

# Material Requirements Planning



## MATERIAL REQUIREMENTS PLANNING (MRP)

A technique for calculating the quantity and due date of production and purchase orders needed to meet the master production schedule.

Source: BS 5191 (new edition in press)

### ALSO KNOWN AS

MRP I – though this is strictly speaking not correct.

### PURPOSE

Material Requirements Planning (MRP) is a computer-based technique which plans

- **what** to make or buy
  - **when** to make or buy
  - **how much** to make or buy.
- MRP works to minimise inventory levels needed to meet customer demands and master production schedules (independent and dependent demand). It can
- Create supply orders
  - Adjust supply orders
  - Reschedule supply orders
  - Cancel supply orders
  - Recommend changes to supply orders and may do any or all of these depending on the circumstances.

Today, MRP is normally a component of Enterprise Resource Planning (ERP) or Manufacturing Resource Planning (MRP II). Early examples had more limited links.

### KEY FUNCTIONS AND FEATURES

Material Requirements Planning (MRP) maintains optimal material levels by generating new planned orders to satisfy actual and projected requirements and by recommending changes to existing supply orders. It does this by analysing current and projected manufacturing activities in the form of supply orders. As new material and order information becomes available to MRP it makes adjustments to the plan.

### How MRP Works

For any day (today or future) MRP will, for each item it is analysing

1. Collect the net total of the demands due on or before that day
2. Collect the net total of the supplies due on or before that day, and
3. Apply these totals to the starting inventory (today's stock), to give
4. The **projected available inventory**.

Then,

● If the projected available inventory is **greater than zero**, MRP may recommend

- rescheduling orders later or
- reducing orders or
- cancelling orders.

● If the projected available inventory is **less than zero**, MRP may recommend

- rescheduling orders earlier or
- increasing orders or MRP may
- create new planned orders;

● If the projected available inventory is **exactly zero** the system is in balance: supplies equal demands and no action is required.

MRP carries out all its functions simultaneously, allowing the system to react to changes as they occur. The functions of MRP can be defined as

● **Determine what items require action** ('what to make or buy').

MRP accomplishes this through an explosion of the bill of materials, taking into account

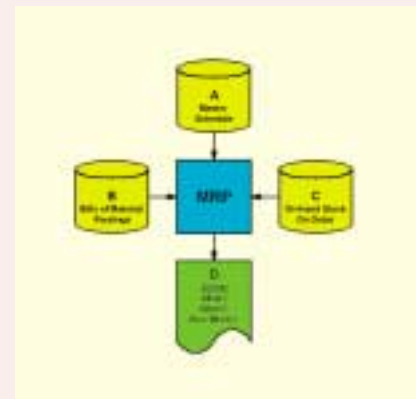
- demand policy parameters
- lot sizing parameters
- analysis options

● **Determine when required** ('when to make or buy'). MRP takes into consideration

- lead times
- order quantities if dynamic lead times are used
- lead time offsets

● **Determine quantity** ('how much to make or buy'). MRP uses net demand information to plan orders and to implement stock policy by

adjusting MRP recommendations. Order planning is carried out using order policy parameters including sizing parameters.



### The MRP Equation

$$\begin{aligned}
 & \mathbf{A1} \text{ What We Plan To Do} \\
 & \quad \text{(Master Schedule)} \\
 + & \mathbf{A2} \text{ What We Also Require} \\
 & \quad \text{(Customer Orders)} \\
 \times & \mathbf{B} \text{ How We Do It (Item Master,} \\
 & \quad \text{Bill of Materials)} \\
 - & \mathbf{C} \text{ What We Have Done} \\
 & \quad \text{(Current On-Hand Stock} \\
 & \quad + \text{Open Manufacturing Orders} \\
 & \quad + \text{Open Purchase Orders)} \\
 \hline
 = & \mathbf{D} \text{ What We Need To Do} \\
 & \quad \text{(Material Requirements)}
 \end{aligned}$$

### Data Used by MRP

MRP depends on other data elsewhere in the ERP / MRP II system. In most systems MRP does not maintain any data of its own. Sources of data are

- Item Master data
- Bill of Materials data
- Inventory data
- Supply Order and Demand Order data.

As its name suggests Material Requirements Planning is concerned with production materials rather than with other resources, although some implementations include non-production materials such as



Lot sizing parameters provide MRP with instructions on how to lot size orders when new planned orders or order recommendations are generated. These parameters are specific to each item and are part of the Item Master data.

Examples of these parameters are:

- Fixed Order
- Least Unit Cost
- Part Period Balancing
- Minimum Order Quantity
- Maximum Order Quantity
- Minimum Days' Coverage
- Maximum Days' Coverage
- Multiple Order Quantity.

Other similar parameters may be available.

### Net Change or Regeneration?:

In most manufacturing enterprises it is important to maintain excellent responsiveness to changing demands and supply conditions. Accordingly MRP may be run every day or at least weekly. Some systems even permit so-called "on line MRP" although this can be dangerous if data such as inventories are changing rapidly.

In this atmosphere of rapid change it is clear that the attention of planners, managers and others must focus on the items that require some action to be taken or which pose potential problems. Large amounts of irrelevant data will obscure these, especially if the MRP system relies heavily on paper output. Planners will fail to complete a scan of one cycle's output before the next arrives.

To address this problem MRP II systems provide **net change** facilities for MRP and often for other sub-systems such as MPS and Cost Generation. Here the system will only work on those items which have been flagged as requiring attention, and will by-pass all others. The flag can be generated by events such as:

- Bill of Material changes
- Lead Time changes
- Order Policy Parameter changes
- Demand changes
- Supply changes
- Unplanned Issues or Receipts.

There may be occasions when it is appropriate to re-analyse or re-plan all items. This approach is termed **regeneration** since the result is to create a completely new manufacturing plan and purchasing plan.

It should not normally be necessary to use regeneration unless:

- There are major company policy changes
- There are radical changes in MRP system operation.

The reactivity of the MRP system may be modified by the use of **sensitivity filters**. These can either limit the extent of the changes to which net change MRP will respond, or can limit the changes made or recommended by MRP, or both. For example, it may be possible to arrange for the MRP system to restrict recommendations to orders in certain order statuses only, to exclude recommendations to reschedule by less than x days, to eliminate quantity changes of less than y %.

### The Role of the Planner in MRP

The planner is responsible for:

- Inventory Levels
  - Supply Order Coverage
  - Reconciliation of Demand and Supply
- for a range of items. This range may be organised:
- **vertically**, with the planner managing a selection of finished products and their components right back to purchased materials, or
  - **horizontally**, with the planner managing a selection of items relating to one or a few manufacturing levels or departments.

In any case the planner is at the centre of a web of communications and is responsible for getting others to accept his solutions to problems as well as devising those solutions.

Characteristic human planning actions are in part comparable to those performed by MRP. The planner will first attempt to balance demand and supply by manipulating supply:

- Rescheduling supply orders earlier or later
- Adjusting supply order quantities up or down
- Adding new supply orders
- Cancelling supply orders (an extreme form of adjustment)
- Releasing held inventory eg. quarantined material
- Arranging material substitutions

perhaps at many levels but within the limits of feasibility. If all of these do not solve the problem he has to address the underlying master schedule and independent demand by communication with the master scheduler and with sales / marketing.

A good guideline for the planner is: Don't report or make adjustments to schedules if

- The quantity is insignificant
- The schedule change is insignificant
- The risk incurred by not making the change is minor.

Stability is important as well as responsiveness.

### The Future for MRP

The functions of MRP are increasingly being performed by a variety of Advanced Planning and Scheduling (APS) systems such as Supply Chain Management (SCM). However, in many companies, especially those with large numbers of items, MRP still plays an active and essential part.

### INDUSTRY SPECIFICS

MRP has been and is being used in almost every kind of manufacturing industry, including discrete, batch process, repetitive and hybrid manufacturing and in make-to-stock, make-to-order and intermediate styles. The only area where application of MRP has been difficult is continuous process manufacturing eg. oil refining.

### RELATED TOPICS

See also:

Enterprise Resource Planning (ERP)  
 Manufacturing Resource Planning (MRP II)  
 Item Master Data  
 Bills of Material, Formulæ and Recipes  
 Lead Times

### REFERENCES AND SOURCES OF ADDITIONAL INFORMATION

Many MRP references are available. Good and easily obtainable sources include:

Kenworthy, John, *"Planning and Control of Manufacturing Operations"*, Cambridge, Woodhead Publishing / IOM, 1998.

Wight, Oliver, *"Manufacturing Resource Planning: MRP II - Unlocking America's Productivity Potential"* (revised edition), Essex Junction, VT., Oliver Wight, 1981.

Vollmann, Thomas E., William L. Berry & D. Clay Whybark, *"Manufacturing Planning and Control Systems"*, Chicago, Irwin, 1992.