MANAGEMENT ISSUES-MRP

MRP is a confusing term because it has two definitions, materials requirements planning and manufacturing resource planning. The first of these is the original meaning, used in the 1960s, when what is now called MRP I (MRP One) was used to help a company work out how many materials of which types were required and when they were required. MRP I (Figure 1) takes information from the order book and sales forecast in order to create a combined schedule and then identifies all the components needed to make these orders.

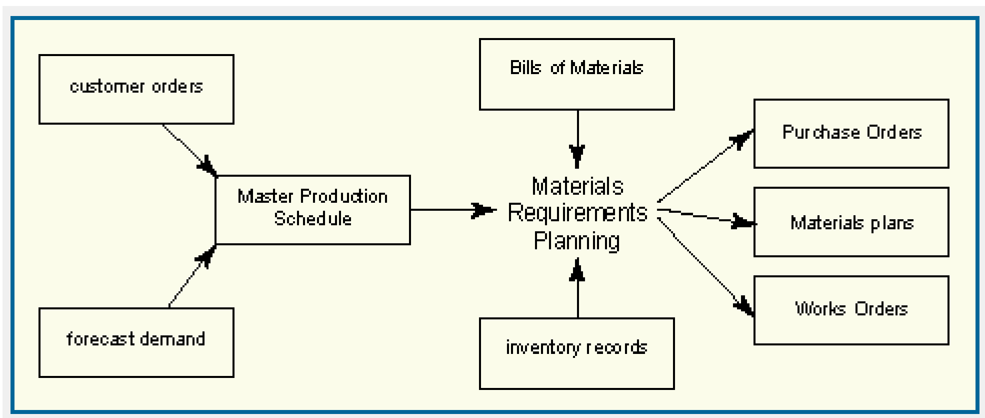

Figure 1: MRP I shown schematically

The calculations that MRP I performs are based on the 'Master Production Schedule' (MPS), a combination of firm orders-on-hand and estimates of future orders, defined by time and required date. Typically the schedule that results will take into account such aspects as capacity constraints, spares demand, and security stock requirements.

Using the MPS, the MRP program calculates the volume and timing of assemblies, subassemblies and materials required to meet the schedule. If we take a simple example of preparing a lunch box that contains fruit, a foil-wrapped ham and tomato sandwich, and a piece of cherry cake, we can illustrate how this is done.

The final output is a box containing the food, but in order to make it we need to know what components are required. At the top level, these are the box itself and the completed ingredients shown in the table below.

Part number: LB001

Description: Lunch box

Part number	Quantity	Description
120011	1	box
110001	2	wrapped ham and tomato sandwich
110501	1	wrapped cherry cake slice
100001	1	banana
100105	1	grapefruit juice drink
100903	1	paper serviette
120012	1	lid

Figure 2: Top-level BoM for a lunch box

However, the sandwich needs to be made and wrapped. Even if we buy sliced bread and sliced ham, there are subsidiary operations to butter the bread and slice the tomatoes, both of which take time and ‘tooling’.

In the same way, the cake has to be sliced. And what if it is to be home-made? In that case, our bill of materials needs to contain all the ingredients in the recipe and the ‘jigs and equipment’ needed to make the cake. If we look at the flow chart in Figure 3, we have a sequence of operations that takes time, but also involves delay, because slicing and wrapping hot cake doesn’t yield a satisfactory result!

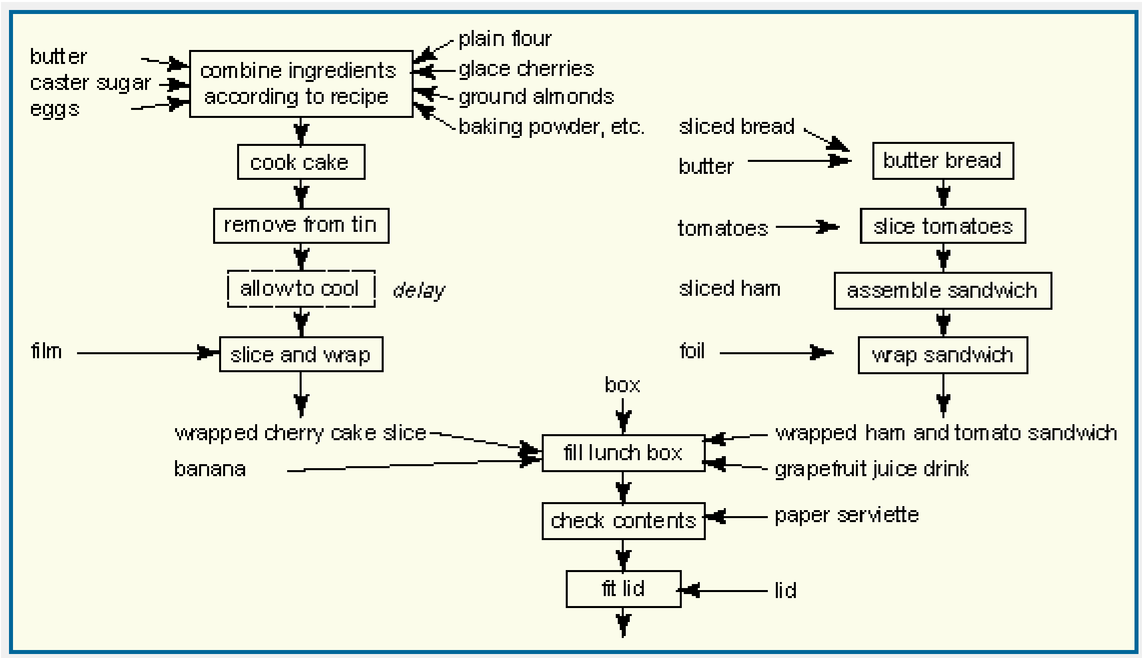

Figure 3: Flow diagram for preparing a lunch box

So a bill of materials will be associated (at least informally) with both a flow diagram and information on the resources used. For example, one operator can't wrap sandwiches and cake simultaneously.

The simple bill of materials can be shown graphically, as we have above, but is far too unwieldy for a product that may have many levels of sub-assembly and thousands of different parts. MRP systems cope with this by using 'single-level' bills of materials and 'indented' bills of materials. In single-level BoMs, details of the relationships are stored one level at a time, with each BoM showing only the parts that go directly into it (Figure 4).

Part number: LB001

Description: Lunch box

Level: 0

Level	Part number	Quantity	Description
1	120011	1	box
1	110001	2	wrapped ham and tomato sandwich
1	110501	1	wrapped cherry cake slice
1	100001	1	banana
1	100105	1	grapefruit juice drink
1	100903	1	paper serviette
1	120012	1	lid

Part number: 110501

Description: Wrapped cherry cake slice

Level: 1

Level	Part number	Quantity	Description
2	110012	as needed	film
2	111501	0.1	cherry cake

Part number: 111501

Description: Cherry cake

Level: 2

Level	Part number	Quantity	Description
3	300001	225g	butter
3	300002	225g	caster sugar
3	300051	4	Size 1 eggs
3	300101	225g	plain flour
3	300201	250g	glace cherries
3	300301	110g	ground almonds
3	300904	as needed	baking powder, etc.

Figure 4: Some of the single-level Bills of Materials for a lunch-box

Most MRP systems actually store the relationships of parts of assemblies in this way, but also have the ability to present them in what is referred to as an indented Bill of Materials that shows all the components and materials. The term ‘indented’ refers to the level of the sub-assembly, as shown in the left-hand column. This may be shown as a number or by physical indenting, depending on the style of programme used (Figure 5). Note that the quantities will appear different from the single level BoMs, because the parts are calculated on the basis of content of the final product rather than the unit of production of the intermediate stages.

Part number: LB001

Description: Lunch box

Indented explosion

Level	Part number	Quantity	Description
.1	120011	1	box
.1	100001	1	banana
.1	100105	1	grapefruit juice drink
.1	100903	1	paper serviette
.1	120012	1	lid
..2	110011	as needed	foil
..2	110012	as needed	film
...3	300001	22.5g	butter
...3	300002	22.5g	caster sugar
...3	300051	0.4	Size 1 eggs
...3	300101	22.5g	plain flour
...3	300201	25g	glace cherries
...3	300301	11g	ground almonds
...3	300904	as needed	baking powder, etc.
...3	400001	180g	sliced ham
....4	100004	100g	tomatoes
....4	300501	4 slices	sliced bread
....4	300001	as needed	butter

Figure 5: Indented bill of materials for a lunch-box

Closely related to the BoM and sometimes integrated with it, is the manufacturing ‘process route sheet’, the information that indicates the sequence of operations, the work centre at which the operations are carried out, and the relevant work instructions, specifications and standards. If it is not obvious, the ‘point of entry’ of any materials has to be spelt out either on the route sheet or on other manufacturing instructions. Sometimes these documents take the form of an annotated flow chart; in other cases they may be a simple list of operations. Alternatively, the BoM may indicate against each item the process stage at which it is used. Practices vary enormously in this respect. Note that, when a company converts to lead-free, much of this process documentation will also need to be reviewed, as well as reconsidering the part numbering.

The BoM file provides base data on the materials used in the products; suitably adjusted for percentage yields, this forms the foundation for the total materials cost of the product. Phased according to when parts are required by the MPS, the materials requirement in the BoM is also fed into the inventory management system; after all, we only want to buy materials if we don’t already have them in stock.

MRP I typically controls the inventory records using an ‘item master file’, a transaction file and a location file. The item master file is usually a part number which contains all the stable data on a part, such as part description, the unit of measure and a standard cost. The transaction file keeps a record of receipts and issues and a running balance, and the location file shows where the parts are held. Sometimes the location is fixed, but other companies operate a random location system where parts are stored in the nearest available space. The random location system is more efficient in utilising space, and also makes it easier to implement a FIFO system by instructing the storekeeper to pick items from the oldest stock first. It does, however, demand a greater degree of control, because the same item may be kept at several different locations.

In order to be efficient, the MRP system needs accurate stock records, so inventory checking is necessary. Traditionally carried out only annually, leading to frequent shortages caused by errors, the checking practice is now generally carried out on a rolling basis referred to as Perpetual Physical Inventory (PPI).

The MRP system performs its calculations by first ‘exploding’ all the levels of the Bill of Materials to check how many subassemblies and parts are required, and then generates ‘works orders’ for items made in house and purchase orders for bought-in materials and components. The programme will also take into account the timing and scheduling of materials, to allow for delays in procurement and manufacture.

During the 1980s, the basic MRP I system was extended by Oliver Wight into Manufacturing Resource Planning, MRP II (MRP Two), including the engineering and financial implications of the master schedule as well as the materials required. For this, each product is associated not only with a list of materials, but also with a list of the resources needed to manufacture it. By analysing the resources down to work centre level, MRP II gives information that can be used to answer capacity planning questions: “Do we have the available machines, time and labour, as well as the materials?”

MRP II also tries to integrate data previously held separately. For example a Bill of Materials may be held both in Engineering and by Materials Management, but only associated with information on the manufacturing sequence, processes and so on, within the Engineering/design Department. Where a change is made to the design, both databases have to be updated, with an obvious potential for error. Discrepancies cause problems, and the difficulties are particularly severe with products that undergo a substantial number of design iterations. MRP II tries to create a single database that contains all information, including cost information from finance.

When implementing lead-free, the MRP system has to be modified so as to identify the lead-free status of both components and assembly. Typically this will require changes to the part numbers and the Bill of Materials, and process changes may also modify the process sequence. However, conceptually, at least, an MRP system will do its job as well with lead-free as with any other assembly.

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Source: http://www.ami.ac.uk/courses/topics/0173_mrp/index.html