

Prof Bart MacCarthy
Division of Operations
Management and
Information Systems

Lecture 3 Self-Study Session 1

5. MRP-based Planning - Self study



Outline

1. Aggregate Planning
2. Sales & Operations Planning (S&OP)
3. MRP principles and overview
 - o Independent and Dependent demand
 - o Overview, main components and computations
4. MRPII and Capacity Requirements Planning
 - o Requirements for effective MRP-based control

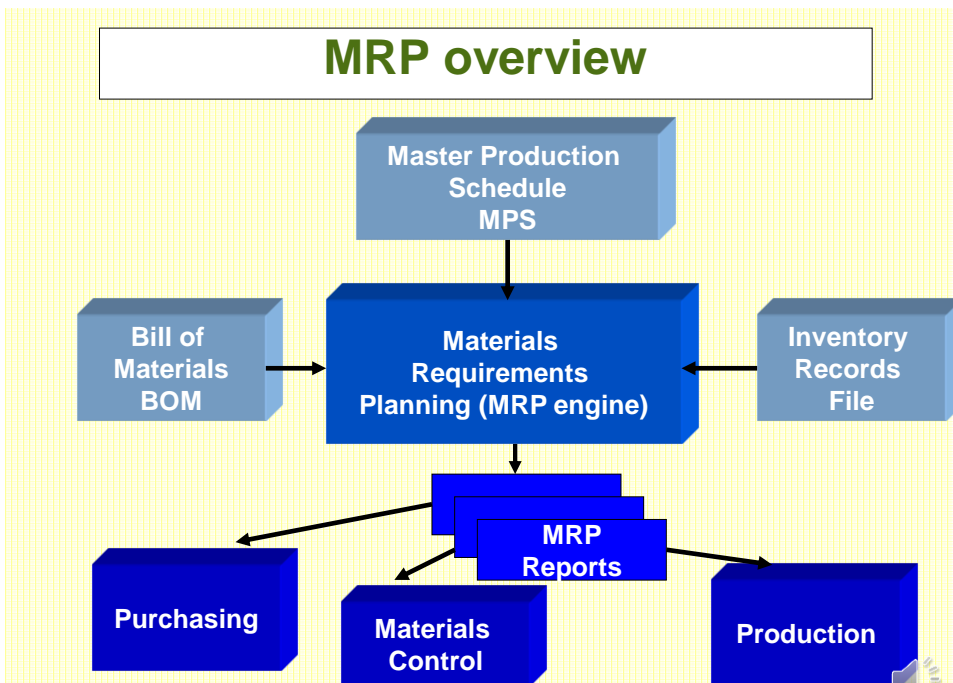
Pre-Recorded Self Study Session on Moodle

5. Running an MRP- based planning and control
6. Enterprise Resource Planning (ERP) systems and IS/IT support for Supply Chain Planning
7. Review questions





How do we plan and make an office chair?



What does the product comprise of?

BOMs and Parts Master File

- **BOMs** relate dependent items to independent items:

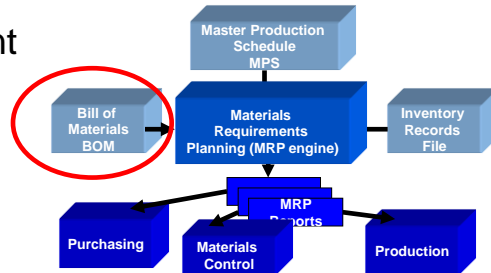
- quantities per build
- level in build

- **Parts Master Files**

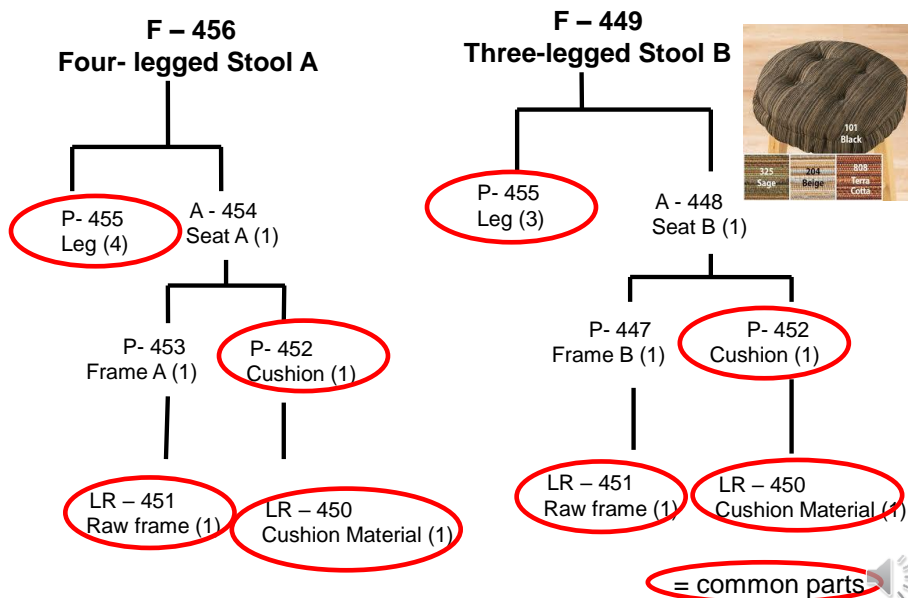
provide information on each part:

- Description
- Unit of measure
- **Lead time**
- **Lot size policy**
- **Safety stock policy**

- Make or buy
- Cost information
- Storage information
- Level code

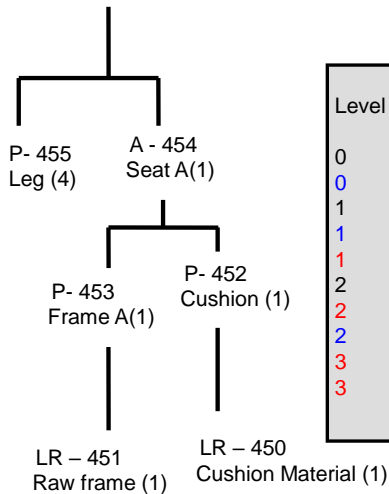


The Bills of Materials (BOMs)



Bills of materials & Parts master file

Four- legged Stool A



Parts Master File

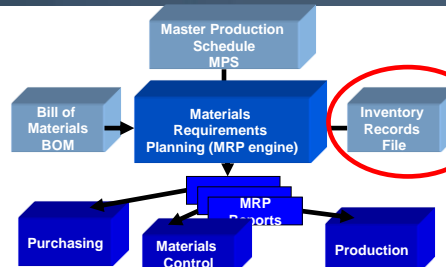
Level	Number	Lot size	Lead time	Description	Make/buy
0	F-449	L	2	Stool B	M
0	F-456	L	2	Stool A	M
1	A-448	L	1	Seat B	M
1	A-454	L	1	Seat A	M
1	P-455	L	2	Leg	B
2	P-447	L	1	Frame B	M
2	P-452	L	1	Cushion	M
2	P-453	L	1	Frame A	M
3	LR-450	L	3	Cushion Mat	B
3	LR-451	L	2	Raw Frame	B



What have we got? - Inventory records

MRP systems require:

Accurate databases needed on **current inventory** holdings (on hand) and **inventory that is ordered** (scheduled receipts), when it will arrive (including inventory produced in-house)



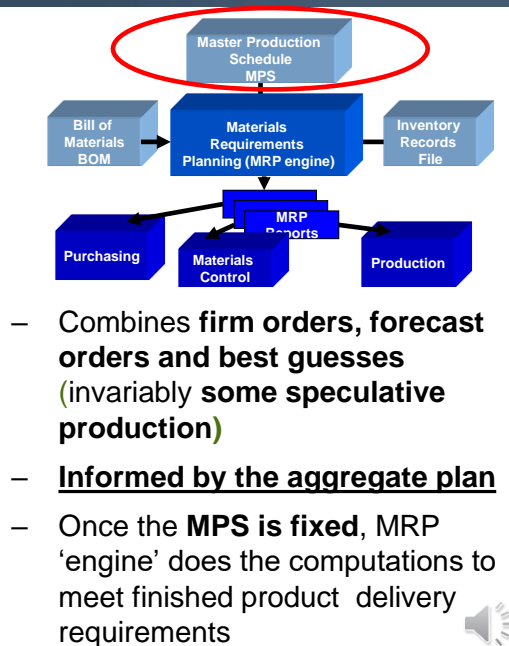
Level	Number	M/B	On Hand	Scheduled receipts
0	F-449	M	14	6
0	F-456	M	0	0
1	A-448	M	10	0
1	A-454	M	4	24
1	P-455	B	54	10
2	P-447	M	0	0
2	P-452	M	6	0
2	P-453	M	0	14
3	LR-450	B	18	16
3	LR-451	B	0	0

Inventory databases need to be **kept accurate and up to date!**



The Master Production Schedule (MPS)

- What is it?
- The MPS drives the MRP system**
- The MPS states **what the company intends to produce at independent demand level** by defining the required quantities of each end item in each time period **over a rolling horizon**



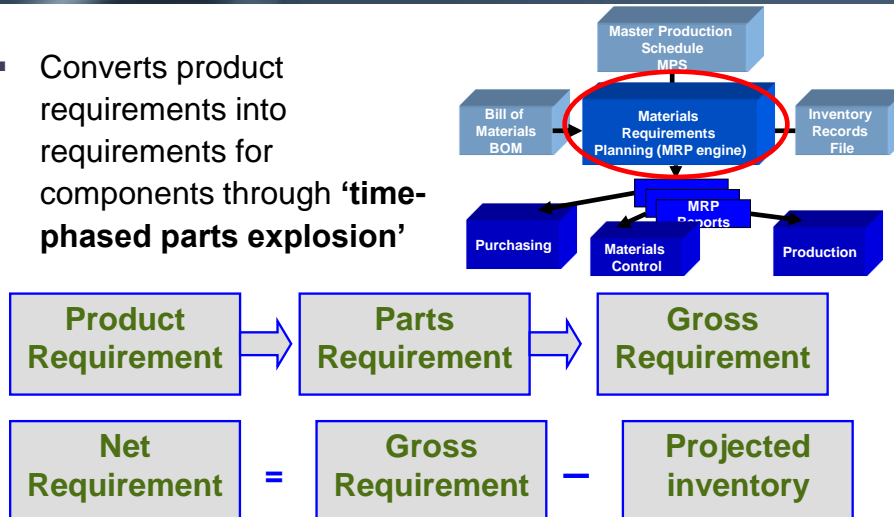
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MRP computations: Gross/ Net/ Time Phasing

- Converts product requirements into requirements for components through **'time-phased parts explosion'**



- Projected inventory** is material allocated from current inventory & orders scheduled for receipt

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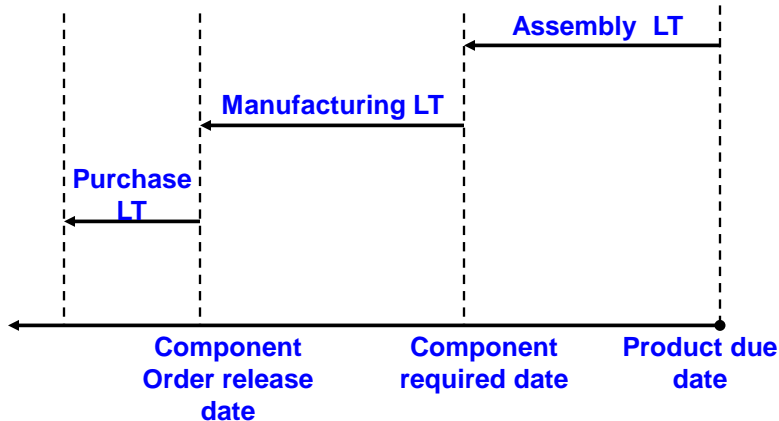
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MRP computations - Lead times

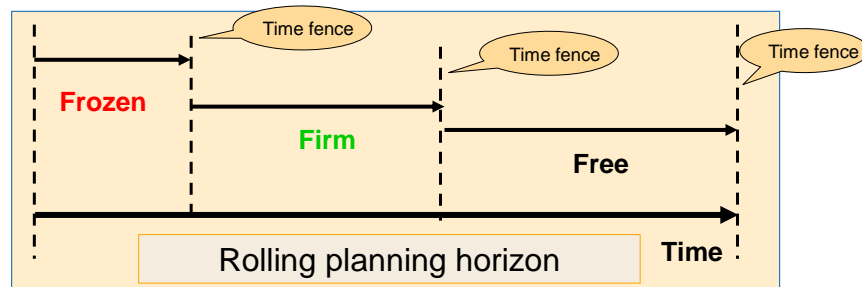
- Requirements are **time-phased**

- Known as **backward scheduling**
- Normally within established time periods (as the most manageable approach)

LEARN THE
CALCULATIONS IN
LECTURE 7



Running an MRP system - the rolling planning horizon



- As time rolls forward, **forecasts orders become firm orders (hopefully)** – demand consumes the forecast
- ‘Time fences’** are set relative to lead time - **important and difficult**
 - Determines **the balance between stability and responsiveness** - schedule adherence may conflict with ability to be responsive
- Impact & authority to amend firm & frozen zones – may need policy decisions

Running and MRP system – two approaches

Regenerative approach

- **Re-explodes** the MPS **totally** at preset intervals (weekly, monthly, quarterly)
- **Works through all levels of the BOMs** - complete regeneration of net requirements and planned orders
 - Overall plan may change significantly

Net change approach

- Current MPS and MRP stored. May be modified at any time
- **Partial explosions** carried out when plans affected by:
 - new orders, material supply or capacity problems, engineering changes
 - More reactive but may propagate **errors & exception** reports



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Dealing with uncertainty in MRP systems

	Sources	
Types	Demand	Supply
Timing	Requirements shift from one period to another	Orders not received when due
Quantity	Requirements for more or less than planned	Orders received for more or less than planned

Categories of uncertainty in MRP systems, adapted from Vollman et al. (2005), Ch 11.

Safety stock helps to buffer against supply and demand uncertainties



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MRP Complicating factors - Lot sizing and Safety stock

1. Lot sizing

- **Net requirements generated** by the MRP system for a specific part over a future planning period will be (i) **discrete** and (ii) **lumpy**
- **Lot sizing techniques** attempt to achieve a **minimum cost ordering plan** by balancing the costs of placing an order with cost of carrying inventory over future periods

2. Safety stock

- specifies a minimum holding level of a part
- easily handled within MRP by calculating net requirements **on top of the minimum level**
- estimating the appropriate safety level is difficult
- scrap rates may influence the level



Buffering and safety stock

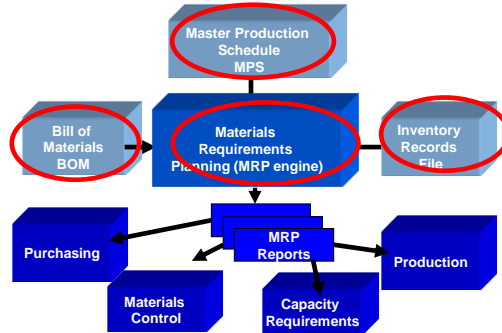
- **Buffering can mask underlying problems**
 - poor demand forecasting, poor quality manufacturing, poor quality supply, poor delivery performance of suppliers....
 - results in 'behavioural issues' and 'informal systems' to tell people **what is really needed**
 - when combined with lot sizing can result in **MRP system nervousness** – small changes in the plan at one level result in large changes lower down
- Every effort should be made to reduce uncertainties and hence the reliance on extensive buffering
- **Safety lead time** - an alternative approach to buffering
- **Essentially MRP-based control with buffering is a 'PUSH' system with potentially high inventory levels**



MRPII system requirements

Accurate database information needed

- Many **different types of data** needed
 - Inventory information
 - Master parts and bills of materials
 - Supplier information
 - Routing information
 - Work centre information
 - Tooling information
 - Safety policies/lot sizes (**system parameters**)



MRPII systems require **current inventory** holdings (on hand) and inventory that is ordered (scheduled receipts), when it will arrive (including inventory produced in-house).
The real system and the MRP system must be closely aligned!

Key learning points

- **MRP is the dominant approach** in industrial planning
 - Typically batch manufacturing, combination of MTS/MTO
 - Makes assumptions e.g. constant static lead time!
 - Originally developed for engineered products with complexity at component & assembly levels
 - Now used very widely e.g. even JIT systems will have some level of MRP control
- **You should understand**
 - The components of an MRP/MRPII system
 - The **inputs** to an MRP system
 - The **outputs** from an MRP system
 - How it does its **calculations**
 - **MRPII adds** to basic MRP functionality particularly by requiring capacity checks
 - Some of the **challenges** in running and MRP system