

MATERIALS REQUIREMENTS PLANNING

Materials requirements planning (MRP) helps us to establish an MRP schedule showing the components required at each level of the assembly and, based on lead times, calculates when these components will be needed.

This MRP schedule has three inputs including:

Input 1: The MPS Schedule

The MPS schedule indicates the **quantity** and **timing** of end items required. To see how this relates to the previous section discussed in this tutorial (Master production scheduling), look at the first MPS schedule discussed in this section. The MPS indicates (on the basis of a Chase strategy with Fixed Batch Quantities of 70), that production is required in week 2, 5, 6, and 8

	June				July			
	1	2	3	4	5	6	7	8
MPS (planned production)		70			70	70		70

These end items could have been anything, but for the sake of obtaining clarity, let's assume they were tables. We therefore are required to produce/assemble 70 tables in week 2, 5, 6 and 8.

To do that, we need to know **the parts (and number thereof)** required to make 1 table. Hence, for an MRP schedule, we require Input 2.

Input 2: The Bill of Materials

Simplified, the Bill of Materials (BOM) is a listing of the **parts required** to produce/assemble 1 end item. It also includes the **quantities required of each part** to produce/assemble 1 end item.

In the case of a table, perhaps we would require 1 wooden table top, 4 wooden legs and 16 screws (4 per each wooden leg)

To assemble these table, we need to order the respective parts (listed above), but before we order, it is imperative that we find out:

- 1) How much **stock we currently have** of the respective items.
- 2) The **lead times** of the various items (time between when we order the parts and when we receive the parts)

Hence, for an MRP schedule, we require Input 3.

Input 3: Inventory records

Inventory records supply two kinds of information. The first is called **Inventory status**. The second is called **planning factors**.

- 1) **Input 3.1: Inventory status** - How much material is available of each part for future demand
- 2) **Input 3.2: Planning factors** - Includes information such as order quantities, lead times, and safety stock

To assist us towards compiling MRP schedules there are **two tools** that assist towards this end:

Tool 1: Product Structure Tree

The product structure tree is a visual description of the requirements in a bill of materials, where all components are listed by levels.

Tool 2: Indented Bill of Materials

A table reflecting the following details for each part used in the production/ assembly of the end item

- Part Level (Determined by Tool 1: Product Structure Tree)
- Part Number (provided)
- Part Description (provided)
- Lead time (provided)
- Quantity required (Determined with assistance from Tool 1: Product Structure Tree)

As can be seen from Tool 2, the **Indented Bill of Materials**, some items reflected in this tool are calculated with the assistance of Tool 1, the **Product Structure Tree**. It is therefore necessary to first complete the Product Structure Tree before you complete the **Indented Bill of Materials**.

Against the backdrop of the underlying theoretical components to MRP schedules, the best means of practically explaining how to complete an MRP schedule is to carry out an example and explain the actions step by step.

MRP PROBLEM 1:

A company manufactures product A which is made up of one unit of B, and half a unit of C. Each unit of B is made up of one unit of D, two units of E, and one unit of F. Each unit of C needs half a unit of G and three units of H. The lead times to manufacture all these components are as follows:

A	2 weeks
B	1 week
C	2 weeks
D	2 weeks
E	3 weeks
F	1 week
G	2 weeks
H	1 week

All these parts have 20 units in stock. It is required to make 100 units of A for delivery in seven weeks time.

You are required to:

- Draw up a product structure tree
- Draw up an indented bill of materials for the product.
- Draw up a gross materials requirements plan for the manufacturer of the product.
- Construct a net materials requirements plan for the manufacturer of the product.

Before we begin the example, let's take a brief look to see whether we have all the necessary information relating to the three inputs.

Input 1: The MPS Schedule

'It is required to make 100 units of A for delivery in seven weeks time'

Input 2: The Bill of Materials

'product A which is made up of one unit of B, and half a unit of C. Each unit of B is made up of one unit of D, two units of E, and one unit of F. Each unit of C needs half a unit of G and three units of H'

Input 3: Inventory records

Input 3.1 Inventory Status:

'All these parts have 20 units in stock'

Input 3.2 Planning Factors:

'The lead times to manufacture all these components are as follows'

A	2 weeks,
B	1 week
C	2 weeks
D	2 weeks
E	3 weeks
F	1 week
G	2 weeks
H	1 week

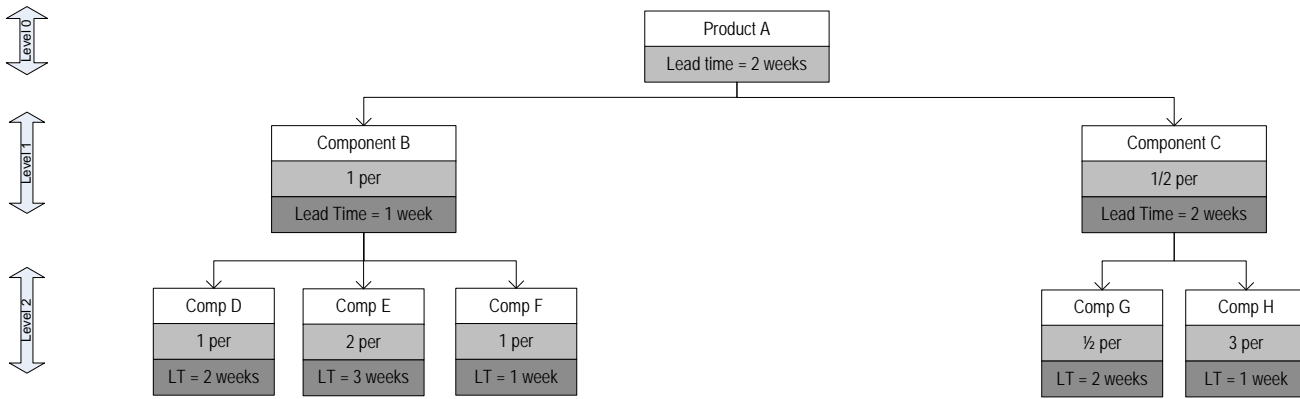
We see from the above exercise, that according to the three types of inputs, we have all the necessary information in order to complete an MRP Schedule for Product A.

Let's begin to answer the question:

a) Draw up a product structure tree

To draw up a product tree, we need to source information from Input 2: The Bill of Materials and Input 3.2: The Planning factors. We then break down the end item (Product A in this instance), level by level, to reflect the parts (and number thereof) required to produce/ assemble the end item. The Product Structure for Product A is revealed below:

Product Structure Tree for Item A



b) Draw up an indented bill of materials for the product.

Indented bill of materials for:

Part:	Product A
Description:	None
Level:	0

Level	Part no	Description	Lead time	Quantity
0	A	None	2 wk	1
.1	B	None	1 wk	1
.1	C	None	2 wk	½
..2	D	None	2 wk	1
..2	E	None	3 wk	2
..2	F	None	1 wk	1
..2	G	None	2 wk	½
..2	H	None	1 wk	3

c) Draw up a gross materials requirements plan for the manufacturer of the product.

d) Construct a net materials requirements plan for the manufacturer of the product.

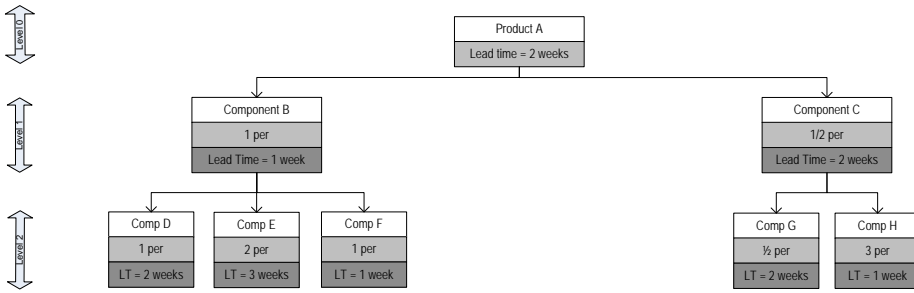
Part (c) of the question required you to draw up a gross materials requirements plan (without taking available stock into account) and part (d) a net materials requirements plan (taking available stock into account). The combined MRP schedules that follow include the information relating to both (c) and (d). The information relating to (c) is included in the line item 'GROSS REQUIREMENTS' within the respective MRP schedules. The information relating to (d) is included in the line item 'PLANNED ORDER RELEASE' within the respective MRP schedules.

The Product Structure for A as well as the MRP SCHEDULES OF ALL PARTS (A to H) are all included on the next page.

By placing all the information on the same page, it is easier to adopt an understanding of the logic and flow of information through the various levels. Please read the answer thoroughly, level by level, and read the EXPLANATORY NOTES that accompany each MRP schedule on the right hand side.

Extra information has been included for the sake of EXPLAINING the logic.

PRODUCT STRUCTURE FOR PRODUCT A



MRP SCHEDULE CALCULATIONS (WITH EXPLANATIONS)

Manufacturing Lead time Definition
The time between the release of an order to production and delivery to the customer. (Includes setup, processing, transportation, and waiting between operations)

Product A	IW1	W2	IW3	W4	W5	IW6	W7
Gross Requirements							100
Scheduled receipts							
On-hand inventory	20	20	20	20	20	20	0
Planned order release				80			

It is required to make 100 units of product A. Shipment must be made to the customer in 7 weeks time (W7). Manufacturing Lead time for Product A is 2 weeks. This means that the time between delivery to the customer and release of the order is 2 weeks. (See definition of Manufacturing Lead time on left). We therefore need to make sure that the order is released 2 weeks before week 7, thus in week 5 (W5). Why do we only order 80 when we require 100? We are told that we already have stock of 20 units. We therefore only require 80 units to make the full amount of 100 units. The on-hand inventory of 20 units reaches zero in week 7 when it is delivered to the customer

Arrow = LT for Comp B, using Comp D, E, F

Component B	IW1	W2	IW3	W4	W5	IW6	W7
Gross Requirements					80		
Scheduled receipts							
On-hand inventory	20	20	20	20	0		
Planned order release				60			

Each Product A is made up of 1 Component B. Lead time is 1 week. Therefore time between delivery and order release is 1 week. Therefore, for delivery of component B in week 5 (W5), we must place the order in week 4 (W4)

Arrow = LT for Comp C, using Comp G, H

Component C	IW1	W2	IW3	W4	W5	IW6	W7
Gross Requirements					40		
Scheduled receipts							
On-hand inventory	20	20	20	20	0		
Planned order release			20				

Each Product A is made up of 1/2 a Component B. To make 80 of product A, we therefore need only 40 of Component C (80 x 0.5 = 40). Lead time is 2 weeks. Therefore time between delivery and order release is 2 weeks. Therefore, for delivery of component C in week 5 (W5), we must place the order in week 3 (W3).

Arrow = LT for Comp D

Component D	IW1	W2	IW3	W4	W5	IW6	W7
Gross Requirements				60			
Scheduled receipts							
On-hand inventory	20	20	20	0			
Planned order release		40					

Each Component B is made up of 1 component D. Lead time is 2 weeks. Therefore, for delivery of component D in week 4 (W4), we must place and order in week 2 (W2)

Arrow = LT for Comp G

Component G	IW1	W2	IW3	W4	W5	IW6	W7
Gross Requirements				10			
Scheduled receipts							
On-hand inventory	20	20	10	0			
Planned order release	0						

Each Component C is made up of 1/2 a unit of component G (20 x 0.5 = 10). Lead time is 2 weeks. Therefore, for delivery of component G in week 3 (W3), we must place and order in week 1 (W1)

Arrow = LT for Comp E

Component E	IW1	W2	IW3	W4	W5	IW6	W7
Gross Requirements				120			
Scheduled receipts							
On-hand inventory	20	20	20	0			
Planned order release	100						

Each Component B is made up of 2 components E (60 x 2 = 120). Lead time is 3 weeks. Therefore, for delivery of component D in week 4 (W4), we must place and order in week 1 (W1)

Arrow = LT for Comp H

Component H	IW1	W2	IW3	W4	W5	IW6	W7
Gross Requirements				60			
Scheduled receipts							
On-hand inventory	20	20	0				
Planned order release	40						

Each Component C is made up of 3 units of component H (20 x 3 = 60). Lead time is 1 week. Therefore, for delivery of component G in week 3 (W3), we must place and order in week 2 (W2)

Arrow = LT for Comp F

Component F	IW1	W2	IW3	W4	W5	IW6	W7
Gross Requirements				60			
Scheduled receipts							
On-hand inventory	20	20	20	0			
Planned order release			40				

Each Component B is made up of 1 component F. Lead time is 1 week. Therefore, for delivery of component F in week 4 (W4), we must place and order in week 3 (W3)

MRP PROBLEM 2:

Material requirements planning (MRP) is used to plan and control material requirements. The master production schedule (MPS) for three sizes of adjustable wrenches is given in the table below. All three adjustable wrenches (200 mm, 250 mm and 300 mm) use the same handle. The MPS requirements are:

Item	Week				
	1	2	3	4	5
200 mm	5	5	3	9	
250 mm	18		20		20
300 mm	12	5	2	6	6
MPS	35	10	25	15	26

The inventory record (item master file) shows the following planning factors: batches are set at quantities of 20; safety stock is set at two handles; the available inventory is 70 and the lead time for orders is two weeks. When will the **first order** be issued (ie in which week) and what will the **available inventory** be in week 2 and 5 (ie quantity of items)?

Solution

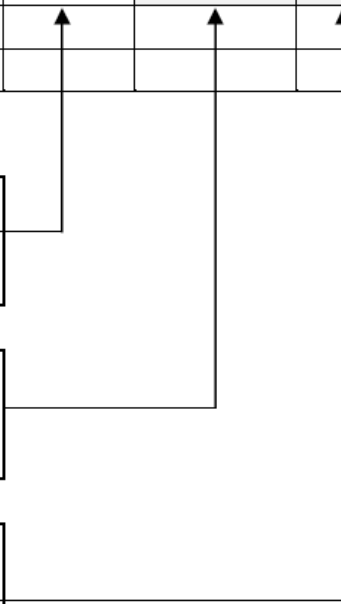
Step 1

		1	2	3	4	5
Demand		35	10	25	15	26
On hand / Available	70	35	25			
Order						

Inventory = 70 as given in the question

On-Hand (70) - demand in week 1 (35) = 35

On-Hand week 1 (35) - demand in week 2 (10) = 25



Step 2

		1	2	3	4	5
Demand		35	10	25	15	26
On hand / Available	70	35	25	20		
Order		20				

On-Hand week 2 (25) - demand in week 3 (25) = 0. The question states that orders are in batches of **20** (lead time of two weeks) and safety stock is set at **2**. This means that "on hand" must be at least **2** and not **0** as in this case. An order of **20** must then be placed in week **1**. Thus on-Hand week 2 (25) - demand in week 2 (25) = 0 + order week 1 (20) = **20**

Step 3

		1	2	3	4	5
Demand		35	10	25	15	26
On hand / Available	70	35	25	20	5	
Order		20				

On-Hand week 3 (20) - demand in week 4 (15) = 5 (within the limit of safety stock which is 2 handles)

Step 4

		1	2	3	4	5
Demand		35	10	25	15	26
On hand / Available	70	35	25	20	5	19
Order		20		40		

On-Hand week 4 (5) - demand in week 5 (26) = -21. The question states that orders are in batches of **20 (lead time of two weeks)** and safety stock is set at **2**. This means that "on hand" must be at least 2 and not -21 as in this case. An order of 40 must then be placed in week 3. Thus on-Hand week 4 (5) - demand in week 5 (26) = -21 + order week 3 (40) = 19