650		
5	J01609	1018TR/240A	5/9/02	400			19/9/02	400		
6	J01709	1017R/140			14/9/02	800			25/9/02	800
7	J01809	311SW/120					22/9/02	300		
8	J01909	024/240	5/9/02	347						
9	J02009	115BC/140	5/9/02	1200						
10	J02109	022CP/220					23/9/02	1000		
11	J02209	002W/140			16/9/02	58				
12	J02309	018C/240							26/9/02	250
13	J02409	4012W	7/9/02	400						
14	J02509	400/400			18/9/02	690				
15	J02609	BA2	7/9/02	1000			23/9/02	500		
16	J02709	7002F			19/9/09	426				
17	J02809	016C/120							28/9/02	225

Figure 4.11. Master Production Schedule Form.

Work Order Confirmation Notice

No: 9300902 Prepared by Wannee

Date: 2/9/02 Prepared for Chumpol

No:	Job no.	Descriptions:	Quantity:	Action:	Remarks:
1	J00109	2x40w T-Bar type with clear acrylic	250 units	W.F.M	35 sh. Acrylic Sheet
2	J00209	3x40w Ceiling type with reflector	500 units	Cancelled	
3	J00309	1x40w Industrial type with w-wing	400 units	Confirmed	
4	J00409	2x40w Industrial type with w-wing	1900 units	Expedited	To 12/09/02
5	J00509	lx2Ow Batten type 115	600 units	Confirmed	
6	J00609	11cm. Downlight Adjustable	200 units	Delayed	To 28/09/02
7	J00709	250w-400w Mercury Street Light	550 units	W.F.M	200 pcs. Glass Cover
8	J00809	2x20w T-Bar type with reflector	800 units	Confirmed	
9	J00909	1 x4Ow Wire-guard Batten type	500 units	Confirmed	
10	J01009	2x40w Dust-proof type	1000 units	Expedited	To 19/09/02

Note Confirmed Orders can be launched immediately.

Cancelled Orders was cancelled by customer.

Expedited Orders must be moved forward.

Delayed Orders can be moved backward.

W.F.M Orders can not be launched as they have to wait for some materials and components.

Signature: OK_ >`6%,-.

Production Planner 2/09/02 Approval 2/09/02

Figure 4.12. Work Order Confirmation Notice.

Purchase Requisition Notice

No: 9300902 Prepared by Wannee

Date 2/9/02 Prepared for Chumpol

No:	ItemCode:	Descriptions:	Quantity:	Request date:	Release date:	Remarks:
1	CRSS 48-0.7	Cold Rolled Steel Sheet 4x8 fi	5000Kgs.	10/9/02	5/9/02	
	mm.	Thickness 0.7mm.				
2	SLLH1-S4	Spring load type Lamp Holder	2000 units	12/9/02	9/9/02	
		serie S4				
3	BCW	0.5 sq.mm. Black THW	1800 m.	20/9/02	17/9/02	
		Copper Wire				

Note:

Signature

Requestor	Approval	Receiver	Recorder
2/09/02	2/09/02	3/09/02	2/09/02

Figure 4.13. Purchase Requisition Notice.

Material Requisition Notice

No. mr098

Date: 15/9/02

Department: D1-SH

Job No: J02809

Job Name: 114/240

Requisition detail ra" Materials/Componentl] Parts 111 Maintenance

List:	ItemCode:	Descriptions:	Quantity:	Request date:	Remarks:
1	CRSS48-0.7m	Cold Rolled Steel Sheet 4x8 ft. Thickness 0.7mm.	22 Kgs.	28/9/02	

Note:

Signature

D1

Requestor Approval Receiver Recorder

...../...../..... ...../ ..... /..... ...../...../..... /___/___

Figure 4.14. Material Requisition Notice.

Inventory Status Report

Prepared by Wannee

Date 30/9/02

Prepared for Chumpol

Item Level 1

No:	Item Code:	On-hand	Safety Stock	Qty. Required	Ending Amount	Unit cost:	Ending Balance	Lead time	S.R Qty.	S.R. Date
1	011SC/120	345	200	458	87	76	6,612.00	2 weeks	500	9/9/02
2	011SC/140	127	200	180	147	132	19,404.00	2 weeks	500	9/9/02
3	011SC/220	200	100	56	244	110	26,840.00	2 weeks	500	13/9/02
4	011SC/240	876	500	845	531	165	87,615.00	2 weeks	500	15/9/02
5	111SC/120	164	200	220	144	138	19,872.00	2 weeks	500	21/9/02
6	111SC/140	557	200	720	37	209	7,733.00	2 weeks	500	21/9/02
7	111SC/220	261	100	350	11	209	2,299.00	2 weeks	500	10/9/02
8	111SC/240	928	500	1200	228	319	72,732.00	2 weeks	500	10/9/02
9	113 SCD/120	445	200	245	400	47	18,800.00	2 weeks	500	25/9/02
10	113 SCD/140	247	200	380	67	63	4,221.00	2 weeks	500	27/9/02
11	114SC/120	34	200	100	134	55	7,370.00	2 weeks	500	4/10/02
12	114SC/140	108	200	260	48	77	3,696.00	2 weeks	500	4/10/02
13	115BC/120	12	200	20	192	39	7,488.00	2 weeks	500	16/10/02
14	115BC/140	56	200	180	76	50	3,800.00	2 weeks	500	25/9/02
15	311SW/120	132	100	90	142	83	11,786.00	2 weeks	500	6/10/02
16	311SW/140	65	100	15	150	121	18,150.00	2 weeks	500	6/10/02

page 1>>

Figure 4.15. Inventory Status Report.

Purchase Order Commitment Report

No: 9300902 Prepared by Wannee

Date: 30/9/02 Prepared for Chumpol

No.	PO. No:	Issue date:	Description:	Qty.	@	Total cost:	Supplier name:	Status:
1	4509001	4/9/02	Opal Acrylic Sheet 4x8x2.5mn	60 sh.	1,020.00	61,200.00	Thai Poly.	Received
2	4509002	4/9/02	0.5 THW Copper Wire Ya.	1000m	7.78	7,780.00	S.Suphakij	Received
3	4509003	8/9/02	Pre-anodized Aluminium Sheei	15000kg	250.00	3,750,000.00	Alanod	Unrecieved
			86%					
4	4509004	16/9/02	Starter holder	2000 u.	3.50	7,000.00	Paiboon	Received
5	4509005	16/9/02	Spring load type Lamp holder	5000 u	12.00	60,000.00	Paiboon	Received
			113					
6	4509006	25/9/02	Color Powder	100 kgs.	115.00	11,500.00	PowderTec	Received
7	4509007	25/9/02	Cold Rolled Steel Sheet	10000kg	17.56	175,600	Taveeporn	Received
			4x8x7mm.					

Note:

Figure 4.16. Purchase Order Commitment Report.

Material Movement Report

No: 181012

Date 30/9/02

Prepared by Wannee

Prepared for Chumpol

ลำดับ	Material Code:	Description:	[illegible]	[illegible]	Job name:	Recived fr:1	Destination	Time used:	Status:
1	CRSS48-0.7m	Cold Rolled Steel Sheet	[illegible]	[illegible]	[illegible]	Storeroom	Dl-SH	8 Hrs.	Completed
		4x8ft. Thickness 0.7mm.							
2	ACS312-0.25m.	1Stipple Acrylic Sheet	[illegible]	[illegible]	Forming	Storeroom	[illegible]	[illegible]	Completed
		30x120cm.Thickness 0.25m.							
3	[illegible]	Housing of model 1017/240	[illegible]	[illegible]	C. Coating	D4-ARC	D6-ASB	7 Hrs.	Completed
4	ALS86P	Pre-anodized Aluminium	[illegible]	[illegible]	Shearing	Storeroom	[illegible]	[illegible]	[illegible]
		[illegible]							
5	SPLH113	Spring load type Lampholde	[illegible]	[illegible]	Assembly	Storeroom	[illegible]	[illegible]	In-process
		[illegible]							
No.									

Material Movement Report.

Forecast of Monthly Material Used Report

No:	FM0090	Prepared by:	Wannee
Date:	30/9/2002	Prepared for:	Chumphol

Month	Quantity		% Comparison		Remark:
	Forecast	Actual			
January	3,967,000.00	3,679,796.58	96	**80%**	
Febuary	3,850,000.00	4,591,824.07	120	80%	
March	4,000,000.00	2,516,033.56	66	20%	
April	3,680,000.00	3,753,914.32	98	70%	
May	3,800,000.00	3,713,730.25	97	70%	
June	3,800,000.00	3,057,589.68	80	40%	
July	3,550,000.00	3,677,471.30	96	70%	
August	3,780,000.00	3,889,406.19	102	30%	
September	3,940,000.00	4,028,715.93	102	20%	
October	4,000,000.00				
November					
December					
Total	38,367,000.00	32,908,481.88			

Forecast and actual demand of material use

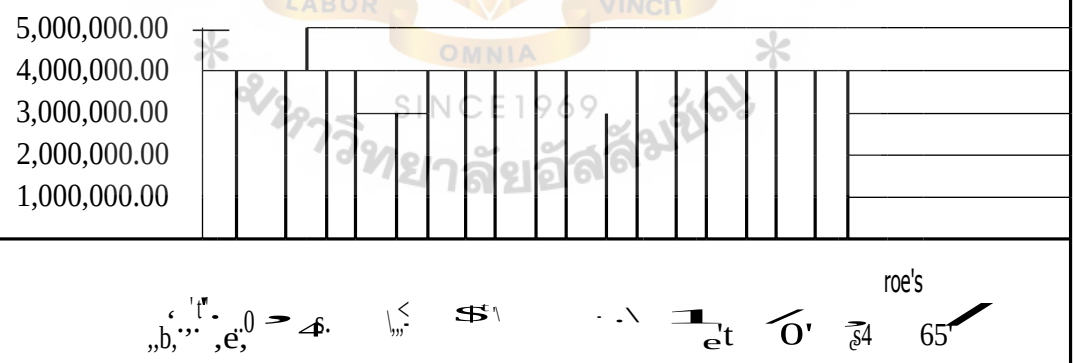


Figure 4.18. Mateial Planning Forecast Report.

Planned Order Schedule Report

Date: 30/9/02

Prepared by Wannee

Prepared for Chumpol

Item Code:	Description:	Level Code:	Parent Code:	Gross Req.	Net Req.	Release Date	Receive Date
HS1017/140	Housing of 1017/240	2	1017R/240	300	120	2/9/02	$1^{9}/_{9}$/02
WS-40-BC	Wiring Set - 40w Rotary LampHolder	2	115BC/240	15400	13800	2/9/02	12/9/02
			1017R/240				
			1219C/240				
			1018TR/340				
			1019C/340				
RW111S3/140	Reflector Wing 1x40	2	111S3/140	154	61	5/9/02	8/9/02
WW011/120	White Wing 1x20		011SC/120	230	210	6/9/02	9/9/02
WG016/220	Wire Guard2x20	2	016C/220	660	453	7/9/02	17/9/02
CB-340	Cross Blade 3x40	2	1019C/340	1078	912	7/9/02	$1^{9}/_{9}$/02
			1017R/240				
			1018TR/340				
PACO24/140	Prismatic Acrylic cover of 024/140	2	024P/140	227	150	15/9/02	22/9/02
SACO22/220	Stipple Acrylic cover of 022/220	2	022U/220	679	456	17/9/02	24/9/02
HS311/140	Housing of 311/140	2	311SW/140	880	569	17/9/02	28/9/02
HS1018/240B	Housing of 1018/24013	2	1018TR/240E	1245	1065	17/9/02	$2^{8}/_{9}$/02
GC400/400	Glass Cover of 400/400	2	400/400W	580	436	18/9/02	$1^{8}/_{1}$0/02
HS002/120	Housing of 002/120	2	002W/120	340	120	26/9/02	3/10/02
WS-120-S4	Wiring Set for 1x2OW Spring load S4	2	$11^{4}/_{1}$20	2800	1549	28/9/02	6/10/02
			114/240				
			311SW/I40				
DF-E27	Downlight Frame -E27 LampHolder	2	7002F/E27	600	560	28/9/02	6/10/02
			7002S/E27				

Figure 4.19. Material Requirement Planning Report.

4.7 Interfaces and Dialogues Design

Interface Design concerns designing of layouts, structuring and controlling data entry. When designing the layout of computer-based forms, the sequence of movement between fields is designed to flow from left to right and top to bottom. Flexibility and consistency are primary concern in designing the navigation procedures within the system. The design allows the users are to be able to freely move forward and backward or to any desired data entry fields. Various types of function capabilities like cursor control capabilities, editing capabilities, and exit capabilities are available to provide smooth navigation and data entry. These functions are consistent throughout the entire system. Boxed caption and radio button are selected as the options for entering text and allow the users to choose standard textual responses. The interfaces in the MRP system are exhibited from Figure 4.20 to Figure 4.30. The first interface is Log On screen which requires the users to enter their names and authorized passwords. The Log On screen is shown in Figure 4.20. Next screen is the Main Menu screen. The Main Menu screen provides three choices to the users. It is exhibited in Figure 4.21. The MRP Process is divided into two screens. The first screen is the screen for entering the item code. The second screen is for entering the gross requirements for that item. They are exhibited in Figure 4.22 and Figure 4.23 respectively. The Update Inventory Data screen is exhibited in Figure 4.24. The Generate MRP Report screen is shown in Figure 4.25. The Planned Order Schedule screen lists the choices of order receipts and order release. It is shown in Figure 4.26. The Planned Order Receipts and Planned Order Release screen allow the users to view the result. These two screen are shown in Figure 4.27 and Figure 4.28 respectively. The Action Notice screen is shown in Figure 4.29. The Management Report screen is shown in Figure 4.30. The sequence

in which information is displayed to and obtain from a user is represented by the dialogue diagram. The dialogue diagram of the system is illustrated in Figure 4.31.

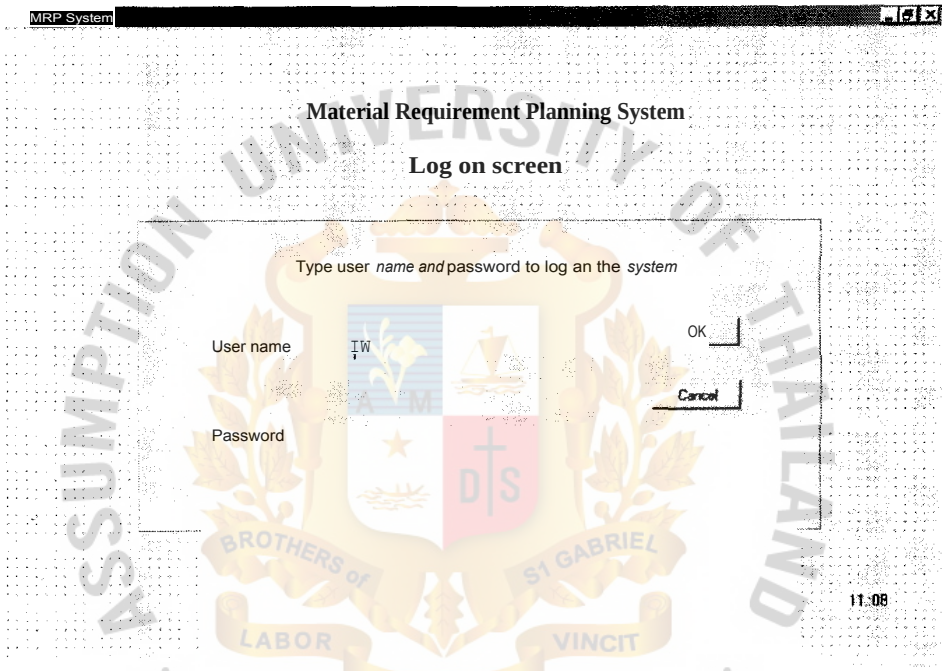


Figure 4.20. Log On Screen of MRP System.

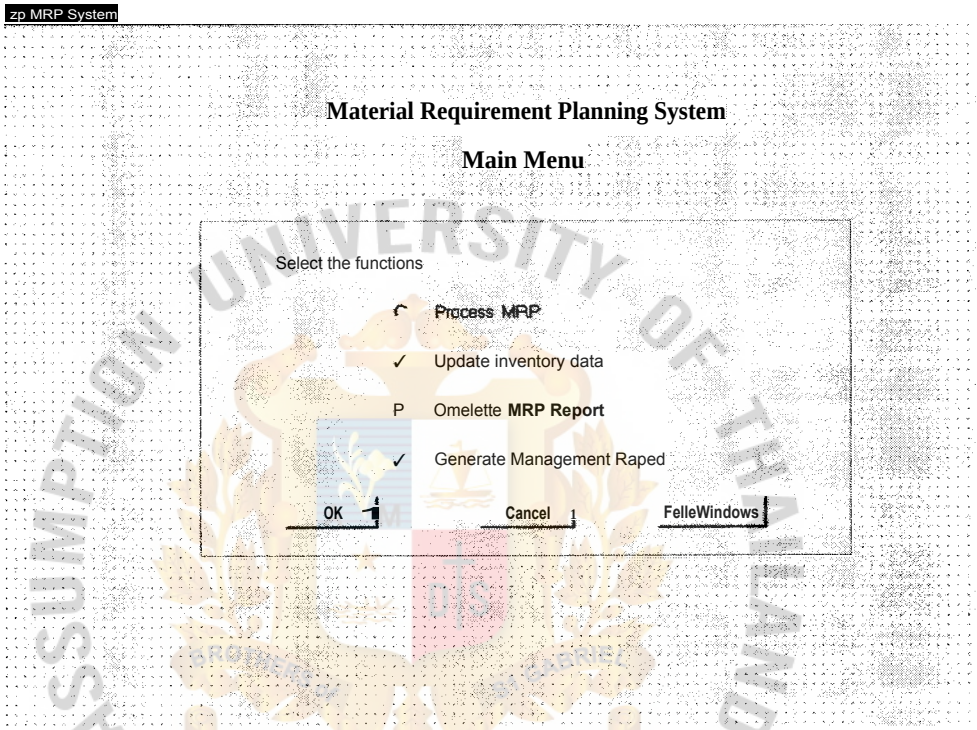


Figure 4.21. Main Menu Screen of MRP System.

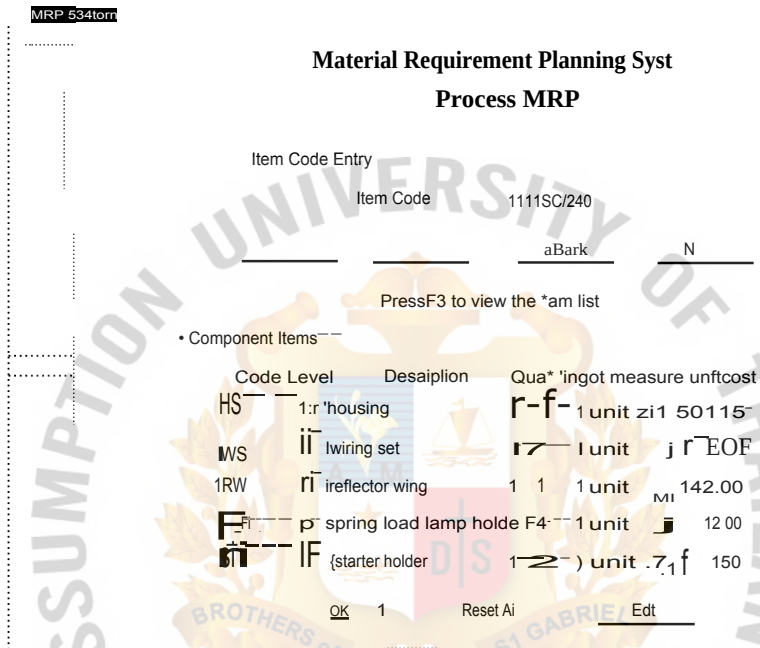


Figure 4.22. Item Code Entering Screen of MRP System.

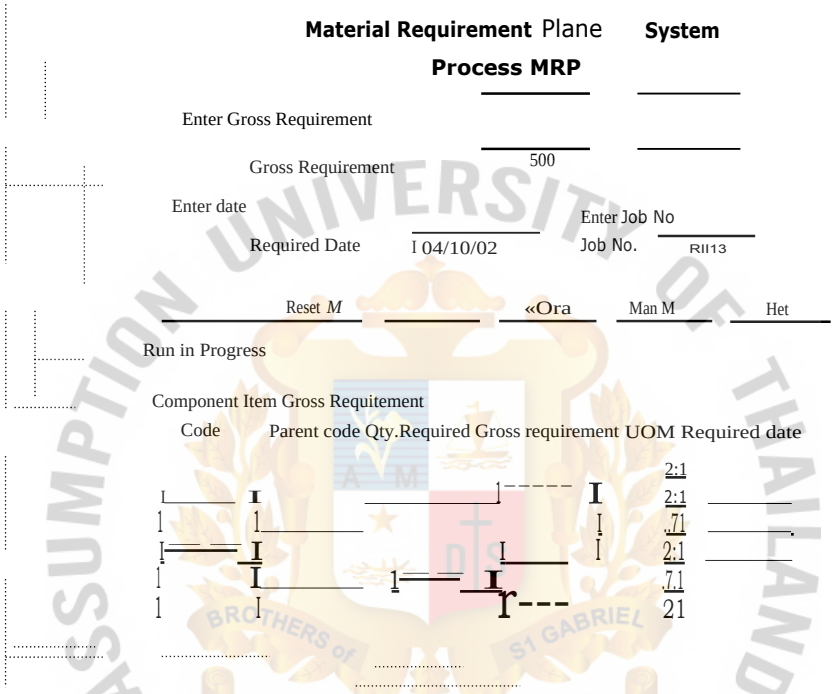


Figure 4.23. Gross Requirement Entering Screen of MRP System.

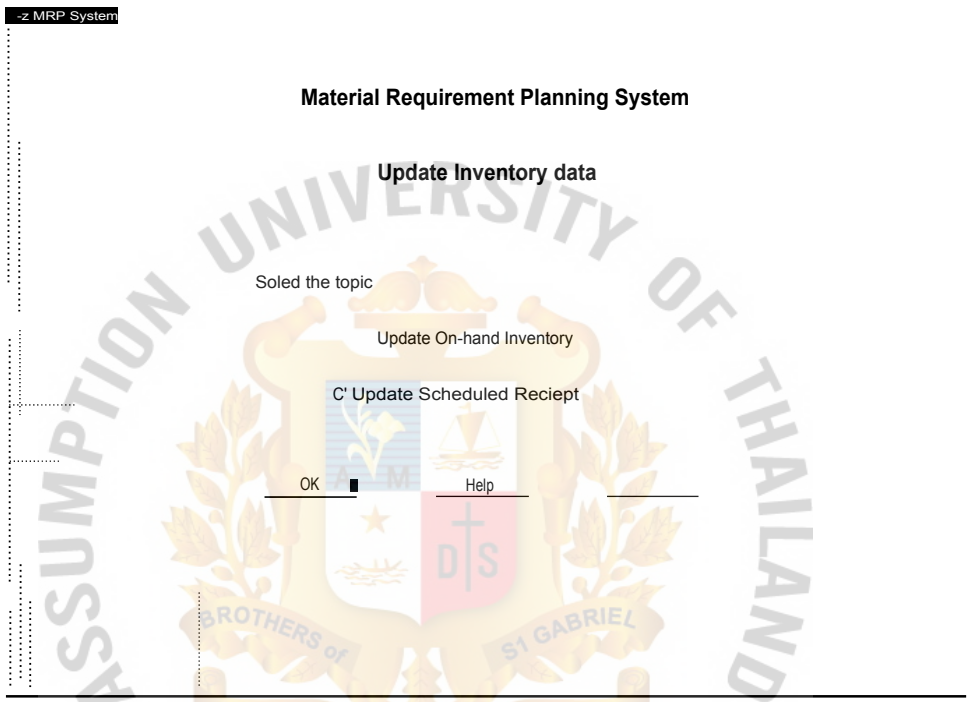


Figure 4.24. Update Inventory Data Screen of MRP System.

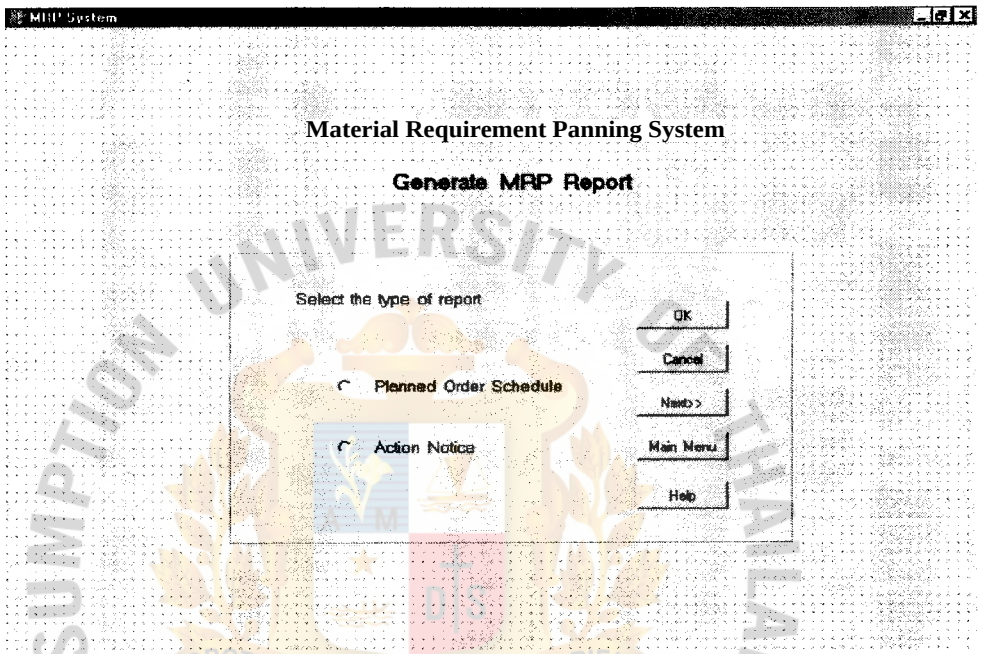


Figure 4.25. Generate MRP Report Screen of MRP System.

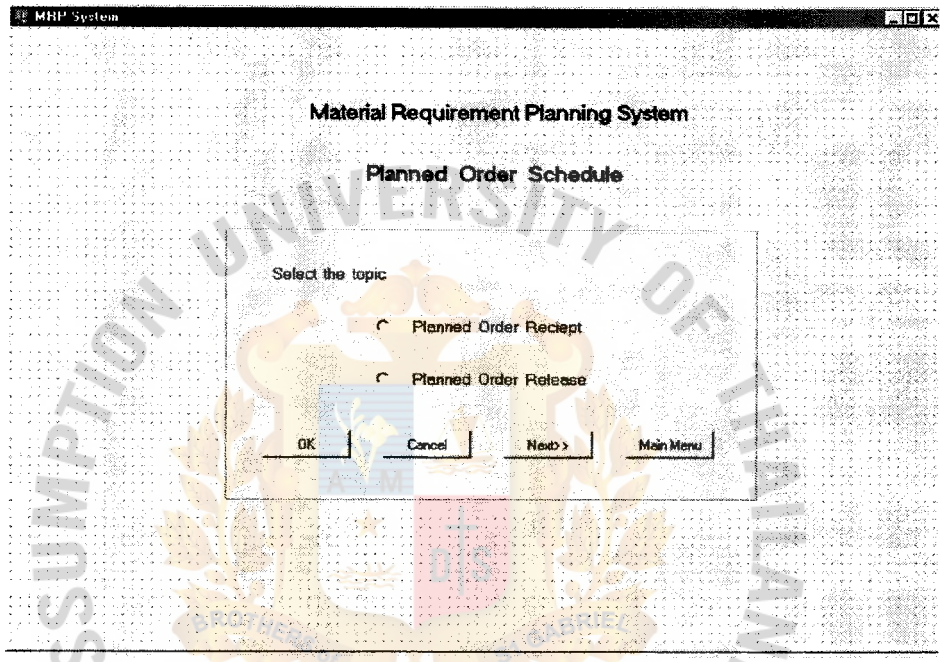


Figure 4.26. Planned Order Schedule Screen of MRP System.

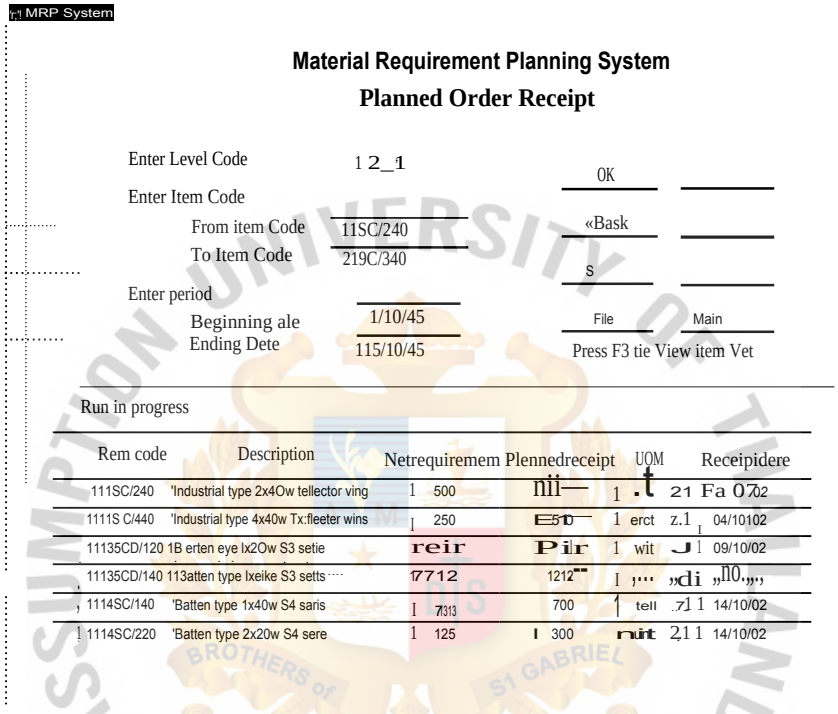


Figure 4.27. Planned Order Receipt Screen of MRP System.

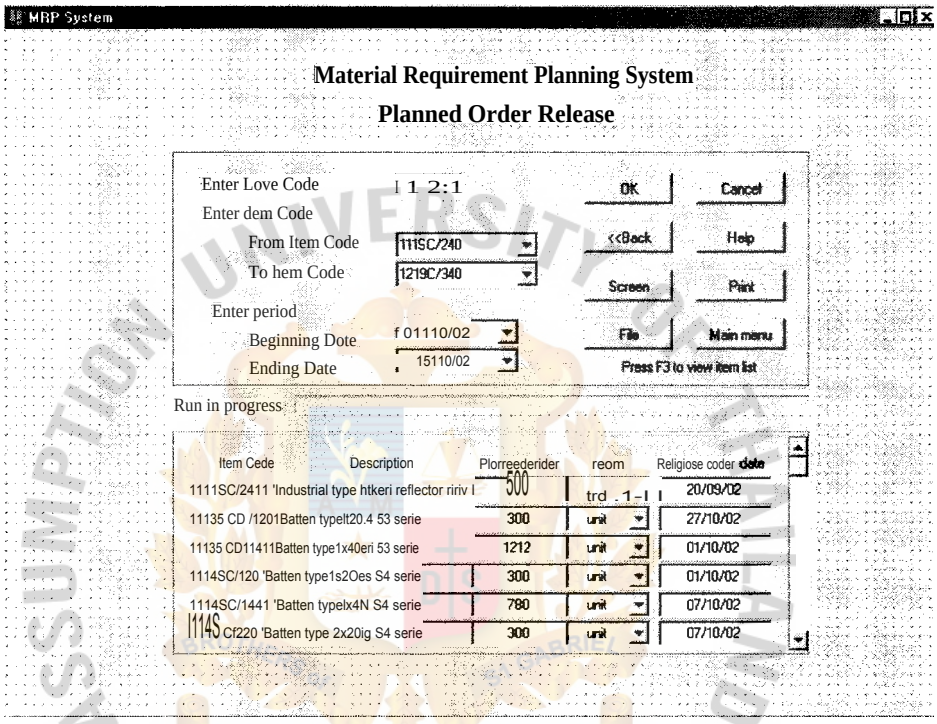


Figure 4.28. Planned Order Release Screen of MRP System.

Figure 4.29. Action Notice Screen of MRP System.

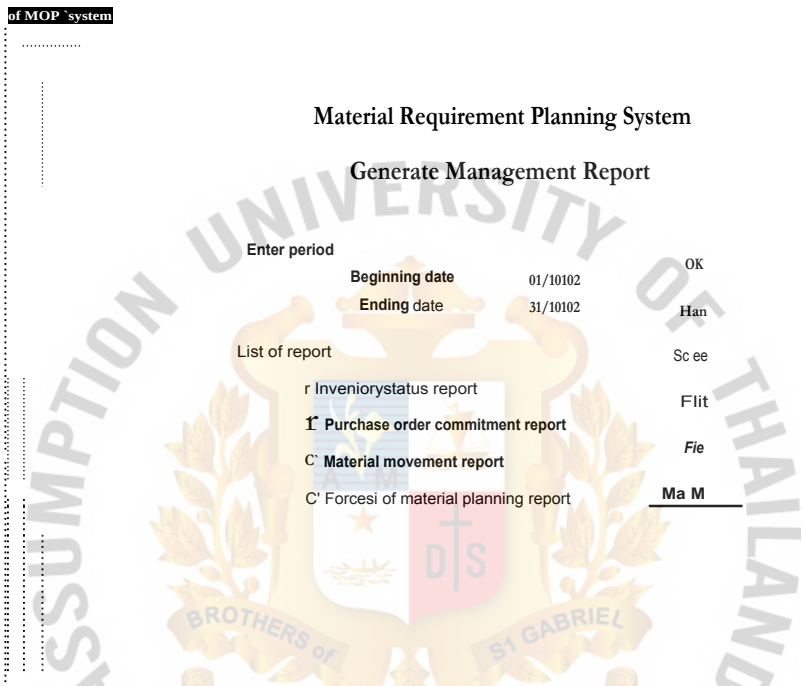


Figure 4.30. Generate Management Report Screen of MRP System.

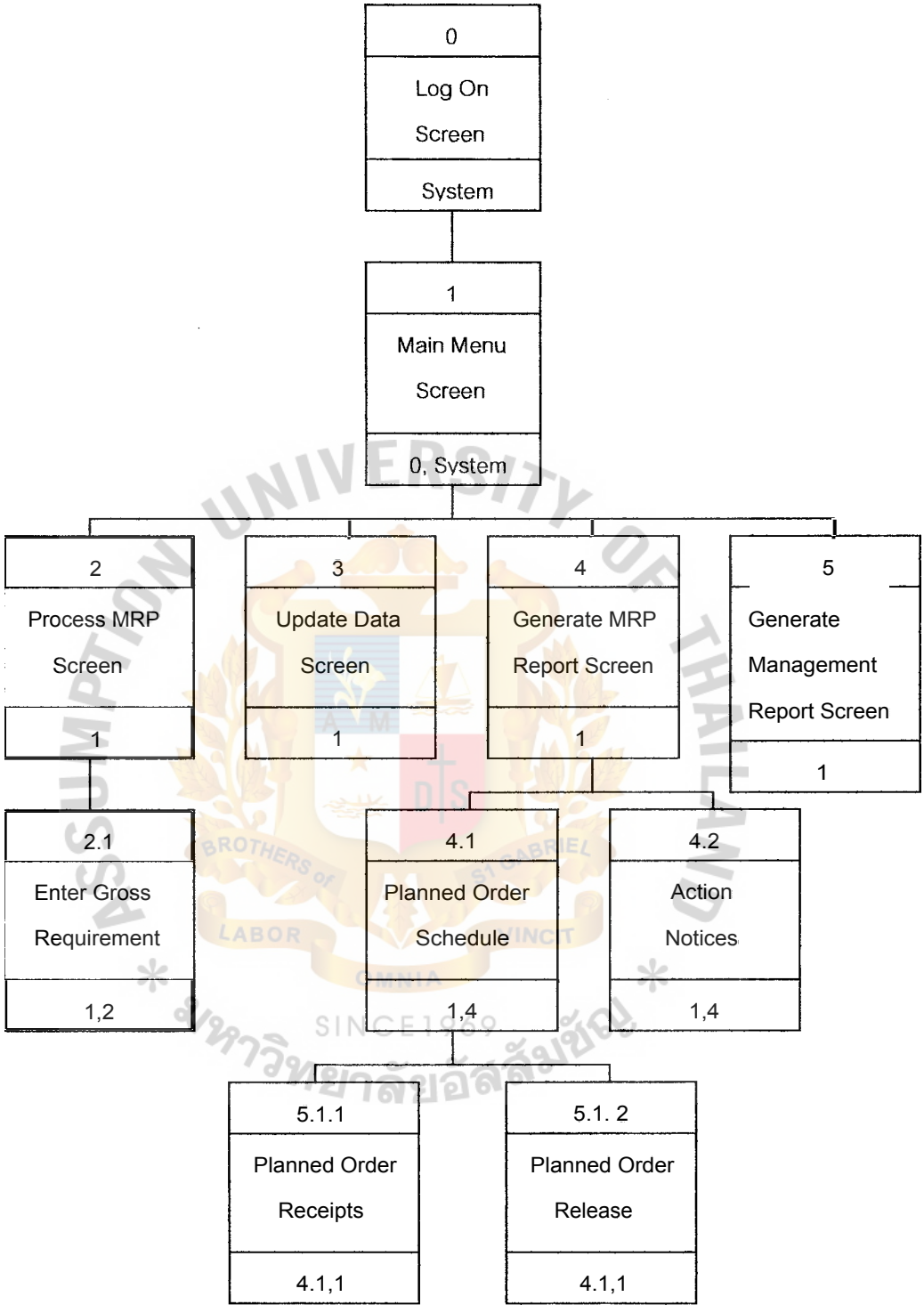


Figure 4.31. Dialogue Diagram of MRP System.

4.8 Hardware and Software requirements for the proposed system

The followings are hardware and software requirements for the proposed system.

4.8.1 Hardware Requirements

Micro-computer (Server)	1 unit
CPU Pentium IV	
Memory 128 RAM	
Hard Disk 20GB (installation usage 100MB)	
Micro-computer **III** (Client)	4 units
CPU Pentium III	
Memory 64 RAM	
Hard Disk 20GB	
Ethernet set	5 units
Ethernet Card (16 bit)	
Cabling	
Printer HP desk jet 845c series	2 units
Printer Switching box	2 units
UPS 500 VA.	3 units

4.8.2 Software Requirements

Operating System	: Microsoft windows 98
System Development Software	: Delphi 5
Database Management Software	: Paradox 8
Network Management Software	: Microsoft SQL
Documentation Preparation Software	: Microsoft Excel 97
	: Microsoft Word 8.0

4.9 Security and Control

When large amounts of data are stored in electronic form they are vulnerable to many more kinds of threats than when they exist in manual form. The common threats are hardware failure, software failure, personnel actions and terminal access penetration. As the system uses Net ware for LAN operation, the information are directly accessible by many individuals. Legitimate users may gain easy access to portions of data that they are not authorized to view. Also, the unauthorized individuals can gain access to the system. So, the security can be promoted by assigning the password only to the authorized user. No one can log on to the system without a valid password. In addition to restricting access to the system, the data sets, and the programs, the access control function also be able to record all events concerning system access. This record provides an audit trail to use in those situations where the system has been used improperly. Limiting the distribution of documentation containing the information and establishing the backup and recover procedures are the policy. The frequency of backup is about once a week. For the physical security, all devices are placed in appropriate area without heat and moisture which are two of the worst enemies of computers. The uninterrupted power supply (UPS) is provided to prevent lost of information or abnormal termination of program caused by fluctuations in the power and increases or decreases in voltage.

V. SYSTEM EVALUATION

5.1 Economic Feasibility

This analysis has the purpose to determine whether the benefits derived from the proposed system outweigh the costs. Cash inflow and cash outflow are estimated below.

5.1.1 Estimated Benefits

The benefit can be considered as both tangible and intangible.

(1) Tangible Benefits

The tangible benefits for Material Requirements Planning System are very obvious. These benefits can be considered in term of monetary as follows:

Reduce order cancellation Bht. 180,000 per annum.

(Average Bht.15,000 per month x 12 months)

Reduce over stock of materials Bht. 100,000 per annum.

(2% of average material inventory cost)

Reduce over-time cost Bht. 74,248 per annum.

(Bht.165/ 8 hrs.x 1.5 x 20 persons x avg. 10days / month x 12 months)

Reduce set up cost Bht 63,373 per annum.

(Labor: (Bht.165/ 8 hrs.) x 0.5 hrs.x 10 persons x 30 days x 12 months)

(Technician: (Bht.7,000/ 30 days/ 8 hrs.) x 2.5 hrs x 30 days x12 months)

Total tangible benefits Bht. 417,621 per annum.

The estimation of these savings derives from the company historical data and observations. The saving value of reduction in order cancellations is provided by sale and marketing department. To estimate the saving, total

loss of revenue from order cancellations in the past twelve months is averaged into monthly basis. The average saving is about Bht. 15,000 per month. The determination of savings of the material inventory cost, the over time cost, and the set up cost are prepared by the production department. From the production report, the ending balance of material is about Bht. 5,000,000 per month. It is expected that , after the MRP system is implemented, the reduction about two percent of material inventory cost can be achieved. The saving of over time cost is calculated based on the wage pay to worker and the average time spent in each month. The maximum level of over time work which has been required by the planner was 30 hours. The over time pay rate is 1.5 time of the wage. For the estimation of set up cost, the number of machines that have to be reset must be considered.

(2) Intangible Benefits

Intangible benefit is the benefit which cannot be easily measured in monetary term. The major intangible benefit will be summarized as follows:

(a) Improve customer satisfaction.

(b) Improve purchasing performance.

(c) Increase manufacturing efficiency.

(d) Improve managerial control of material planning section.

(e) Better management information and Support decision making

(f) Improve communication between departments.

(g) Increase organizational flexibility.

5.1.2 Estimated Costs

The cost can be classified either as one-time or recurring. Both costs of this proposed system are summarized in Table 5.1 and Table 5.2 respectively. One-time cost is the cost in acquiring the hardware, application software, packaged software and training cost. Recurring cost refers to the cost resulting from the use of the system. All costs are based on the current market value.

Table 5.1. One-time Costs of Proposed System.

Description	Baht
Development cost (Bht.15,000 x 3 months)	45,000
Hardware cost	
-Server unit (1 unit @ Bht.43,500)	43,500
-Client unit (4 units @ Bht.23,500)	94,000
-Ethernet set (5 units @ Bht. 900)	4,500
-Printer set (2 units @ Bht. 6,200)	12,400
Software cost	
-Windows 98 (4 units @ Bht. 2,800)	11,200
-Delphi 5	18,000
-Paradox 8	free (bundle with Delphi)
-Microsoft SQL	30,000
-Documentation preparation software	free (bundle with Windows)
User training cost (4 persons x Bht. 1200)	4,800
Total One-time Costs	263,400

Table 5.2. Recurring Costs of Proposed System.

Description	Baht.
Maintenance cost (hardware)	15,000 per annum
Maintenance cost (software)	10,000 per annum
Supplies	6,000 per annum.
Total Recurring Costs	31,000 per annum.

5.1.3 Cost-Benefit Analysis

To conduct the analysis, it requires that the cash outflow compared with the net cash inflows that occur many years later. But these two kinds of inflows are not directly comparable because the time value of money. Money received in the future has to be discounted by some appropriate percentage rate. The discount rate used in the calculation of both present values of benefits and costs is minimum loan rate (MLR) at 7.5%. Information systems differ from manufacturing systems in that their expected life is shorter. The very high rate of technological change in computer-based information systems means that the most systems are seriously out of date in five to eight years. The system has about 5 years life expectancy. To calculate the net present value (NPV), the summary worksheet is created to reflect the present value of all benefits and costs. The summary worksheet is exhibited in Figure 5.1.

Unit: Baht

	Year of Project						
	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	TOTALS
Net economic benefits	0	417,621	417,621	417,621	417,621	417,621	
Discount rate(7.5%)	1.0000	0.9302	0.8653	0.8050	0.7488	0.6966	
PV of benefits	0	388,471	361,367	336,185	312,715	290,915	
NPV of all BENEFITS	0	388,471	749,838	1,086,023	1,398,738	1,689,653	1,689,653
One-time Costs	(263.400)						
Recurring Costs	0	(31,000)	(31,000)	(31,000)	(31,000)	(31,000)	
Discount rate(7.5%)	1.0000	0.9302	0.8653	0.8050	0.7488	0.6966	
PV of recurring costs	0	(28,836)	(26.824)	(24,955)	(23,213)	.585)	
NPV of all COSTS	(263.400)	(292.236)	(319.060)	(344,015)	(367,228)	(388,813)	(388,813)
Overall NPV							1,300,840
Overall ROI (Overall NPV / NPV of all costs)							3.34
Yearly NPV Cash Flow	(263,400)	359,635	334,543	311,230	289,502	269,330	
Overall NPV Cash Flow	(263.400)	96,235	430,778	742,008	1,031,510	1,300,840	

Notes: All baht values' have been rounded to the nearest baht.

Figure 5.1. NPV Summary Worksheet of MRP System.

From the worksheet, it summarizes that the net present value of all benefits from the project exceed the net present value of all costs. So, it is feasible to implement the project.

5.1.4 Break-even Analysis

The purpose of the analysis is to find out at which point the benefits will cover the cost. From the Figure 5.1, it shows that the system break-even occurs between year 0 and yearl. The first year of positive cash flow is used to calculate break-even fraction. It is summarized that actual break-even occurs at month 9 of the first year. Break-even analysis of the MRP system is shown in Figure 5.2.

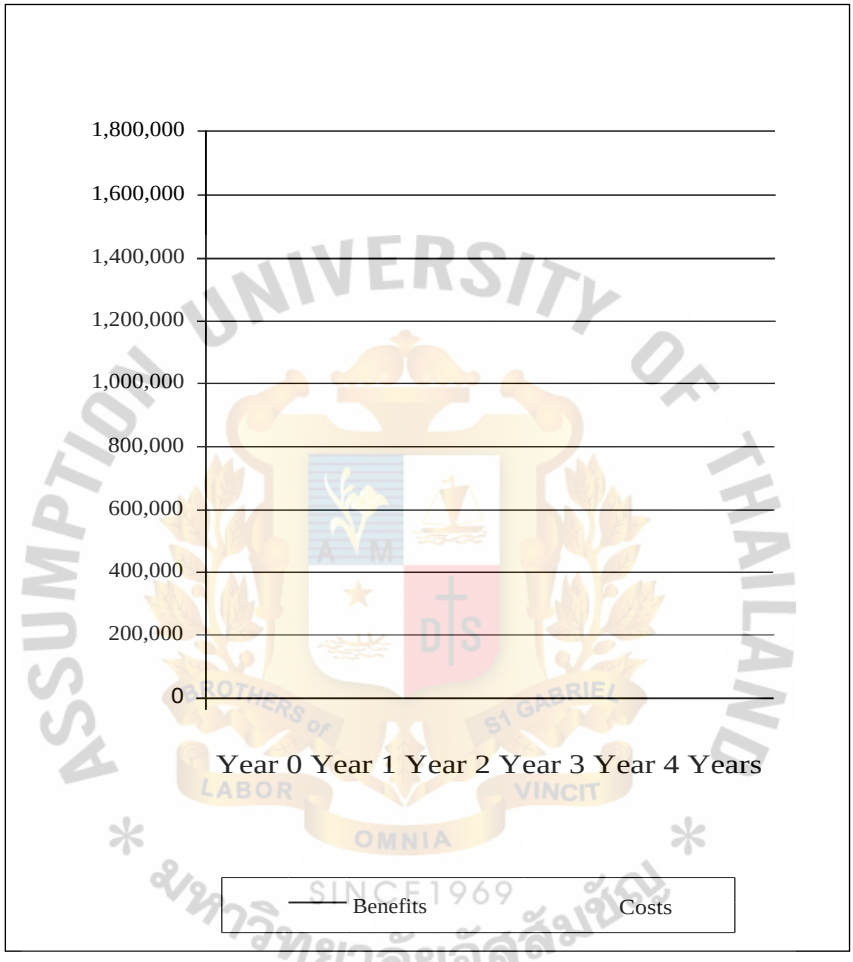


Figure 5.2. Break-Even Analysis of Proposed System.

5.2 Verification and Validation

The objective of the system evaluation is to find out whether the proposed system can fulfill the user requirements, help reduce or get rid of the current problems, and support the operations. Besides the feasibility aspect, there are the other two aspects concerned when one verifies and validates the system. The first aspect is the simplicity of the system. The design of the system should be simple and easy to understand so that it will be easier in redesigning that might be required during implementation process. The second aspect is the capability of the system. The system should be stable and can function properly. Testing is conducted to see whether the system produces the desired results. It can be divided into four types of activities.

(1) Unit testing tests each module in the system separately in attempt to discover any errors. Once pinpointed, the problems can be corrected.

(2) Integration testing is gradual. The procedure begins with testing of coordinating module. Then, the subordinate modules and the modules from the next level are added. The procedure continues until the entire system has been tested as a unit.

(3) System testing tests the functioning of the system as a whole to determine if discrete modules will function together as planned. It is essential that testing data must be carefully prepared, result-reviewed, and corrections made in the system.

(4) Acceptance testing must be done to ensure users' satisfaction. The system must be evaluated by the users and reviewed by the management.

VI. CONCLUSIONS & RECOMMENDATIONS

6.1 Conclusions

In the current business environment with more competitors and highly diverse markets, the companies have to keep enough inventory to meet customer demand. At the same time, companies are continuously seeking to lower costs so they can provide a better product at a lower price. Companies has increased their reliance on MRP of several aspects of the materials planning. V.C.K. Industrial Line Co., Ltd. is among of many companies which realizes this fact. So, this project is proposed. The purpose of this project is to analyze the existing system and to design the proposed system for the materials planning. In the existing system, the decision about when and how much to release orders of material and components depends on subjective judgement of the planner, bases on the planner's work experience and observation. And this, many times, results in the incidence of over stock of some materials and shortage of some materials. The accuracy of information can not be guaranteed. Information is prepared manually and kept in the separate file. It takes a lot of time when searching needed data and in preparation of monthly report. Based on the analysis of the existing system, it is suggested that a proposed computer system should be used instead of manual system.

In the proposed system, the MRP software application is equipped to provide more accurate monthly material requirement planning and the rescheduling of plan. The program is coded in Delphi and the database is kept in Paradox. The system is designed to solve the current problems and fulfill user requirements. The features of this MRP system are bill of materials, stock integration, and purchasing integration. The system has bill of material capability. When bill of materials is integrated with

MRP, it supplies the detailed database of materials for calculating the requirement information. Integration with stock module is required to provide MRP with access to the information about on-hand quantity, scheduled receipts, lot size rule, and lead time. When purchasing is integrated with MRP, the planner can see what is on order and when is to be received. Prior to MRP, the factory completed less than 85 percent of its order on time. After MRP, the on-time delivery rose to 97 percent. With its computerized database, MRP is able to keep track of the relationship of job orders so that if a delay in one aspect of production is unavoidable, other related activities can be rescheduled. The systems have the ability to keep schedules valid and up to date. It also help to improve and reduce work processes and increase the efficiency and the effectiveness of the production department's operations. MRP system typically benefits to management in terms of excellent summarized report as it provides timely, correct and reliable performance information.

Anyway, the quality of input is required in order to obtain the quality output. The focus on the integrity of input data is the key success factor in an MRP implementation. Data integrity means completeness, timeliness and accuracy. Input data should be provided by related people or machine in time and accurately. Discipline, attitude and training are the keys to data integrity. Education of employees is the most important factor. Management must accept the responsibility for the training, discipline and motivation of everyone who handles data.

6.2 Recommendations

Most MRP systems are usually developed on an modular (distributed) basis, rather than as part of a highly integrated information system. Typically, the modules include the following:

(1) Production planning/ master production scheduling

(2) Product structure/ bill of material processor

(3) Inventory control

(4) Material requirements planning

(5) Capacity planning

(6) Shop floor control

(7) Purchasing

(8) Financial analysis

(9) Accounting

Some of these modules are inputs or outputs of the proposed MRP system. Others represent a broadened scope of MRP-related activities. As MRP evolved and more modules and features were added in the areas of capacity planning, marketing, and finance, this new and improved system became known as a Manufacturing Resource Planning System, or MRP II. The enhanced version is more powerful than the original MRP. It provides a common database that the entire company could use. Bill of materials, for example, could be shared with an engineering information system data base, order release and order receipts data could be shared by the order billing and accounts payable information system, and inventory status data could become part of marketing and/or purchasing information systems. Figure 7.1 shows how the various MRP II functions interact.

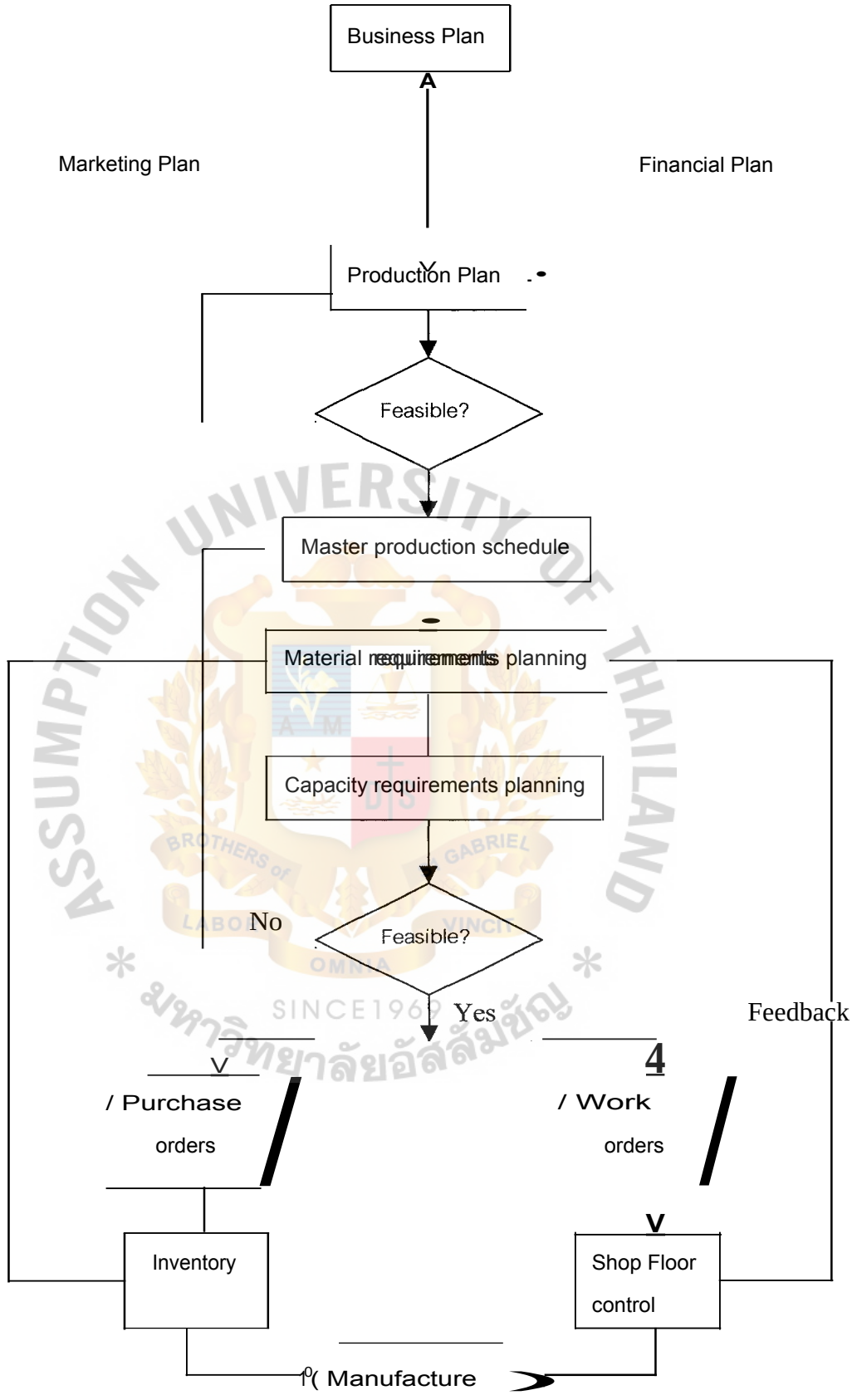


Figure 6.1. Manufacturing Resource Planning (MRP II).

With the introduction of technological enhancements such as open systems platform and client/server architecture, MRP II evolves into Enterprise Resource Planning Systems (ERP). The ERP systems are more technologically advanced and more comprehensive than MRP II systems. They integrate processes, information, and people across functions, plants, companies, and geographic locations. ERP systems typically contain production-oriented MRP modules, as well as MRP II- type modules for business planning, customer service, financial management, and accounting. The ERP system plans not only the allocations of manufacturing resources but also other resources, and has the applications in service as well as manufacturing industries. SAP R/3 is the one of popular ERP software. It consists of a series of application modules that can be used alone or in concert. The modules are fully integrated, use a common database, and support processes that extend across functional areas. Transactions in one module are immediately available to all other modules at all relevant sites. Figure 6.2 shows SAP's enterprise resource planning modules.

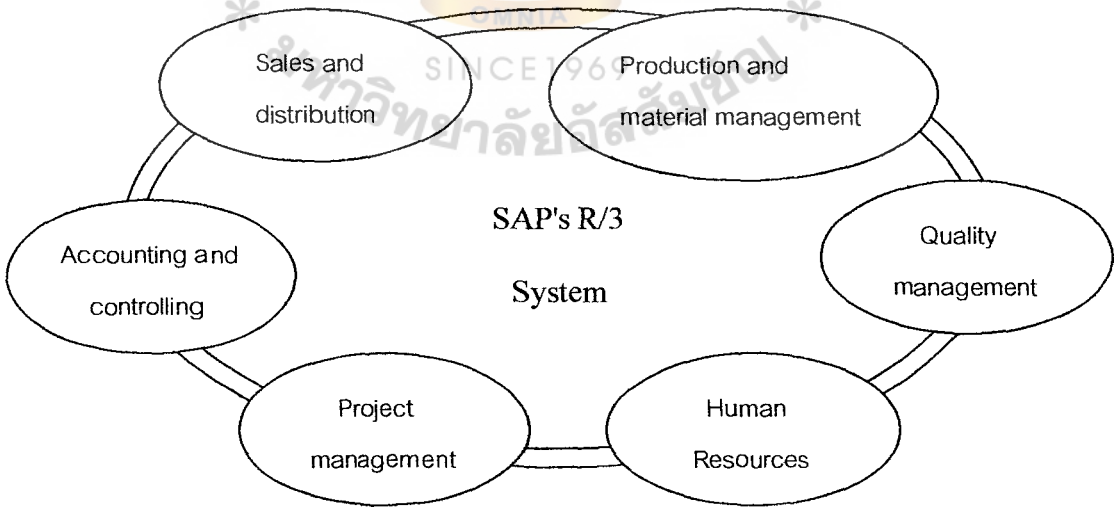


Figure 6.2. SAP's Enterprise Resource Planning Modules.

As shown in figure 6.2, R/3's modules can be grouped into six main categories. The accounting and controlling module encompasses financial accounting, investment management, cost control, treasury management, asset management, and enterprise controlling. The sales and distribution module supports customer-related activities such as order processing, product configuration, and delivery quotations. Pricing, promotions, availability, and shipping options are determined as sales orders are entered. Distribution requirements, transportation management, shipping schedules, and export controls are included in the module. Also, billing, invoicing, rebate processing, product registrations, and customer complaints are included. Material management manages all tasks related to the supply chain, including purchasing, inventory and warehouse functions, supplier evaluations, JIT deliveries, and invoice verification. Production planning is set up to handle all types of manufacturing. The module interfaces with CAD programs; performs process planning, bill of material processing, and product costing; processes engineering change orders; plans material requirements; allocate resources; and schedules and monitors production. Quality management monitors, captures and manages all processes related to quality along the entire supply chain. It coordinates inspections of incoming and in-process material, take corrective measures and integrate laboratory information. Plan maintenance plans, controls, and schedules preventive maintenance and performs breakdown maintenance to ensure the maximum availability of physical assets. Customer service relates to the repair, return, and replacement of unsatisfactory items, the availability of service parts, product reliability and customer satisfaction. The human resources module covers all personnel management tasks, including workforce planning, employee scheduling, training and development, payroll and benefits, applicant data, job descriptions, and work flow analysis. The project management module coordinates

and controls all phases of a project from quotation to design and approval, to resource management and cost settlement. It plans and monitors data and resources using work breakdown structures, critical path analysis, and project crashing. Together, these modules form an integrated information technology strategy for effective managing the entire enterprise.

BIBLIOGRAPHY

1. Hoffer, J. A., George, J. F., and Valacich, J. S. Modern System Analysis & Design: Addison Wesley, 1999.

2. Landvater, D. V. World Class Production and Inventory Management. New York: John Wiley & Sons, Inc., 1997.

3. Laudon, K. C. and J. P. Laudon. Management Information System. New Jersey: Prentice-Hall International, Inc., 2000.

4. Russell, R. S. and B. W. Taylor III. Operations Management. New Jersey: Prentice-Hall International, Inc., 2000.

5. Silver, E. A., D. F. Pyke, and R. Peterson. Inventory Management and Production Planning and Scheduling. New York: John Wiley & Sons, Inc., 1998.