Resource Planning

Material requirements planning (MRP)

A dependent demand technique that uses a bill-of-material, inventory, expected receipts, and a master production schedule to determine material requirements.

Demand Patterns

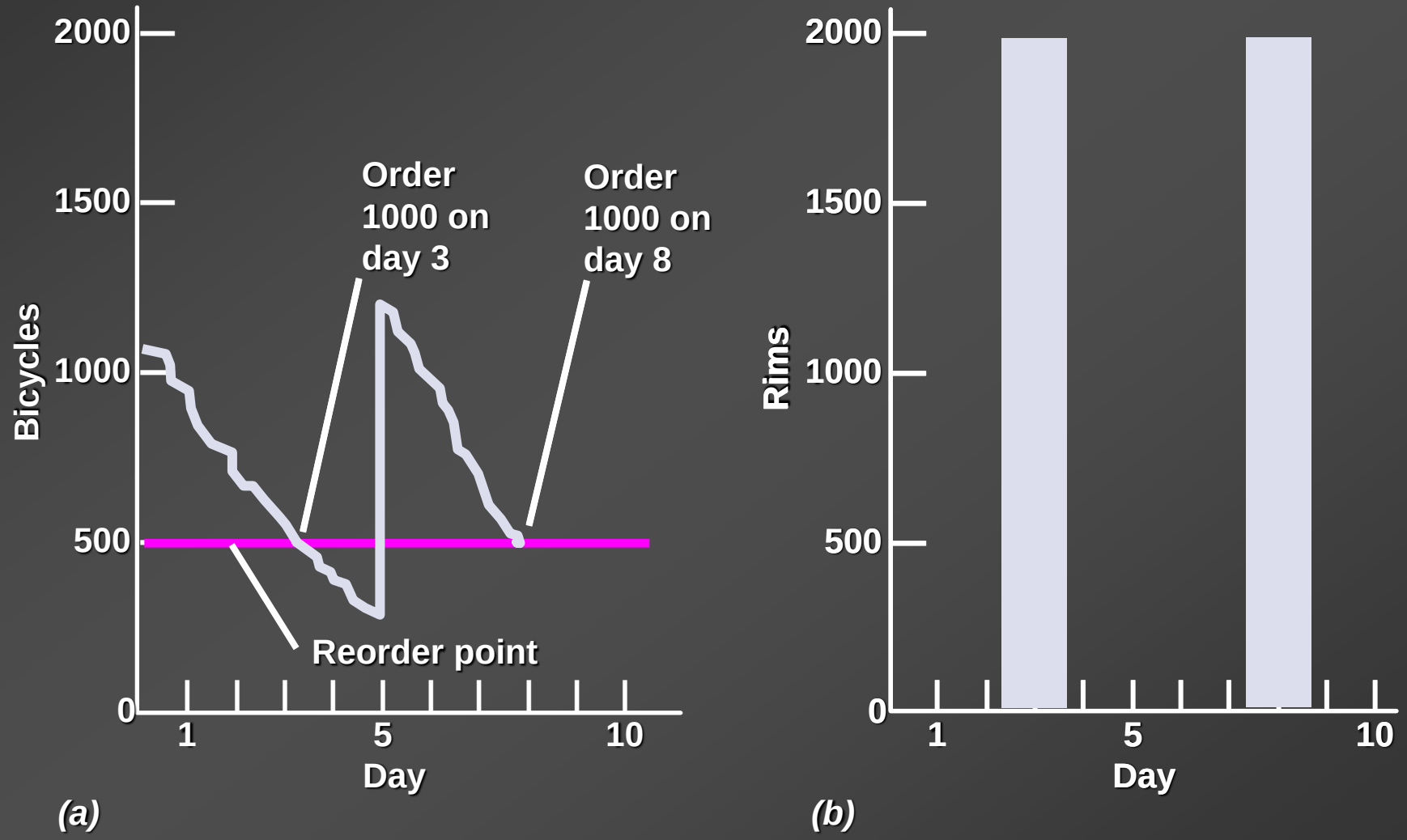


Figure 16.1

BREAK-EVEN POINT

- ***Do not forget***

BE Q = F /(p-v)

F Fixed cost

P Unit selling price

V Unit variable cost

Dependent demand

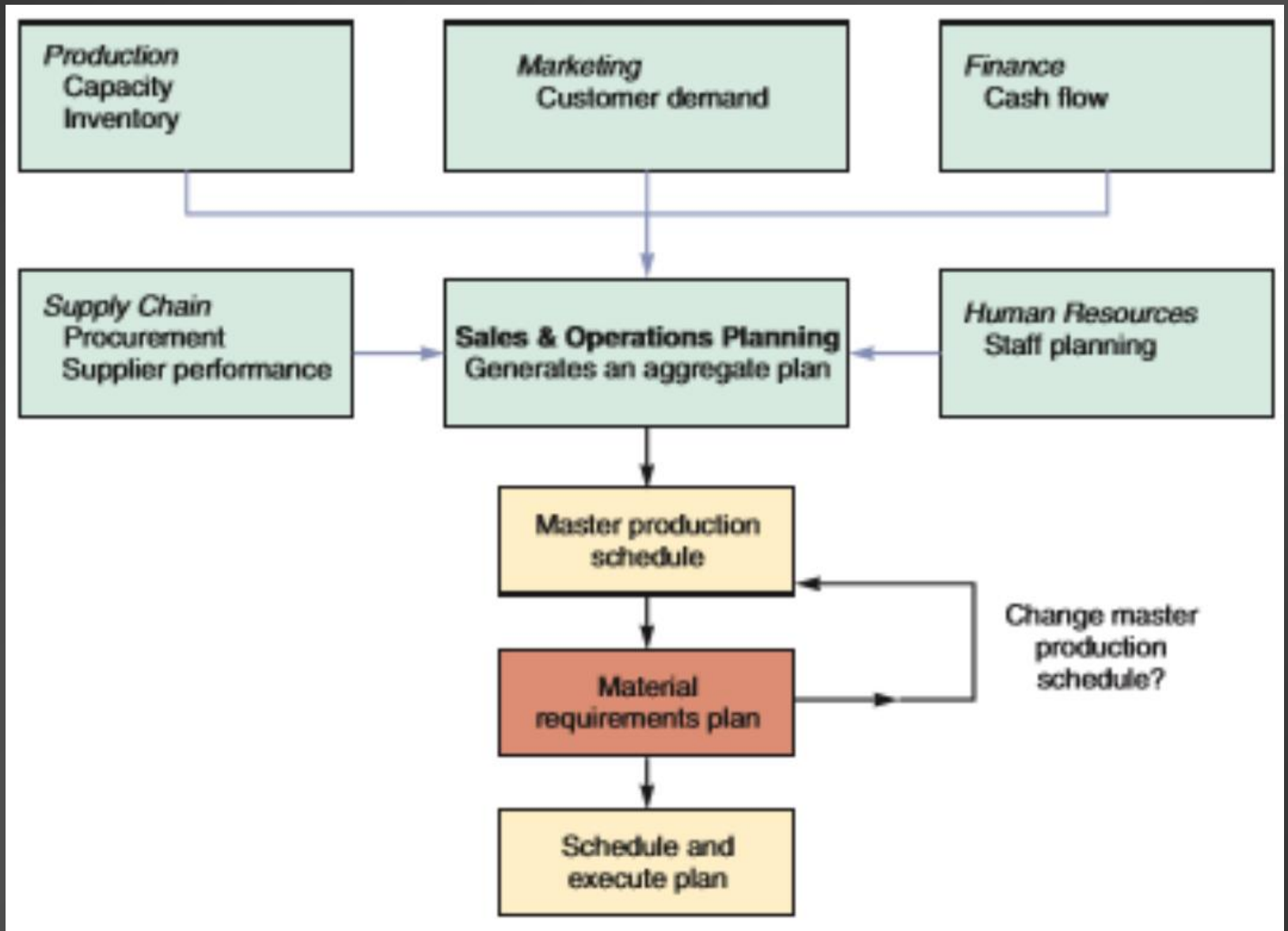
- ***Independent demand is influenced by market conditions***
- ***Dependent demand are elements of the finished product***
  - ***And more …***
- ***Manufactured from a … parent***
  - ***And might have several parents***

Dependent demand

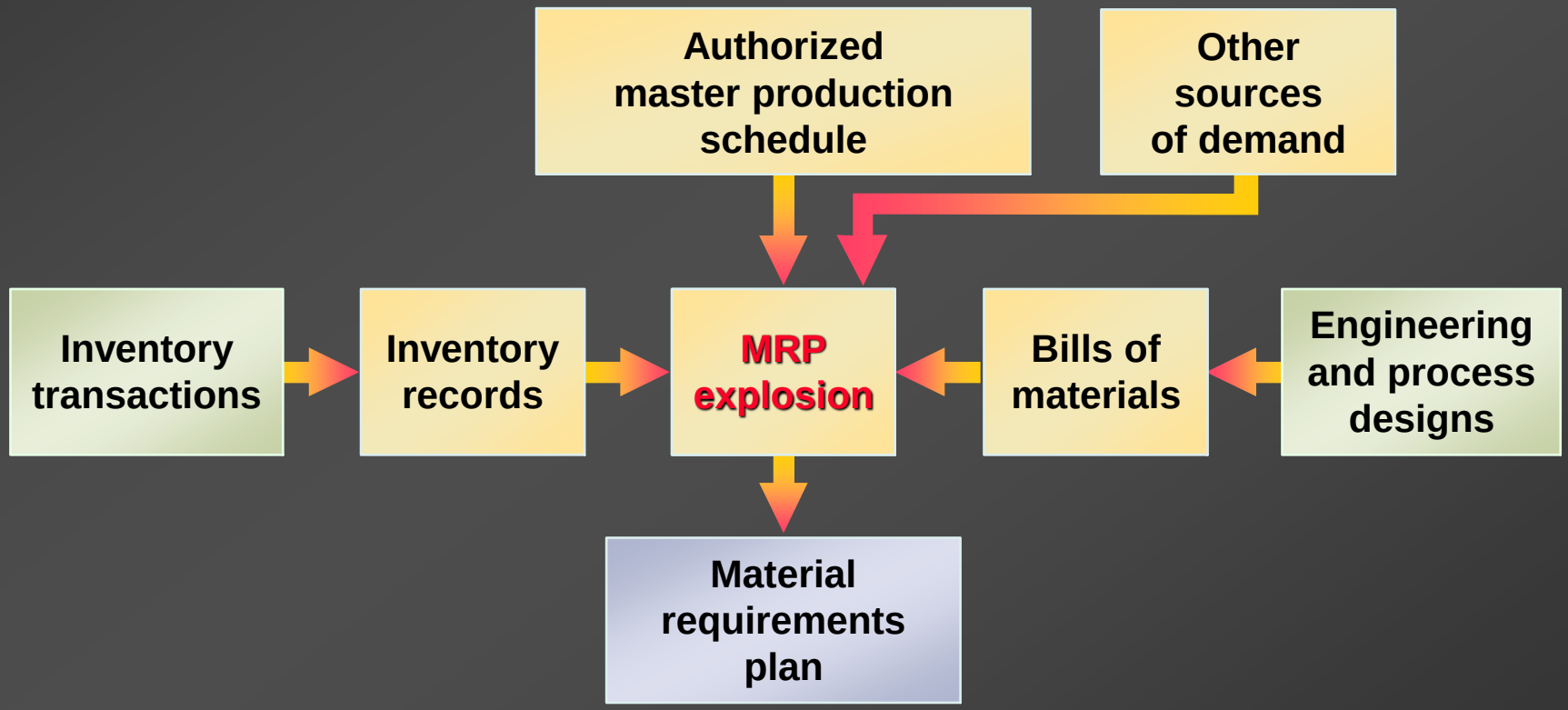
1. **Master production schedule** (what is to be made and when)
2. Specifications or **bill of material** (materials and parts required to make the product)
3. Inventory **availabilit**y (what is in stock)
4. Purchase orders outstanding (what is **on order**, also called expected receipts)
5. **Lead times** (how long it takes to get various components)

Master production schedule (MPS)

A timetable that specifies what is to be made (usually finished goods) and when.



Material Requirements Plan Output



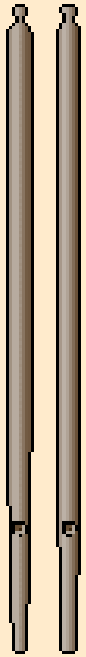
So MPS might be …

- A **customer order** in a job shop (make-to-order) company (examples: print shops, machine shops, fine-dining restaurants)
- **Modules** in a repetitive (assemble-to-order or forecast) company (examples: Harley-Davidson motorcycles, TVs, fast-food restaurant)
- **An end item** in a continuous (stock-to-forecast) company (examples: steel, beer, bread, light bulbs, paper)

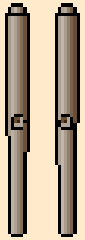
Benefits of MRP

- ***MRP calculates the dependent demand***
- ***For planning capacities and financial requirements***
- ***Automatically update dependent demand and inventory replenishement schedule***

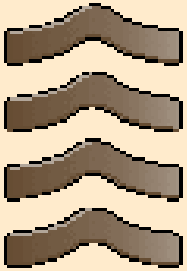
Bill of Materials



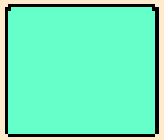
Back legs



Front legs

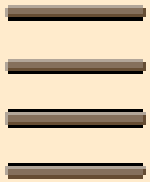


Back slats



Seat cushion

Leg supports



Seat-frame boards

A Ladder-back chair

Figure 16.3

Reorder point introduction

- With **lumpy production** demand
- Time and projected assembling capacities determine quantity
- For both dependent and independent demand
- Standardization of parts or modularity

Bill of Materials

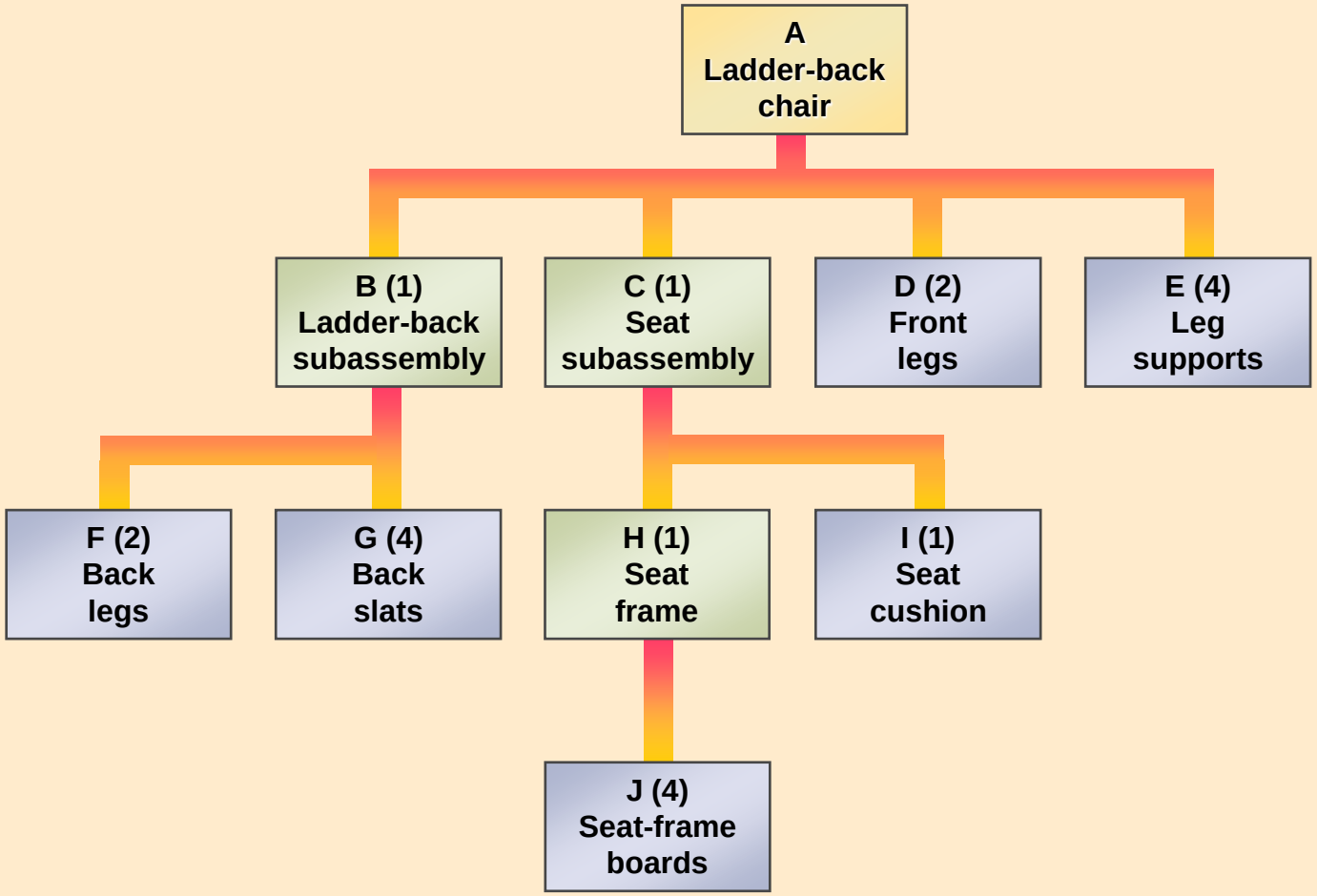


Figure 16.3

Before MPS details, Phantom bills

- **Bills of material** for components, usually subassemblies, that exist only temporarily. These components go directly into another assembly and are never inventoried.
- Therefore, components of phantom bills of material are **coded** to receive special treatment; **lead times are zero**, and they are handled as an integral part of their parent item.
- An example is a transmission shaft with gears and bearings assembly that is placed directly into a transmission.

Master Production Schedule

	April				May			
	1	2	3	4	5	6	7	8
Ladder-back chair	150					150		
Kitchen chair				120			120	
Desk chair		200	200		200			200
Aggregate production plan for chair family	670				670			

Master Production Schedule

- Within specific periods
- **Sum of quantities must equal those in the aggregate plan**
- And …
  - allocate efficiently overtime
  - Capacity limitations
  - And … tailor made processes

MPS more

- Gross requirement
- Scheduled receipt
- On hand
- Net requirements
- Planned receipt
- Open orders

Inventory Record

Figure 16.5

Item: C
Description: Seat subassembly

Lot Size: 230 units
Lead Time: 2 weeks

	Week							
	1	2	3	4	5	6	7	8
Gross requirements	150	0	0	120	0	150	120	0
Scheduled receipts	230	0	0	0	0	0	0	0
Projected on-hand inventory 37								
Planned receipts								
Planned order releases								

Inventory Record

Figure 16.5

Item: C
Description: Seat subassembly

Lot Size: 230 units
Lead Time: 2 weeks

	Week							
	1	2	3	4	5	6	7	8
Gross requirements	150	0	0	120	0	150	120	0
Scheduled receipts	230	0	0	0	0	0	0	0
Projected on-hand inventory 37								
Planned receipts								
Planned order releases								

Explanation:
Gross requirements are the total demand for the two chairs. Projected on-hand inventory in week 1 is 37 + 230 – 150

Inventory Record

Figure 16.5

Item: C
Description: Seat subassembly

Lot Size: 230 units
Lead Time: 2 weeks

	Week							
	1	2	3	4	5	6	7	8
Gross requirements	150	0	0	120	0	150	120	0
Scheduled receipts	230	0	0	0	0	0	0	0
Projected on-hand inventory 37	117							
Planned receipts								
Planned order releases								

Explanation:
Gross requirements are the total demand for the two chairs. Projected on-hand inventory in week 1 is 37 + 230 – 150 = 117 units.

Inventory Record

Figure 16.5

Item: C
Description: Seat subassembly

Lot Size: 230 units
Lead Time: 2 weeks

	Week							
	1	2	3	4	5	6	7	8
Gross requirements	150	0	0	120	0	150	120	0
Scheduled receipts	230	0	0	0	0	0	0	0
Projected on-hand inventory 37	117							
Plann recei								
Plann relea								

Inventory Record

Figure 16.5

Item: C
Description: Seat subassembly

Lot Size: 230 units
Lead Time: 2 weeks

	Week							
	1	2	3	4	5	6	7	8
Gross requirements	150	0	0	120	0	150	120	0
Scheduled receipts	230	0	0	0	0	0	0	0
Projected on-hand inventory 37	117							
Plann recei								
Plann relea								

$$\left[\begin{array}{l}\text{Projected on-hand}\\ \text{inventory balance}\\ \text{at end of week } t\end{array}\right] = \left[\begin{array}{l}\text{Inventory on}\\ \text{hand at end of}\\ \text{week } t-1\end{array}\right] + \left[\begin{array}{l}\text{Scheduled}\\ \text{or planned}\\ \text{receipts in}\\ \text{week } t\end{array}\right] - \left[\begin{array}{l}\text{Gross}\\ \text{requirements}\\ \text{in week } t\end{array}\right]$$

Inventory Record

Figure 16.5

Item: C
Description: Seat subassembly

Lot Size: 230 units
Lead Time: 2 weeks

	Week							
	1	2	3	4	5	6	7	8
Gross requirements	150	0	0	120	0	150	120	0
Scheduled receipts	230	0	0	0	0	0	0	0
Projected on-hand inventory 37	117	117	117	– 3	– 3	–153	–273	–273
Planned receipts								
Planned releases								

$$\left[\begin{array}{l}\text{Projected on-hand}\\ \text{inventory balance}\\ \text{at end of week } t\end{array}\right] = \left[\begin{array}{l}\text{Inventory on}\\ \text{hand at end of}\\ \text{week } t-1\end{array}\right] + \left[\begin{array}{l}\text{Scheduled}\\ \text{or planned}\\ \text{receipts in}\\ \text{week } t\end{array}\right] - \left[\begin{array}{l}\text{Gross}\\ \text{requirements}\\ \text{in week } t\end{array}\right]$$

Planned Orders

Figure 16.6

Explanation:
Without a new order in week 4, there will be a shortage of three units: 117 + 0 + 0 – 120 = – 3 units.

Lot Size: 230 units
Lead Time: 2 weeks

	Week							
	1	2	3	4	5	6	7	8
Gross requirements	150	0	0	120	0	150	120	0
Scheduled receipts	230	0	0	0	0	0	0	0
Projected on-hand inventory 37	117	117	117	–3	– 3	–153	– 273	– 273
Planned receipts								
Planned order releases								

Planned Orders

Figure 16.6

Lot Size: 230 units
Lead Time: 2 weeks

	Week							
	1	2	3	4	5	6	7	8
Gross requirements	150	0	0	120	0	150	120	0
Scheduled receipts	230	0	0	0	0	0	0	0
Projected on-hand inventory 37	117	117	117					
Planned receipts								
Planned order releases								

Planned Orders

Figure 16.6

Explanation:
Adding the planned receipt brings the balance to
117 + 0 + 230 – 120 = 227 units.

Lot Size: 230 units
Lead Time: 2 weeks

	Week							
	1	2	3	4	5	6	7	8
Gross requirements	150	0	0	120	0	150	120	0
Scheduled receipts	230	0	0	0	0	0	0	0
Projected on-hand inventory 37	117	117	117	227				
Planned receipts				230				
Planned order releases								

Planned Orders

Figure 16.6

Explanation:
Adding the planned receipt brings the balance to
117 + 0 + 230 – 120 = 227 units.

Lot Size: 230 units
Lead Time: 2 weeks

	Week							
	1	2	3	4	5	6	7	8
Gross requirements	150	0	0	120	0	150	120	0
Scheduled receipts	230	0	0	0	0	0	0	0
Projected on-hand inventory 37	117	117	117	227				
Planned receipts				230				
Planned order releases								

Planned Orders

Figure 16.6

Explanation:
Offsetting for a two-week lead time puts the corresponding planned order release back to week 2.

Lot Size: 230 units
Lead Time: 2 weeks

	Week							
	1	2	3	4	5	6	7	8
Gross requirements	150	0	0	120	0	150	120	0
Scheduled receipts	230	0	0	0	0	0	0	0
Projected on-hand inventory 37	117	117	117	227				
Planned receipts				230				
Planned order releases		230						

Planned Orders

Figure 16.6

Explanation:
Offsetting for a two-week lead time puts the corresponding planned order release back to week 2.

Lot Size: 230 units
Lead Time: 2 weeks

	Week							
	1	2	3	4	5	6	7	8
Gross requirements	150	0	0	120	0	150	120	0
Scheduled receipts	230	0	0	0	0	0	0	0
Projected on-hand inventory 37	117	117	117	227				
Planned receipts				230				
Planned order releases		230						

Planned Orders

Figure 16.6

Explanation:
The first planned order lasts until week 7, when projected inventory would drop to – 43.

Lot Size: 230 units
Lead Time: 2 weeks

	Week							
	1	2	3	4	5	6	7	8
Gross requirements	150	0	0	120	0	150	120	0
Scheduled receipts	230	0	0	0	0	0	0	0
Projected on-hand inventory 37	117	117	117	227	227	77	–43	
Planned receipts				230				
Planned order releases		230						

Planned Orders

Figure 16.6

Explanation:
Adding the second planned receipt brings the balance to 77 + 0 + 230 – 120 = 187.

Lot Size: 230 units
Lead Time: 2 weeks

	Week							
	1	2	3	4	5	6	7	8
Gross requirements	150	0	0	120	0	150	120	0
Scheduled receipts	230	0	0	0	0	0	0	0
Projected on-hand inventory 37	117	117	117	227	227	77		
Planned receipts				230			230	
Planned order releases		230						

Planned Orders

Figure 16.6

Explanation:
Adding the second planned receipt brings the balance to 77 + 0 + 230 – 120 = 187.

Lot Size: 230 units
Lead Time: 2 weeks

	Week							
	1	2	3	4	5	6	7	8
Gross requirements	150	0	0	120	0	150	120	0
Scheduled receipts	230	0	0	0	0	0	0	0
Projected on-hand inventory 37	117	117	117	227	227	77	187	
Planned receipts				230			230	
Planned order releases		230						

Planned Orders

Figure 16.6

Explanation:
The corresponding planned order release is for week 5.

Lot Size: 230 units
Lead Time: 2 weeks

	Week							
	1	2	3	4	5	6	7	8
Gross requirements	150	0	0	120	0	150	120	0
Scheduled receipts	230	0	0	0	0	0	0	0
Projected on-hand inventory 37	117	117	117	227	227	77	187	
Planned receipts				230			230	
Planned order releases		230			230			

Planned Orders

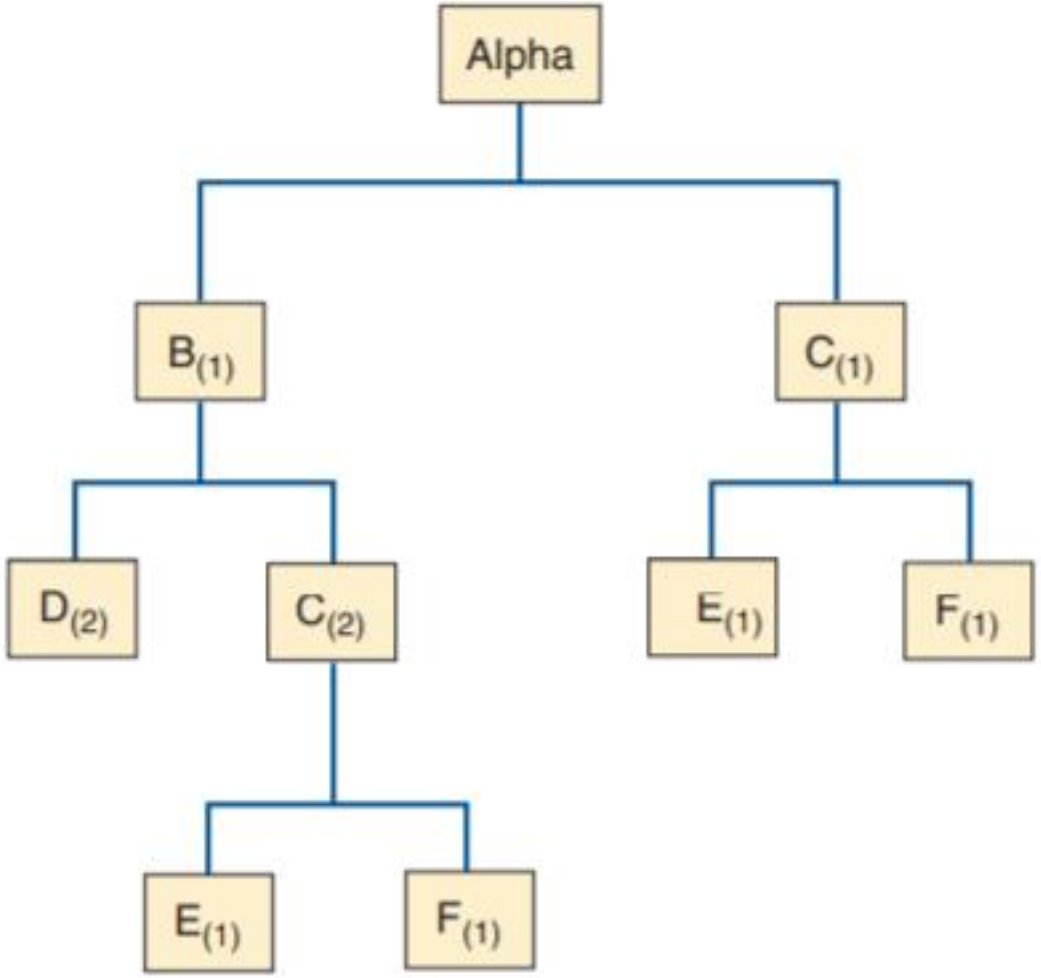
Figure 16.6

Item: C
Description: Seat subassembly

Lot Size: 230 units
Lead Time: 2 weeks

	Week							
	1	2	3	4	5	6	7	8
Gross requirements	150	0	0	120	0	150	120	0
Scheduled receipts	230	0	0	0	0	0	0	0
Projected on-hand inventory 37	117	117	117	227	227	77	187	187
Planned receipts				230			230	
Planned order releases		230			230			

Determine the low-level coding and the quantity of each component necessary to produce 10 units of an assembly we will call Alpha. The product structure and quantities of each component needed for each assembly are noted in parentheses.

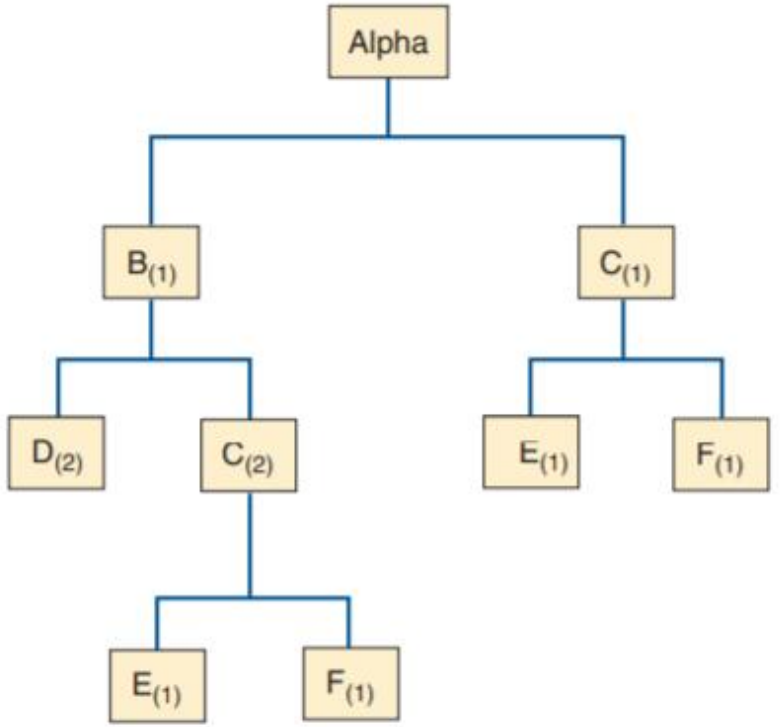


TO CONTINUE

Using the product structure for Alpha in Solved Problem 14.1, and the following lead times, quantity on hand, and master production schedule, prepare a net MRP table for Alphas.

ITEM	LEAD TIME	QUANTITY ON HAND
Alpha	1	10
B	2	20
C	3	0
D	1	100
E	1	10
F	1	50

Determine the low-level coding and the quantity of each component necessary to produce 10 units of an assembly we will call Alpha. The product structure and quantities of each component needed for each assembly are noted in parentheses.



Master Production Schedule for Alpha

PERIOD	6	7	8	9	10	11	12	13
Gross requirements			50			50		100

Periodic Order Quantity

- ***Periodic order quantity (POQ)***
  - is a lot-sizing technique that orders the quantity needed during a predetermined time between orders, such as every 3 weeks.

- ***We define the POQ interval* as**
  - **the EOQ divided by the average demand per period (e.g., one week)**

Lot-Sizing Rules – POQ

Item: C **Lot Size: *P* = 3**
Description: Seat subassembly **Lead Time: 2 weeks**

	Week							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Gross requirements	150			120		150	120	
Scheduled receipts	230							
Projected on-hand inventory 37	117	117	117					
Planned receipts								
Planned order releases								

Lot-Sizing Rules – POQ

$$\left(\begin{array}{c}\text{POQ}\\ \text{lot}\\ \text{size}\end{array}\right) = \left(\begin{array}{c}\text{Gross requirements}\\ \text{for weeks}\\ \text{4, 5, and 6}\end{array}\right) - \left(\begin{array}{c}\text{Inventory at}\\ \text{end of week 3}\end{array}\right)$$

Lot Size: *P* = 3
Lead Time: 2 weeks

	1	2	3	4	5	6	7	8
Gross requirements	150			120		150	120	
Scheduled receipts	230							
Projected on-hand inventory 37	117	117	117					
Planned receipts								
Planned order releases								

Lot-Sizing Rules – POQ

Lot Size: *P* = 3
Lead Time: 2 weeks

	1	2	3	4	5	6	7	8
Gross requirements	150			120		150	120	
Scheduled receipts	230							
Projected on-hand inventory 37	117	117	117					
Planned receipts								
Planned order releases								

Lot-Sizing Rules – POQ

(120 + 0 + 150)

Lot Size: *P* = 3
Lead Time: 2 weeks

		1	2	3	4	5	6	7	8
Gross requirements		150			120		150	120	
Scheduled receipts		230							
Projected on-hand inventory	37	117	117	117					
Planned receipts									
Planned order releases									

Lot-Sizing Rules – POQ

(120 + 0 + 150) – 117

Lot Size: *P* = 3
Lead Time: 2 weeks

	1	2	3	4	5	6	7	8
Gross requirements	150			120		150	120	
Scheduled receipts	230							
Projected on-hand inventory 37	117	117	117					
Planned receipts								
Planned order releases								

Lot-Sizing Rules – POQ

(120 + 0 + 150) – 117 = 153 units

Lot Size: *P* = 3
Lead Time: 2 weeks

	1	2	3	4	5	6	7	8
Gross requirements	150			120		150	120	
Scheduled receipts	230							
Projected on-hand inventory 37	117	117	117					
Planned receipts				153				
Planned order releases								

Lot-Sizing Rules – POQ

(120 + 0 + 150) – 117 = 153 units

Lot Size: *P* = 3
Lead Time: 2 weeks

	1	2	3	4	5	6	7	8
Gross requirements	150			120		150	120	
Scheduled receipts	230							
Projected on-hand inventory 37	117	117	117					
Planned receipts				153				
Planned order releases								

Lot-Sizing Rules – POQ

(120 + 0 + 150) – 117 = 153 units

Lot Size: *P* = 3
Lead Time: 2 weeks

	1	2	3	4	5	6	7	8
Gross requirements	150			120		150	120	
Scheduled receipts	230							
Projected on-hand inventory 37	117	117	117	150				
Planned receipts				153				
Planned order releases								

Lot-Sizing Rules – POQ

(120 + 0 + 150) – 117 = 153 units

Lot Size: *P* = 3
Lead Time: 2 weeks

	1	2	3	4	5	6	7	8
Gross requirements	150			120		150	120	
Scheduled receipts	230							
Projected on-hand inventory 37	117	117	117	150				
Planned receipts				153				
Planned order releases		153						

Lot-Sizing Rules – POQ

(120 + 0) – 0 = 120 units

Lot Size: *P* = 3
Lead Time: 2 weeks

	1	2	3	4	5	6	7	8
Gross requirements	150			120		150	120	
Scheduled receipts	230							
Projected on-hand inventory 37	117	117	117	150	150	0	0	0
Planned receipts				153			120	
Planned order releases		153			120			

Lot-Sizing Rules – POQ

Item: C
Description: Seat subassembly

Lot Size: *P* = 3
Lead Time: 2 weeks

	Week							
	1	2	3	4	5	6	7	8
Gross requirements	150			120		150	120	
Scheduled receipts	230							
Projected on-hand inventory 37	117	117	117	150	150	0	0	0
Planned receipts				153			120	
Planned order releases		153			120			

Lot-Sizing Rules – POQ

Figure 16.7

Solver - Single-Item MRP

Enter data in yellow-shaded areas.

Periods 8

Item Description: Seat Assembly

Period (P) for POQ: 3

Lot Size (FOQ):

Lead Time: 2

POQ Rule

		1	2	3	4	5	6	7	8
Gross Requirements		150			120		150	120	
Scheduled Receipts		230							
Projected On-Hand Inventory	37	117	117	117	150	150			
Planned Receipts					153			120	
Planned Order Releases			153			120			

Lot-Sizing Rules – L4L

Item: C **Lot Size: L4L**
Description: Seat subassembly **Lead Time: 2 weeks**

	Week							
	1	2	3	4	5	6	7	8
Gross requirements	150			120		150	120	
Scheduled receipts	230							
Projected on-hand inventory 37	117	117	117					
Planned receipts								
Planned order releases								

Lot-Sizing Rules – L4L

$$\left(\begin{array}{c}\text{L4L}\\ \text{lot}\\ \text{size}\end{array}\right) = \left(\begin{array}{c}\text{Gross requirements}\\ \text{in week 4}\end{array}\right) - \left(\begin{array}{c}\text{Inventory balance}\\ \text{at end of week 3}\end{array}\right)$$

Lot Size: L4L
Lead Time: 2 weeks

	1	2	3	4	5	6	7	8
Gross requirements	150			120		150	120	
Scheduled receipts	230							
Projected on-hand inventory 37	117	117	117					
Planned receipts								
Planned order releases								

Lot-Sizing Rules – L4L

$$\left(\begin{array}{c}\text{L4L}\\ \text{lot}\\ \text{size}\end{array}\right) = 120 - 117 = 3$$

Lot Size: L4L
Lead Time: 2 weeks

	1	2	3	4	5	6	7	8
Gross requirements	150			120		150	120	
Scheduled receipts	230							
Projected on-hand inventory 37	117	117	117					
Planned receipts								
Planned order releases								

Lot-Sizing Rules – L4L

$$\left(\begin{array}{c}\text{L4L}\\ \text{lot}\\ \text{size}\end{array}\right) = 120 - 117 = 3$$

Lot Size: L4L
Lead Time: 2 weeks

	1	2	3	4	5	6	7	8
Gross requirements	150			120		150	120	
Scheduled receipts	230							
Projected on-hand inventory 37	117	117	117					
Planned receipts				3				
Planned order releases								

Lot-Sizing Rules – L4L

$$\left(\begin{array}{c}\text{L4L}\\ \text{lot}\\ \text{size}\end{array}\right) = 120 - 117 = 3$$

Lot Size: L4L
Lead Time: 2 weeks

	1	2	3	4	5	6	7	8
Gross requirements	150			120		150	120	
Scheduled receipts	230							
Projected on-hand inventory 37	117	117	117	0				
Planned receipts				3				
Planned order releases		3						

Lot-Sizing Rules – L4L

Item: C
Description: Seat subassembly

Lot Size: L4L
Lead Time: 2 weeks

	Week							
	1	2	3	4	5	6	7	8
Gross requirements	150			120		150	120	
Scheduled receipts	230							
Projected on-hand inventory 37	117	117	117	0	0	0		
Planned receipts				3				
Planned order releases		3						

Lot-Sizing Rules – L4L

Item: C
Description: Seat subassembly

Lot Size: L4L
Lead Time: 2 weeks

	Week							
	1	2	3	4	5	6	7	8
Gross requirements	150			120		150	120	
Scheduled receipts	230							
Projected on-hand inventory 37	117	117	117	0	0	0		
Planned receipts				3		150		
Planned order releases		3		150				

Lot-Sizing Rules – L4L

Item: C
Description: Seat subassembly

Lot Size: L4L
Lead Time: 2 weeks

	Week							
	1	2	3	4	5	6	7	8
Gross requirements	150			120		150	120	
Scheduled receipts	230							
Projected on-hand inventory 37	117	117	117	0	0	0	0	
Planned receipts				3		150	120	
Planned order releases		3		150	120			

Lot-Sizing Rules – L4L

Item: C
Description: Seat subassembly

Lot Size: L4L
Lead Time: 2 weeks

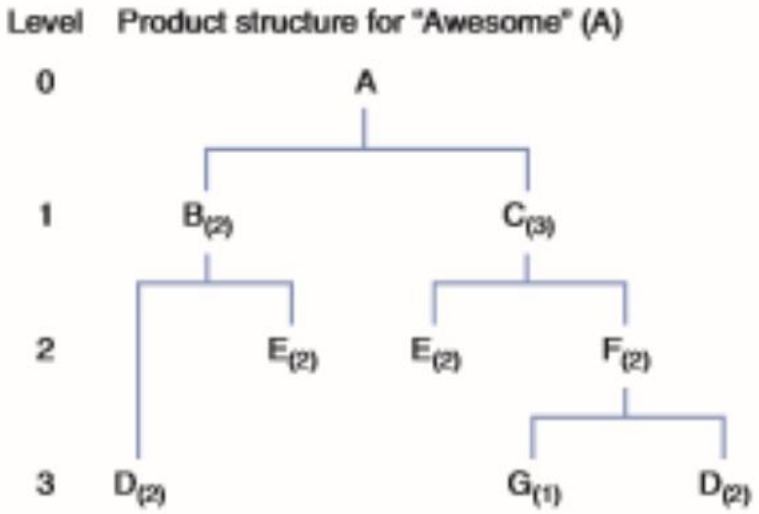
	Week							
	1	2	3	4	5	6	7	8
Gross requirements	150			120		150	120	
Scheduled receipts	230							
Projected on-hand inventory 37	117	117	117	0	0	0	0	0
Planned receipts				3		150	120	
Planned order releases		3		150	120			

L4L calculation

DETERMINING NET REQUIREMENTS

Speaker Kits, Inc., developed a product structure from a bill of material in Example 1. Example 2 developed a gross requirements plan. Given the following on-hand inventory, Speaker Kits, Inc., now wants to construct a net requirements plan. The gross requirement remains 50 units in week 8, and component requirements are as shown in the product structure in Example 1.

ITEM	ON HAND	ITEM	ON HAND
A	10	E	10
B	15	F	5
C	20	G	0
D	10		



Hip Replacements, Inc., has a master production schedule for its newest model, as shown on page 592, a setup cost of $50, a holding cost per week of $2, beginning inventory of 0, and lead time of 1 week. What are the costs of using (a) EOQ and (b) POQ for this 10-week period?

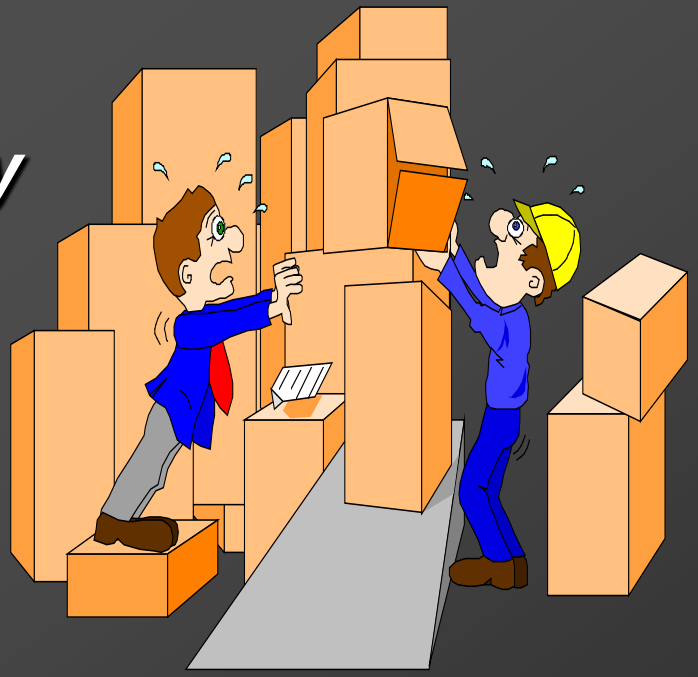
Compare EOQ and POQ

WEEK		1	2	3	4	5	6	7	8	9	10	
Gross requirements		0	0	50	0	0	35	15	0	100	0	
Scheduled receipts												
Projected on hand	0	0	0	0	14	14	14	11	28	28	24	24
Net requirements		0	0	50	0	0	21	0	0	72	0	
Planned order receipts				64			32	32		96		
Planned order releases			64			32	32		96			

WEEK		1	2	3	4	5	6	7	8	9	10
Gross requirements		0	0	50	0	0	35	15	0	100	0
Scheduled receipts											
Projected on hand	0	0	0	0	0	0	0	15	0	0	
Net requirements		0	0	50	0	0	50	0	0	100	0
Planned order receipts				50			50			100	
Planned order releases			50			50			100		

Lot-Sizing Rule Comparison

- *The FOQ rule generates high average inventory because it creates remnants.*
- *The POQ rule reduces average on-hand inventory because it does a better job of matching order quantity to requirements.*



- *The L4L rule minimizes inventory investment but maximizes the number of orders placed.*

Safety Stock

Figure 16.9

Tutor 15.1 - FOQ, POQ, and L4L Rules

FOQ Rule						Lot Size	230
						Lead Time	2
						Safety Stock	80

		1	2	3	4	5	6	7	8
Gross Requirements		150	0	0	120	0	150	120	0
Scheduled Receipts		230	0	0	0	0	0	0	0
Projected On-Hand Inventory	37	117	117	117	227	227	307	187	187
Planned Receipts		0	0	0	230	0	230	0	0
Planned Order Releases		0	230	0	230	0	0	0	0

MRP Outputs

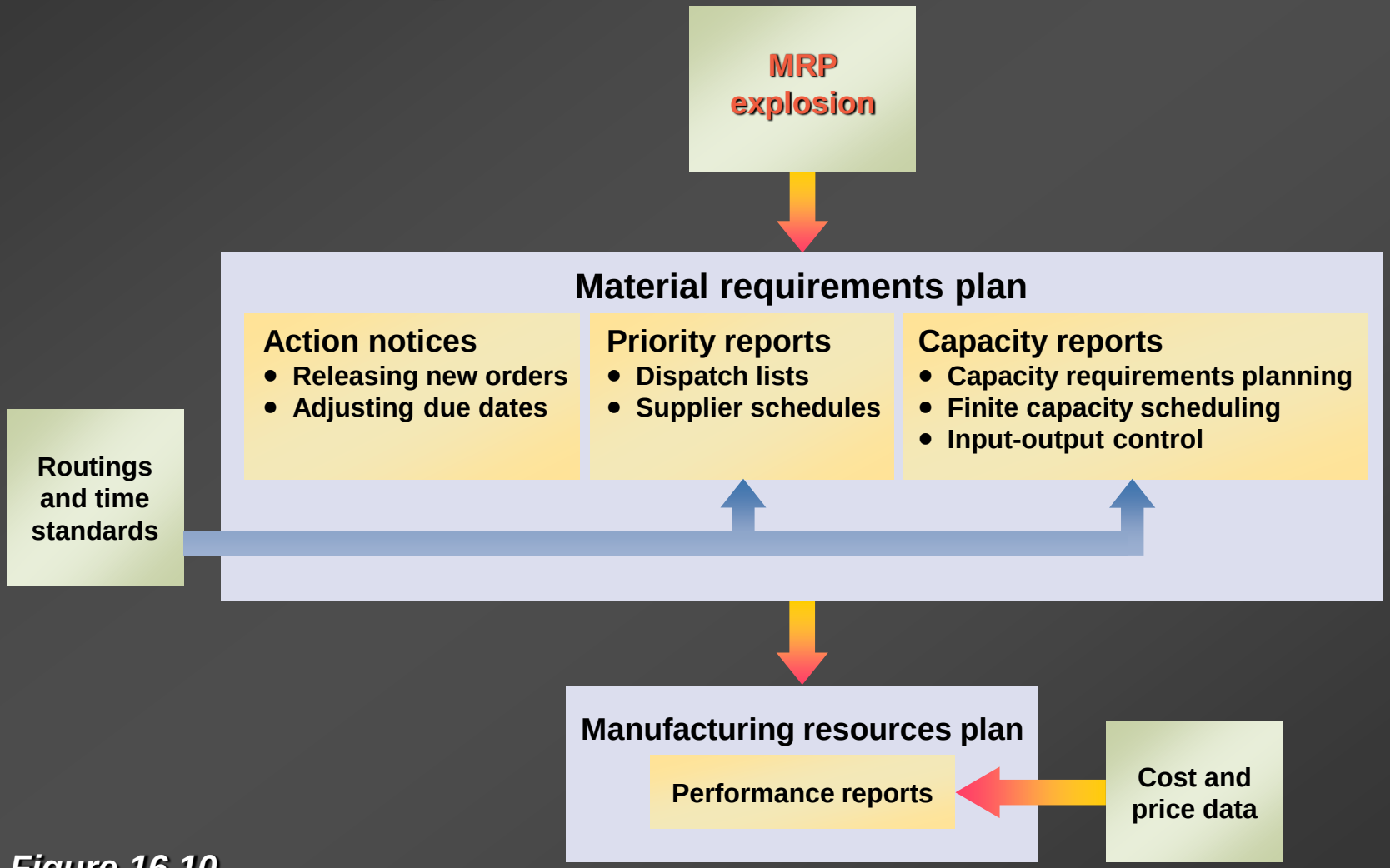


Figure 16.10

Bill of Materials

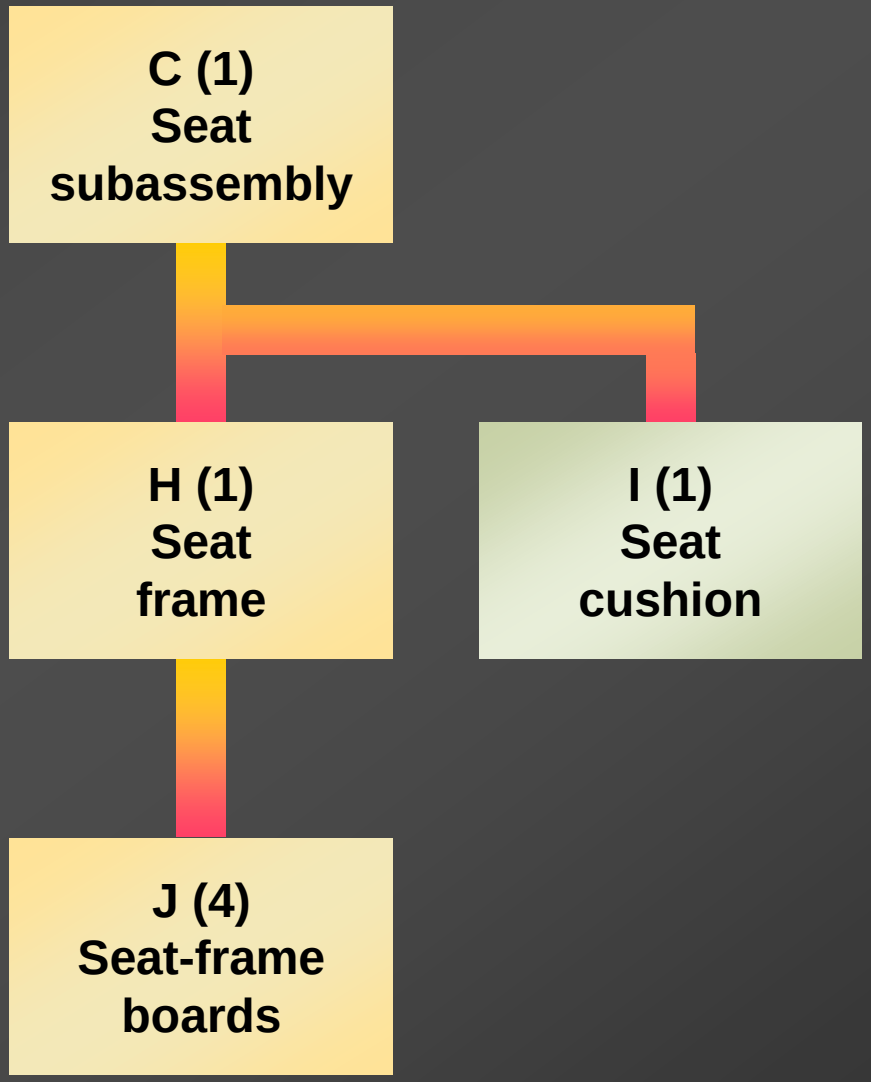


Figure 16.11

MRP Explosion

Item: Seat subassembly
Lot size: 230 units

Lead time: 2 weeks	Week 1	2	3	4	5	6	7	8
Gross requirements	150	0	0	120	0	150	120	0
Scheduled receipts	230	0	0	0	0	0	0	0
Projected on-hand inventory 37	117	117	117	227	227	77	187	187
Planned receipts				230			230	
Planned order releases		230			230			

Figure 16.12

MRP Explosion

Lead time: 2 weeks	Week 1	2	3	4	5	6	7	8
Gross requirements	150	0	0	120	0	150	120	0
Planned receipts				230			230	
Planned order releases		230			230			

Figure 16.12

MRP Explosion

Lead time: 2 weeks	Week 1	2	3	4	5	6	7	8
Gross requirements	150	0	0	120	0	150	120	0
Planned receipts				230			230	
Planned order releases		230			230			

Item: Seat frames
Lot size: 300 units

Lead time: 1 week	Week 1	2	3	4	5	6	7	8
Gross requirements								
Scheduled receipts	0	300	0	0	0	0	0	0
Projected on-hand inventory 40								
Planned receipts								
Planned order releases								

Item: Seat cushion
Lot size: L4L

Lead time: 1 week	Week 1	2	3	4	5	6	7	8
Gross requirements								
Scheduled receipts	0	0	0	0	0	0	0	0
Projected on-hand inventory 0								
Planned receipts								
Planned order releases								

Figure 16.12

MRP Explosion

Lead time: 2 weeks	Week 1	2	3	4	5	6	7	8
Gross requirements	150	0	0	120	0	150	120	0
Planned receipts				230			230	
Planned order releases		230			230			

Usage quantity: 1

Usage quantity: 1

Item: Seat frames
Lot size: 300 units

Lead time: 1 week	Week 1	2	3	4	5	6	7	8
Gross requirements	0	230						
Scheduled receipts	0	300	0	0	0	0	0	0
Projected on-hand inventory 40								
Planned receipts								
Planned order releases								

Item: Seat cushion
Lot size: L4L

Lead time: 1 week	Week 1	2	3	4	5	6	7	8
Gross requirements	0	230						
Scheduled receipts	0	0	0	0	0	0	0	0
Projected on-hand inventory 0								
Planned receipts								
Planned order releases								

Figure 16.12

MRP Explosion

Lead time: 2 weeks	Week 1	2	3	4	5	6	7	8
Gross requirements	150	0	0	120	0	150	120	0
Planned receipts				230			230	
Planned order releases		230			230			

Usage quantity: 1

Usage quantity: 1

Item: Seat frames
Lot size: 300 units

Lead time: 1 week	Week 1	2	3	4	5	6	7	8
Gross requirements	0	230	0	0	230			
Scheduled receipts	0	300	0	0	0	0	0	0
Projected on-hand inventory 40								
Planned receipts								
Planned order releases								

Item: Seat cushion
Lot size: L4L

Lead time: 1 week	Week 1	2	3	4	5	6	7	8
Gross requirements	0	230	0	0	230			
Scheduled receipts	0	0	0	0	0	0	0	0
Projected on-hand inventory 0								
Planned receipts								
Planned order releases								

Figure 16.12

MRP Explosion

Lead time: 2 weeks	Week 1	2	3	4	5	6	7	8
Gross requirements	150	0	0	120	0	150	120	0
Planned receipts				230			230	
Planned order releases		230			230			

Item: Seat frames
Lot size: 300 units

Lead time: 1 week		Week 1	2	3	4	5	6	7	8
Gross requirements		0	230	0	0	230	0	0	0
Scheduled receipts		0	300	0	0	0	0	0	0
Projected on-hand inventory	40	40	110	110	110	180	180	180	180
Planned receipts						300			
Planned order releases					300				

Item: Seat cushion
Lot size: L4L

Lead time: 1 week		Week 1	2	3	4	5	6	7	8
Gross requirements		0	230	0	0	230	0	0	0
Scheduled receipts		0	0	0	0	0	0	0	0
Projected on-hand inventory	0	0	0	0	0	0	0	0	0
Planned receipts			230			230			
Planned order releases		230			230				

Figure 16.12

MRP Explosion

Lead time: 1 week	Week 1	2	3	4	5	6	7	8
Gross requirements	0	230	0	0	230	0	0	0
Planned receipts					300			
Planned order releases				300				

Item: Seat cushion
Lot size: L4L

Lead time: 1 week	Week 1	2	3	4	5	6	7	8
Gross requirements	0	230	0	0	230	0	0	0
Planned receipts		230			230			
Planned order releases	230			230				

Figure 16.12

MRP Explosion

Lead time: 1 week	Week 1	2	3	4	5	6	7	8
Gross requirements	0	230	0	0	230	0	0	0
Planned receipts					300			
Planned order releases				300				

Item: Seat cushion
Lot size: L4L

Lead time: 1 week	Week 1	2	3	4	5	6	7	8
Gross requirements	0	230	0	0	230	0	0	0
Planned receipts		230			230			
Planned order releases	230			230				

Item: Seat-frame boards
Lot size: 1500 units

Lead time: 1 week	Week 1	2	3	4	5	6	7	8
Gross requirements								
Scheduled receipts	0	0	0	0	0	0	0	0
Projected on-hand inventory 200								
Planned receipts								
Planned order releases								

Figure 16.12

MRP Explosion

Lead time: 1 week	Week 1	2	3	4	5	6	7	8
Gross requirements	0	230	0	0	230	0	0	0
Planned receipts					300			
Planned order releases				300				

Item: Seat cushion
Lot size: L4L

Lead time: 1 week	Week 1	2	3	4	5	6	7	8
Gross requirements	0	230	0	0	230	0	0	0
Planned receipts		230			230			
Planned order releases	230			230				

Usage quantity: 4

Item: Seat-frame boards
Lot size: 1500 units

Lead time: 1 week	Week 1	2	3	4	5	6	7	8
Gross requirements	0	0	0	1200	0	0	0	0
Scheduled receipts	0	0	0	0	0	0	0	0
Projected on-hand inventory 200								
Planned receipts								
Planned order releases								

Figure 16.12

MRP Explosion

Lead time: 1 week	Week 1	2	3	4	5	6	7	8
Gross requirements	0	230	0	0	230	0	0	0
Planned receipts					300			
Planned order releases				300				

Item: Seat cushion
Lot size: L4L

Lead time: 1 week	Week 1	2	3	4	5	6	7	8
Gross requirements	0	230	0	0	230	0	0	0
Planned receipts		230			230			
Planned order releases	230			230				

Item: Seat-frame boards
Lot size: 1500 units

Lead time: 1 week	Week 1	2	3	4	5	6	7	8
Gross requirements	0	0	0	1200	0	0	0	0
Scheduled receipts	0	0	0	0	0	0	0	0
Projected on-hand inventory 200	200	200	200	500	500	500	500	500
Planned receipts				1500				
Planned order releases			1500					

Figure 16.12

Capacity Requirements

Date: **Week: 32**

Plant 01 Dept. 03: Lathe Station

Capacity: 320 hours per week

	Week					
	32	33	34	35	36	37
Planned hours	90	156	349	210	360	280
Actual hours						
Total hours						

Figure 16.13

Capacity Requirements

Date: **Week: 32**

Plant 01 Dept. 03: Lathe Station

Capacity: 320 hours per week

	Week					
	32	33	34	35	36	37
Planned hours	90	156	349	210	360	280
Actual hours	210	104	41	0	0	0
Total hours						

Figure 16.13

Capacity Requirements

Date: **Week: 32**

Plant 01 Dept. 03: Lathe Station

Capacity: 320 hours per week

	Week					
	32	33	34	35	36	37
Planned hours	90	156	349	210	360	280
Actual hours	210	104	41	0	0	0
Total hours	300	260	390	210	360	280

Figure 16.13

Capacity Requirements

Date: **Week: 32**

Plant 01 Dept. 03: Lathe Station

Capacity: 320 hours per week

	Week					
	32	33	34	35	36	37
Planned hours	90	156	349	210	360	280
Actual hours	210	104	41	0	0	0
Total hours	300	260	390	210	360	280

Explanation:
Projected capacity requirements exceed weekly hours of capacity.

Figure 16.13

Input-Output Report

Workstation: Rough Mill **Week: 32**

Tolerance: ± 25 hours

	Week Ending				
	28	29	30	31	32
Inputs					
Planned					
Actual					
Cumulative deviation					
Outputs					
Planned					
Actual					
Cumulative deviation					

Figure 16.14

Input-Output Report

Workstation: Rough Mill **Week: 32**

Tolerance: ± 25 hours

	Week Ending				
	28	29	30	31	32
Inputs					
Planned	160	155	170	160	165
Actual	145	160	168	177	
Cumulative deviation	– 15	– 10	– 12	+ 5	
Outputs					
Planned	170	170	160	160	160
Actual	165	165	150	148	
Cumulative deviation	– 5	– 10	– 20	– 32	

Figure 16.14

Input-Output Report

Explanation:
Cumulative deviations between – 25 hours and + 25 hours are allowed.

Workstation: Rough Mill **Week: 32**
Tolerance: ± 25 hours

	Week Ending				
	28	29	30	31	32
Inputs					
Planned	160	155	170	160	165
Actual	145	160	168	177	
Cumulative deviation	– 15	– 10	– 12	+ 5	
Outputs					
Planned	170	170	160	160	160
Actual	165	165	150	148	
Cumulative deviation	– 5	– 10	– 20	– 32	

Figure 16.14

Input-Output Report

Workstation: Rough Mill — Week: 32

Tolerance: ± 25 hours

	Week Ending				
	28	29	30	31	32
Inputs					
Planned	160	155	170	160	165
Actual	145	160	168	177	
Cumulative deviation	– 15	– 10	– 12	+ 5	
Outputs					
Planned	170	170	160	160	160
Actual	165	165	150	148	
Cumulative deviation	– 5	– 10	– 20	– 32	

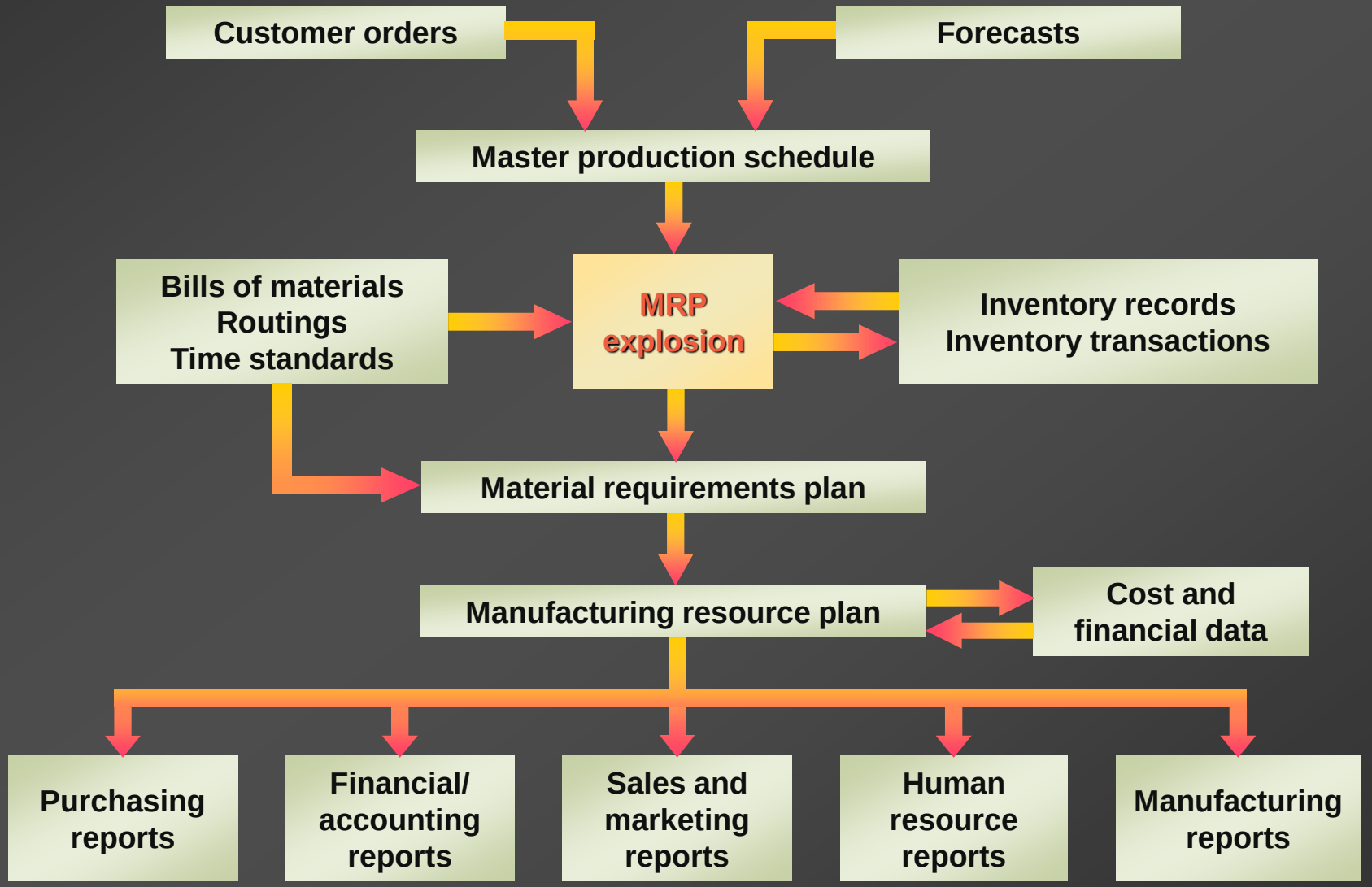
Explanation:
Cumulative deviations between – 25 hours and + 25 hours are allowed.

Explanation:
Cumulative deviation exceeds lower tolerance limit, indicating actual hours of output have fallen too far below planned hours of output and some action is required.

Figure 16.14

MRP II

Figure 16.15



Bill of Resources

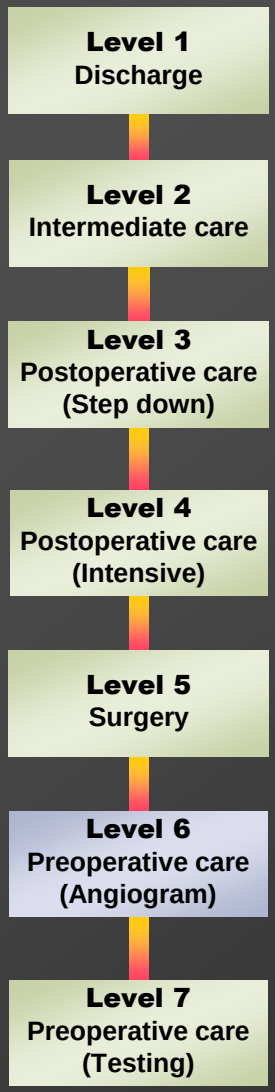
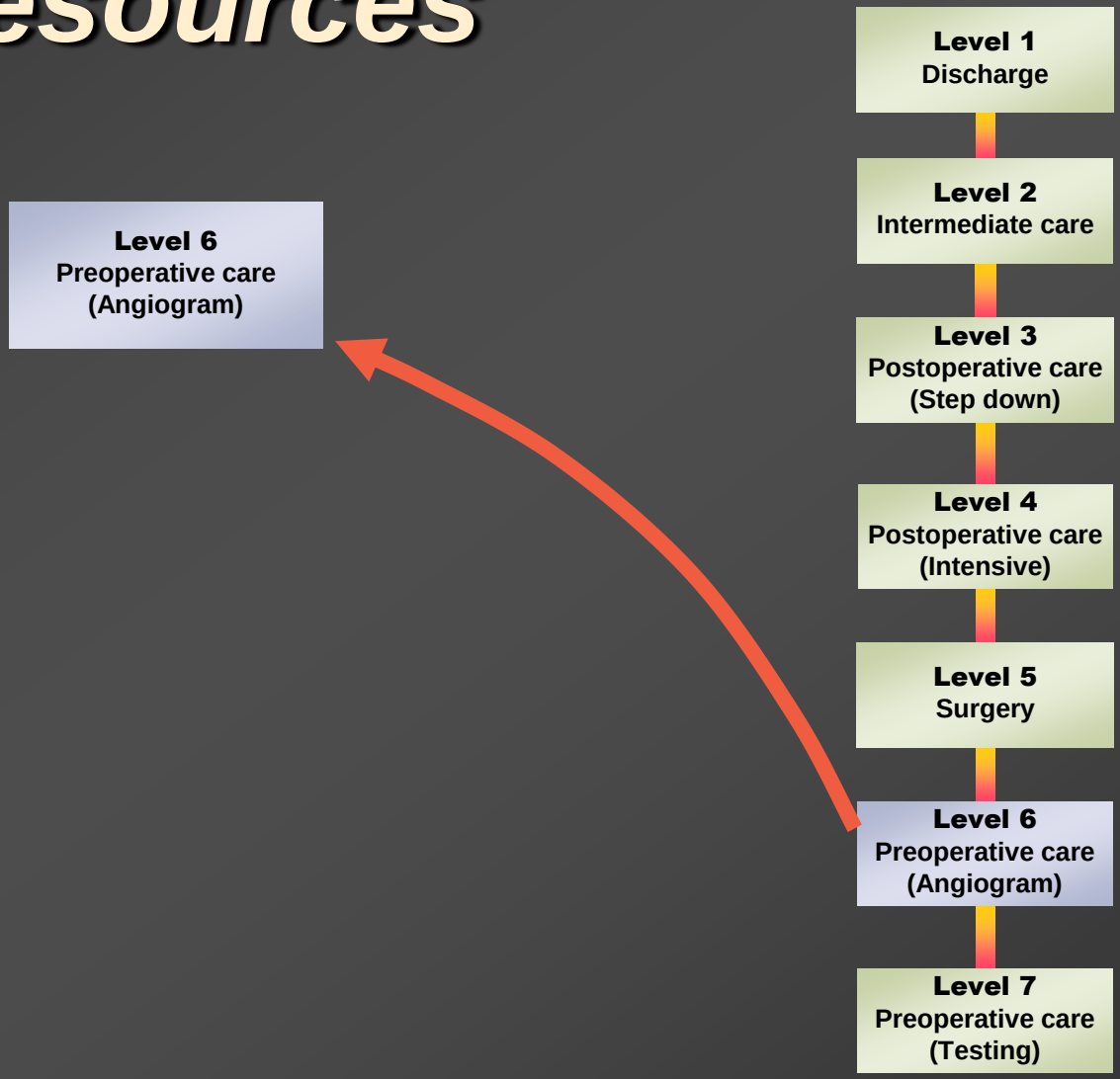


Figure 16.16

(a)

Bill of Resources



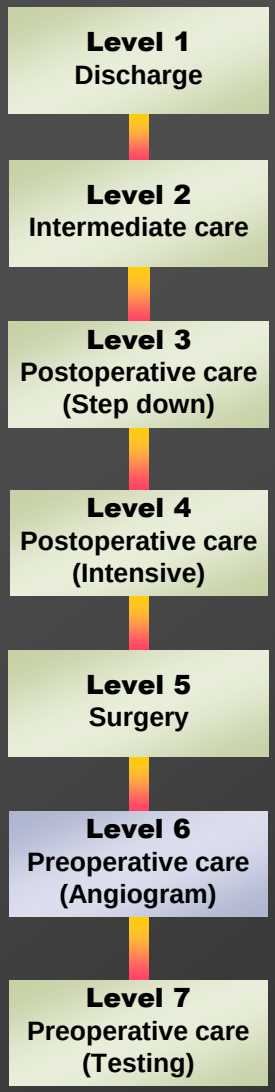
(b)

(a)

Figure 16.16

Bill of Resources

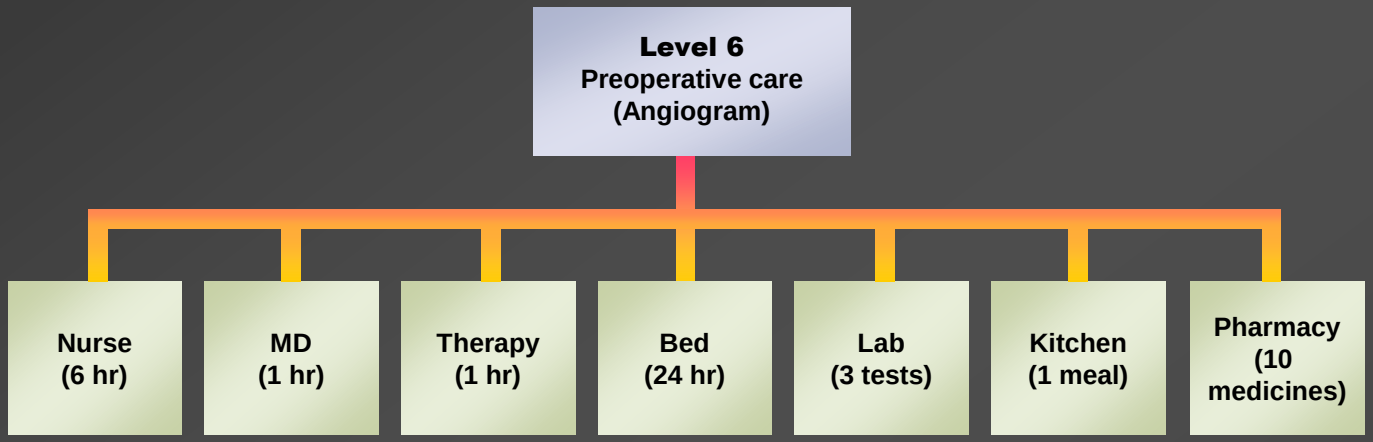
(b)



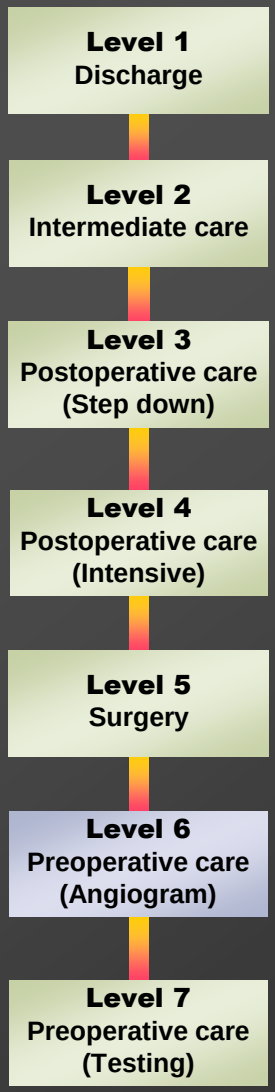
(a)

Figure 16.16

Bill of Resources



(b)



(a)

Figure 16.16

Distribution Requirements Planning

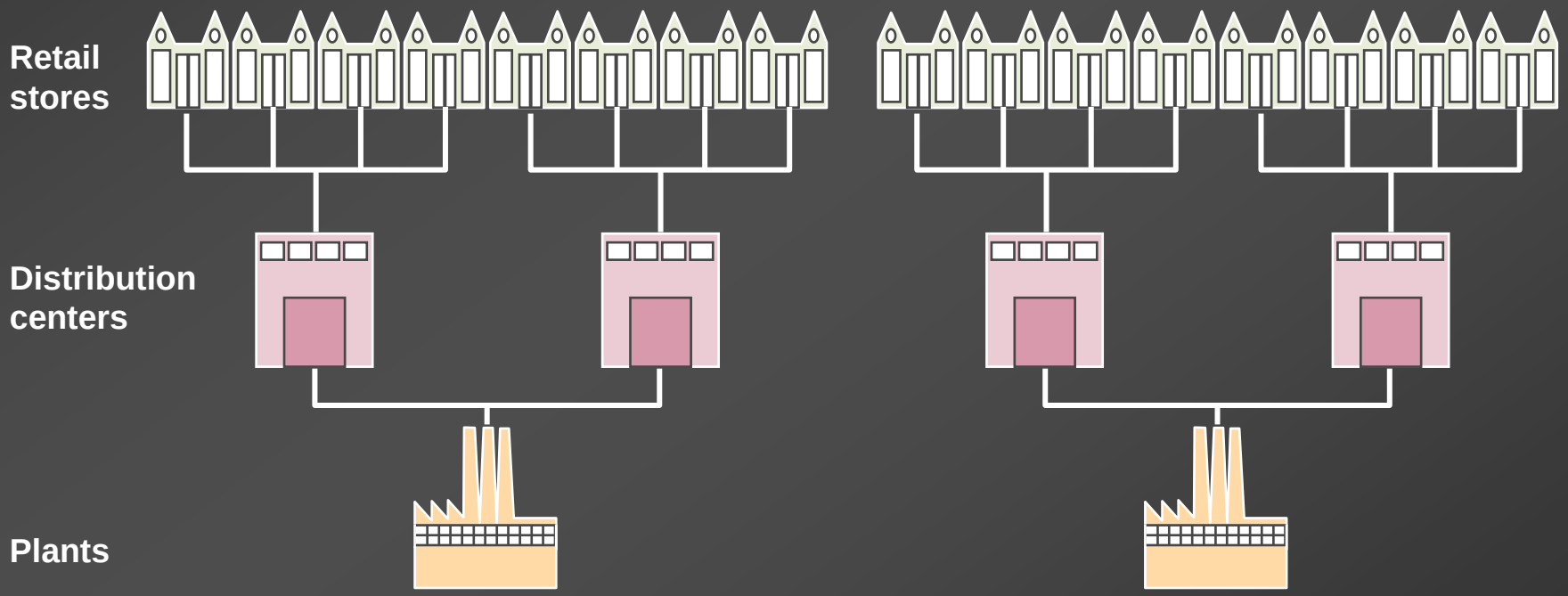


Figure 16.17

Problem 1

Refer to the bill of materials for product A shown in Figure 16.18.

If there is no existing inventory, how many units of items G, E, and D must be purchased, produce five units of end item A?

Solved Problem 1

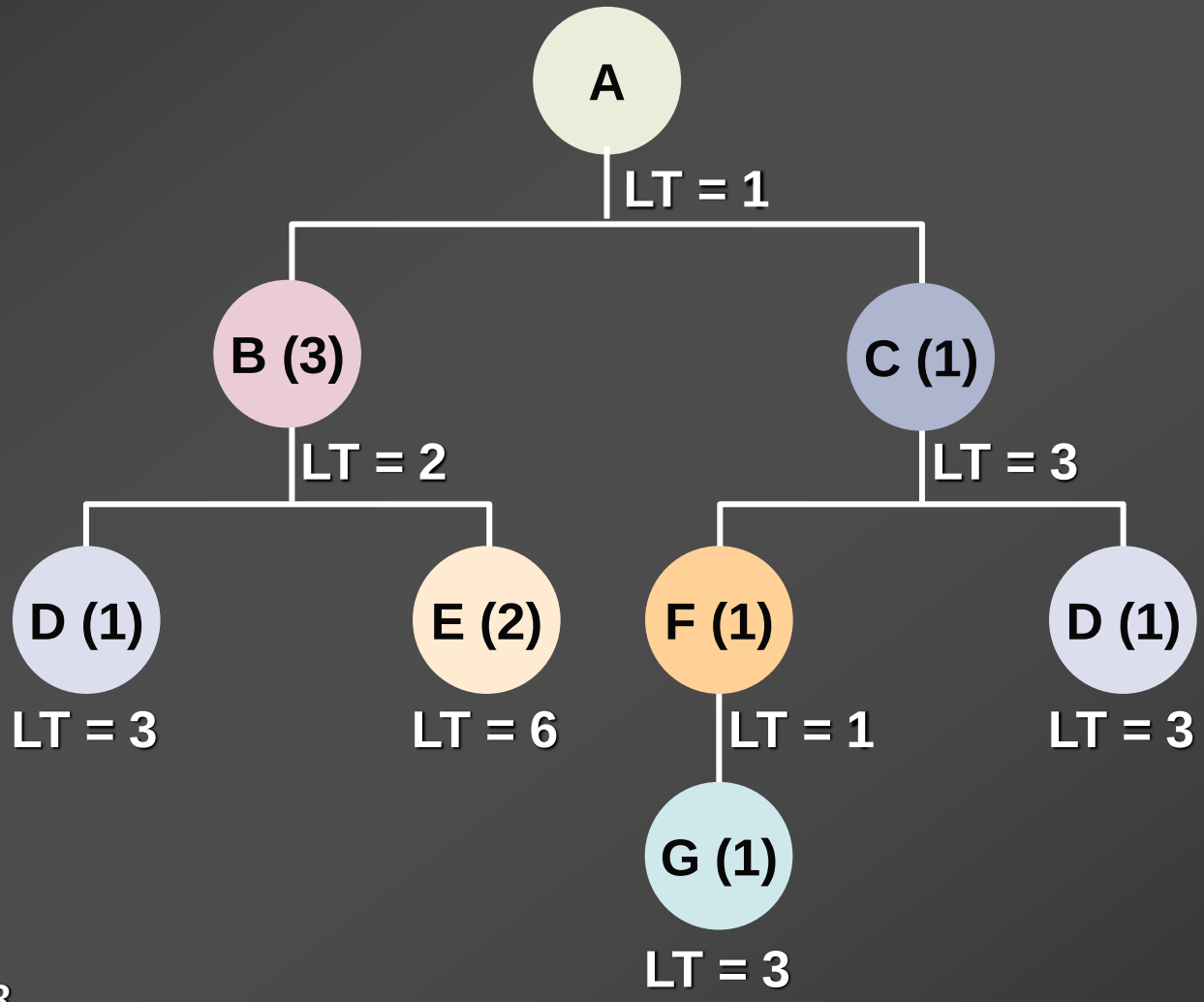


Figure 16.18

Problem 2

The MPS for product A calls for the assembly department to begin final assembly according to the following schedule…

100 units in week 2; 200 units in week 4; 120 units in week 6; 180 units in week 7; and 60 units in week 8.

Develop a material requirements plan for the next eight weeks for items B, C, and D, identifying any action notices that would be provided. The BOM for A is shown in Figure 16.19, and data from the inventory records are shown in Table 16.1.

Solved Problem 2

Figure 16.19

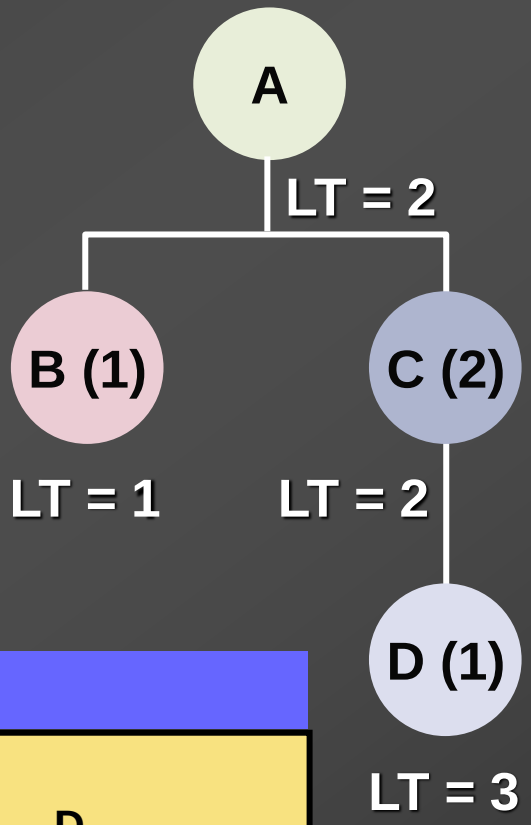
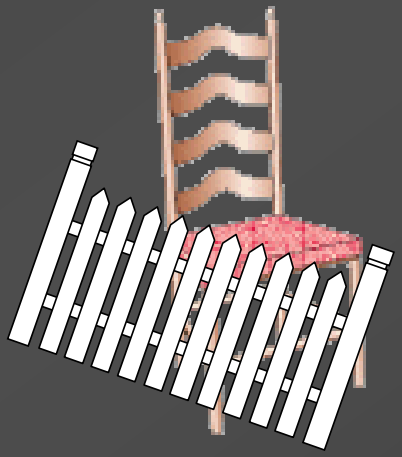


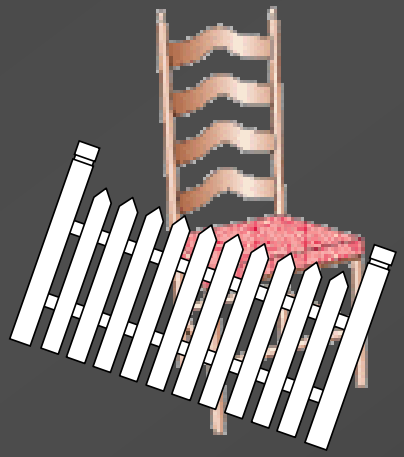
TABLE 16.1 INVENTORY RECORD DATA

DATA CATEGORY	ITEM B	ITEM C	ITEM D
Lot-sizing rule	POQ (P=3)	L4L	FOQ = 500 units
Lead time	1 week	2 weeks	3 weeks
Scheduled receipts	None	200 (week 1)	None
Beginning (on-hand) inventory	20	0	425

Freezing the MPS

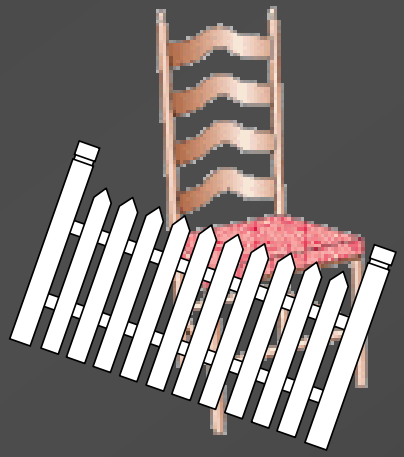


Freezing the MPS



	Week									
	1	2	3	4	5	6	7	8	9	10
MPS quantity	0	150	0	0	0	0	150	0	0	0

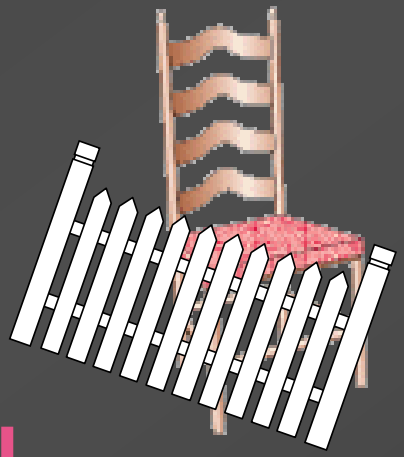
Freezing the MPS



	Week									
	1	2	3	4	5	6	7	8	9	10
MPS quantity	0	150	0	0	0	0	150	0	0	0

Demand time fence

Freezing the MPS



	Week									
	1	2	3	4	5	6	7	8	9	10
MPS quantity	0	150	0	0	0	0	150	0	0	0

Demand time fence

Planning time fence

SELF TEST

- ***A lot-sizing procedure that orders on a predetermined time interval with the order quantity equal to the total of the interval's requirement is:***
  a) periodic order quantity.
  b) part period balancing.
  c) economic order quantity.
  d) all of the above.

- In a product structure diagram:
  a) parents are found only at the top level of the diagram.
  b) parents are found at every level in the diagram.
  c) children are found at every level of the diagram except the top level.
  d) all items in the diagrams are both parents and children.
  e) all of the above.

SELF TEST

- The difference between a gross material requirements plan (gross MRP) and a net material requirements plan (net MRP) is:

a) the gross MRP may not be computerized, but the net MRP must be computerized.

b) the gross MRP includes consideration of the inventory on hand, whereas the net MRP doesn't include the inventory consideration.

c) the net MRP includes consideration of the inventory on hand, whereas the gross MRP doesn't include the inventory consideration.

d) the gross MRP doesn't take taxes into account, whereas the net MRP includes the tax considerations.

e) the net MRP is only an estimate, whereas the gross MRP is used for actual production scheduling.

- Net requirements =

a) Gross requirements + Allocations − On-hand inventory + Scheduled receipts.

b) Gross requirements − Allocations − On-hand inventory − Scheduled receipts.

c) Gross requirements − Allocations − On-hand inventory + Scheduled receipts.

d) Gross requirements + Allocations − On-hand inventory − Scheduled receipts.