Chapter 7: MRP

Objectives

- Understand what MRP is.
- Examine how MRP plays a part in inventory management.
- Appreciate the use of a simple mathematical model of MRP.

1. MRP System

1.1 Introduction

Material requirements planning (MRP) is a production planning and inventory control system used to manage manufacturing processes. Most MRP systems are software-based.

An MRP system is intended to simultaneously meet three objectives:

- Ensure materials are available for production and products are available for delivery to customers.
- Maintain the lowest possible material and product levels in the warehouse.
- Plan manufacturing activities, delivery schedules and purchasing activities.

1.2 Principles of MRP

The principal applications of MRP are in manufacture, particularly batch manufacture.

MRP is concerned primarily with:

- The scheduling of activities
- The management of inventories

It is particularly useful where there is a need to produce components, items or sub-assemblies which themselves are later used in the production of a final product or, in non-manufacturing organizations, where the provision of a transport or service for a customer necessitates the use or provision of certain subsystems.

MRP is a tool to deal with these problems. It provides answers for several questions:

- What items are required?
- How many are required?

- When are they required?

For example, it may be used when a customer orders a motor vehicle from a manufacturing organization, which must first manufacture or obtain various components which are then used in the final assembly of that vehicle for that customer.

In this case, the product requested by the customer can be seen to be the 'final' output of the system, which derives from certain lower-level provisions.

These lower-level provisions are considered to be dependent on the customers' final requirement. Given a measure or forecast of the total number of customers, the demand at lower levels can be obtained.

It takes as one of its inputs the measured or forecast demand for the system's outputs. It breaks down this demand into its component parts, compares this requirement against existing inventories, and seeks to schedule the parts required against available capacity.

The MRP procedure produces a schedule for all component parts, through to purchasing requirements, and where appropriate shows expected shortages due to capacity limitations. The basic procedure is illustrated in Figure 7-1.

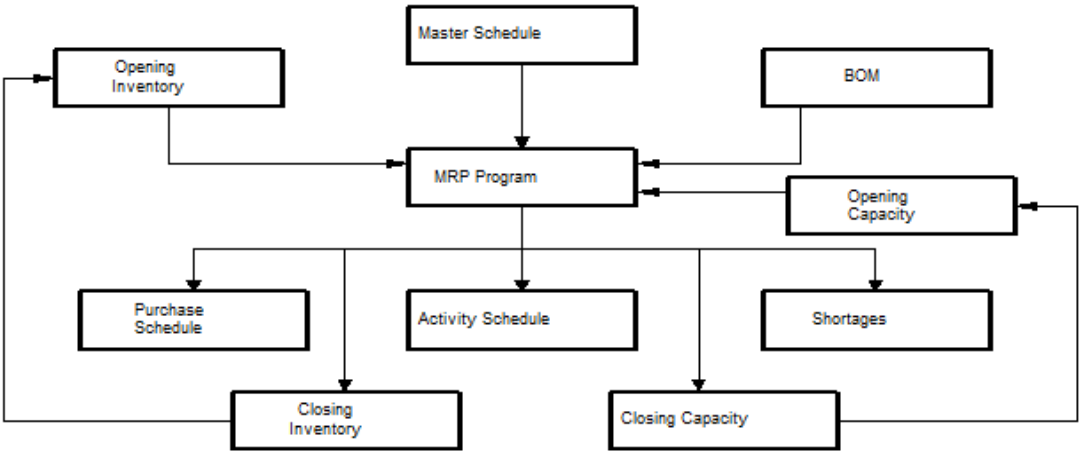

Figure 7-1: MRP Model

The procedure will be undertaken on a repetitive basis, the explosion of scheduling procedure being repeated at regular interval, perhaps corresponding to the intervals at which demand forecasting is undertaken or as and when required as a result of changes in known demand.

1.3 The Application of MRP

The manner in which MRP operates will be described by its principal inputs:

a. The Bill of Materials (BOM)

This identifies the component parts of a final output product. At each level the different components or sub-assemblies are shown, so that the bill shows the total number of sub-parts and the relationship between the parts in a familial-structure manner.

The lead-time of each component of the levels is also shown in BOM structures.

In general, however, the final product level will be referred to as level zero. Below this, at level 1, are the principal sub-assemblies etc which together make up the final product. At level 2 are the components, etc. of the principal subassemblies, and so on through as many levels as appropriate to reach the level of raw materials or bought-in items.

Each item is assigned to one level only, and each item at each level has a unique coding. The different levels and/or branches may correspond to different design or manufacturing responsibilities.

This principle is illustrated in Figure 7-2 below.

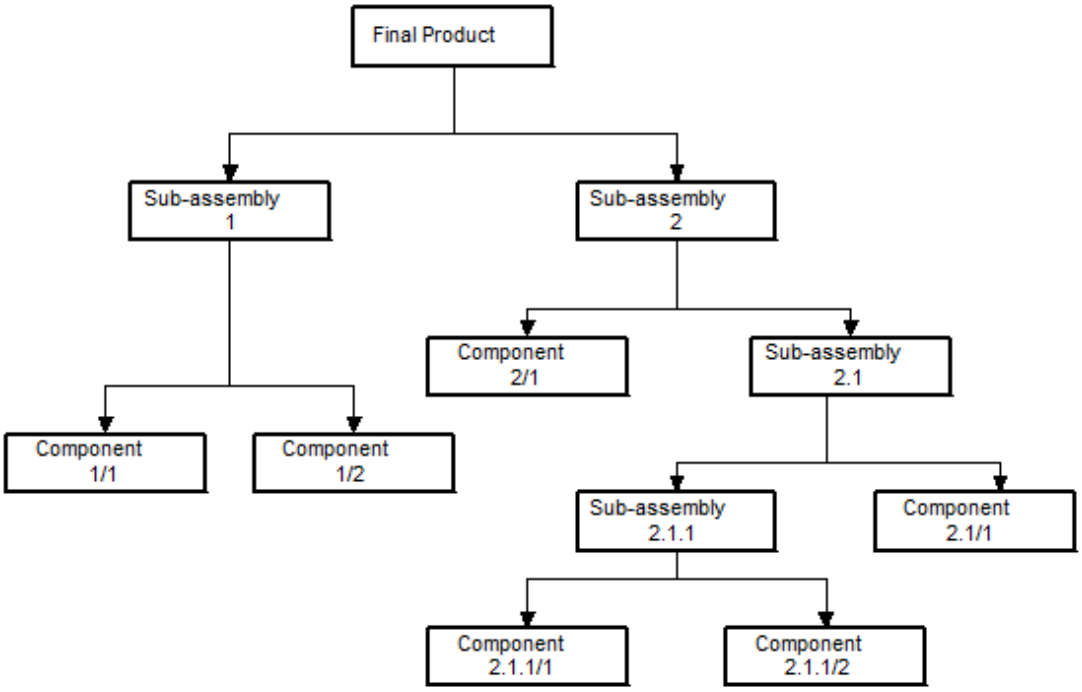

Figure 7-2: BOM

b. The Master Production Schedule (MPS)

It is based on known or forecast demand for a specified future period. The schedule shows how much of each end item is to be produced and when the items are required before they are finally assembled into the end product.

It is in effect the delivery or the 'due date' schedule for each product expressed in terms of both quantity and timing.

In general, however, the time period should allow enough time for the acquisition of all materials, the manufacture of all components, parts and sub-assemblies, and the assembly of the final product.

Lead-time or cycle-time is required to be known.

c. Opening Inventory

This record will show the available inventories of all materials, components, sub-assemblies, etc. required for the manufacture of the end product. In general the file will show both total and free (i.e. unallocated) inventory.

The latter is more important in the context of MRP, since the objective is to compare component or parts requirements against available stock (i.e. excluding those items already committed to the manufacture of other products), in order to determine purchase and manufacture requirements for items for a particular delivery schedule.

d. Opening Capacity

In order for MRP procedure is to be used to provide a production schedule, it will be necessary to have available information on free capacity.

The MRP program will allocate component manufacturing requirements against this capacity so that the appropriate components at each level in the bill of requirements are available at an appropriate time, in order to ensure that the final product is available to the customer at the required time.

The basic procedure involves the 'explosion' of the final product requirements into constituent component and materials requirements. This procedure is performed level by level through the bill of materials.

The gross requirements for each item at each level are compared with available inventory so that the outstanding parts, components or materials requirements can be determined.

This procedure determines how many units of each item are required to meet a given production schedule and also when those units are required, in order that manufacturing lead times might be satisfied.

The result of this procedure will be the production of a schedule of purchase requirements, a schedule of manufacturing requirements (i.e. manufacturing activity schedule).

The principal outputs from the MRP procedure are as follows:

- Purchase requirements, including which items are to be ordered, at what time, and in what quantities
- Manufacturing activity schedules indicating which items are to be manufactured, in what quantities and by what date
- Expected shortages (and/or items which must be expedited)
- Resultant free inventory following satisfaction of the master schedule
- Available free capacity

MRP systems translate the MPS into component-level and raw material-level demand by splitting the top level assembly into the individual parts and quantities called for on the BOM, which reports to that assembly, and directs the purchasing group when to buy them based on the component lead time which is loaded in the MRP system.

1.4 An Example

Tables are assembled from ordered parts, i.e. table top and legs. The lead-time of the table top is 1 week while the leg has a lead-time of 2 weeks. The assembly takes 1 week.

Orders are received for 20 tables in week 5 and 30 tables in week 7. It has stocks of 4 tables, 18 table tops and 40 legs.

Determine the order cycle.

Level 0 – Table							
Week	1	2	3	4	5	6	7
Gross Requirements					20		30
Opening Stock	4	4	4	4	4		
Net Requirements					16		30
Start Assembly				20		30	
Scheduled Receipts					16		30

Level 1 – Table Tops							
Week	1	2	3	4	5	6	7
Gross Requirements				20		30	
Opening Stock	18	18	18	18	2	2	
Net Requirements						28	
Initiate Order					28		
Scheduled Receipts						28	

Level 1 – Table Legs							
Week	1	2	3	4	5	6	7
Gross Requirements				64		120	
Opening Stock	40	40	40	40			
Net Requirements				24		120	
Initiate Order		24		120			
Scheduled Receipts				24		120	

The timetable of events are:

- Week 2 – Order 24 table legs
- Week 4 – Order 120 table legs and assemble 20 tables
- Week 5 – Order 28 table tops
- Week 6 – Assemble 30 tables

Net Requirements in period N = Gross requirements – Scheduled Receipts – Free opening stock

2. Benefits of MRP Systems

MRP systems can provide:

- Better control of inventories
- Improved scheduling
- Productive relationships with suppliers

For design / engineering:

- Improved design control
- Better quality and quality control

For financial and costing:

- Reduced working capital for inventory
- Improved cash flow through quicker deliveries
- Accurate inventory records

3. Issues with MRP Systems

- The integrity of the data. If there are any errors in the inventory data, the BOM data, or the master production schedule, then the output data will also be incorrect.

- Data integrity is also affected by inaccurate cycle count adjustments, mistakes in receiving input and shipping output, scrap not reported, waste, damage, box count errors, supplier container count errors, production reporting errors, and system issues.

- Requirement that the user specify how long it will take for a factory to make a product from its component parts (assuming they are all available).

- Additionally, the system design also assumes that the lead time in manufacturing will be the same each time the item is made, without regard to quantity being made, or other items being made simultaneously in the factory.

4. Conclusion

MRP is a system, usually software based, that helps a business manage inventory levels while making sure necessary materials are in stock when they are needed for manufacturing. It is a program with functions designed to help a business order, manage, and use the materials and resources necessary for production. This type of system can be helpful for a business managing multiple orders that require materials to produce.

Business process plans have set timelines for production designed to help ensure that the finished product is delivered to the customer on time as agreed.

MRP is most often used when planning the smaller tasks necessary to bring about a final finished product. This step is important when planning a business process because it ensures that the materials needed in each step of the process are available when the time comes to execute the step.

If a business does not have enough materials on hand to complete a step, the process is delayed and the timeline is affected, which can cause delay in order delivery.