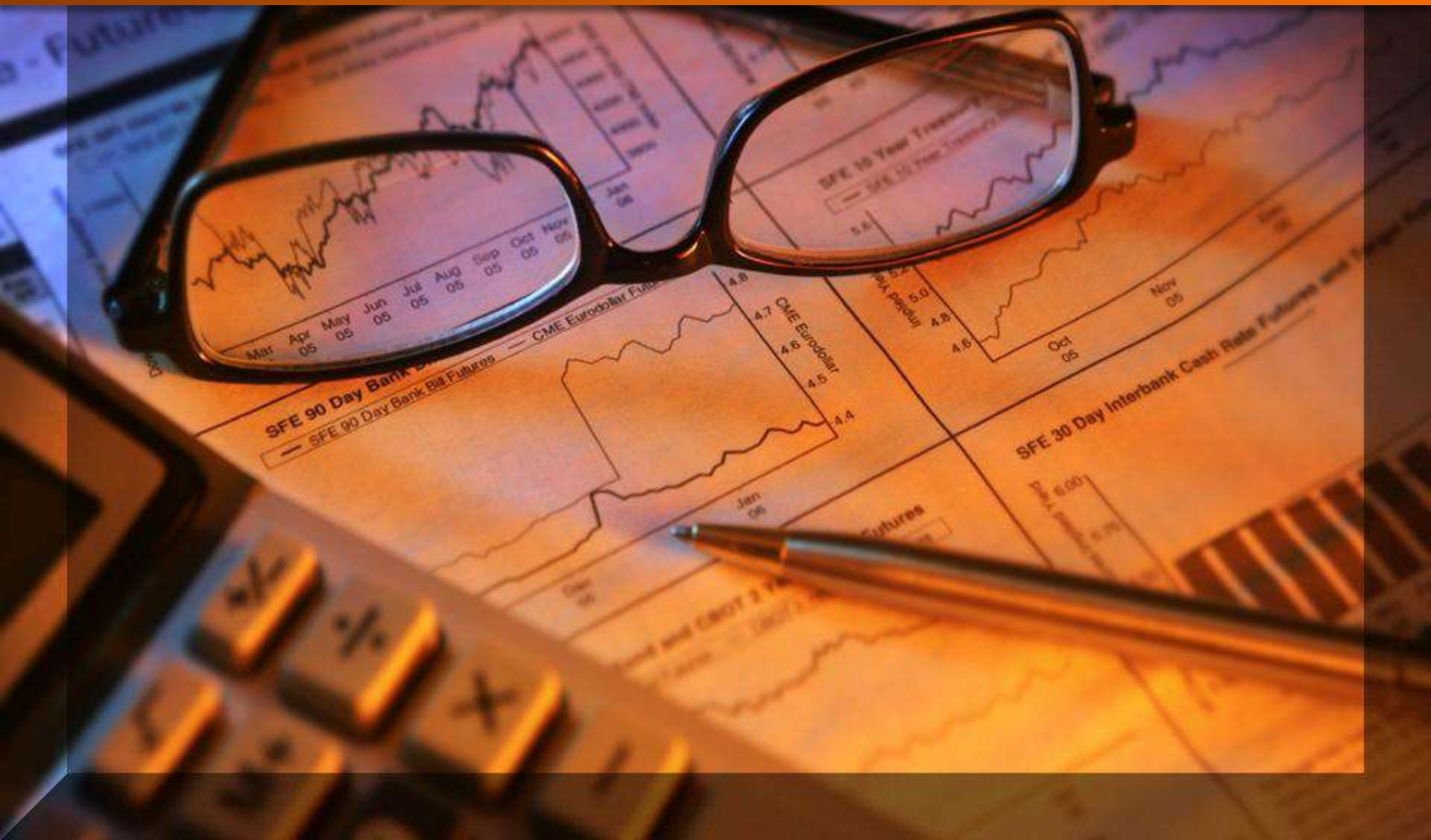
IE 314: Operations Management

Material Requirements Planning (MRP)

Lecture 7

KAMAL



DISCUSSION QUESTIONS

1. What is the difference between a *gross* requirements plan and a *net* requirements plan?
2. Once a material requirements plan (MRP) has been established, what other managerial applications might be found for the technique?
3. What are the similarities between MRP and DRP?
4. How does MRP II differ from MRP?
5. Which is the best lot-sizing policy for manufacturing organizations?
6. What impact does ignoring carrying cost in the allocation of stock in a DRP system have on lot sizes?
7. MRP is more than an inventory system; what additional capabilities does MRP possess?

Discussion Questions

1. The difference between a gross requirements plan and a net requirement plan is that a net plan adjusts for on-hand inventory and scheduled receipts at each level.
2. Once the MRP system is in place, it provides information to assist decision makers in other functional areas such as the amounts of labor required, cash needs, purchase requirements, and timing.
3. The similarities between material requirements planning (MRP) and distribution resource planning (DRP) are that the procedures and logic are analogous.
4. The difference between material requirements planning (MRP) and material resource planning II (MRP II) is that MRP II includes or integrates functions within the firm in addition to the management of dependent demand inventories. Examples of these additional functions include: Order entry, invoicing, bill-ing, purchasing, production scheduling, capacity planning, and warehouse management.
5. There is no one "ideal" lot sizing technique that should be used by all manufacturing organizations. Lot-for-lot is the goal to be sought. However, where setup costs are significant and demand is not particularly lumpy, EOQ is a simple method and typically provides satisfactory results. Too much concern with lot sizing yields spurious results because of MRP dynamics.
6. In a DRP system, inventory residing within the system is moved within the system, rather than entering or leaving the system. Therefore, although effort should be made to reduce total inventory to minimize overall carrying cost, carrying cost per se does not have a significant effect on appropriate lot size.
7. MRP is usually a part of the overall production planning process. Its most important capability is including the timing/ scheduling factor in inventory planning. MRP II, of course, ad-dresses the timing/scheduling of other resources in addition to inventory.

8. What are the options for the production planner who has (a) scheduled more than capacity in a work center next week, but (b) a consistent lack of capacity in that work center?
9. Master schedules are expressed in three different ways depending on whether the process is continuous, a job shop, or repetitive. What are these three ways?
10. What functions of the firm affect an MRP system? How?
11. What is the rationale for (a) a phantom bill of material, (b) a planning bill of material, and (c) a pseudo bill of material?
12. Identify five specific requirements of an effective MRP system.
13. What are the typical benefits of ERP?
14. What are the distinctions between MRP, DRP, and ERP?
15. As an approach to inventory management, how does MRP differ from the approach taken in Chapter 12, dealing with economic order quantities (EOQ)?
16. What are the disadvantages of ERP?

Discussion Questions

8. (a) When a work center is only over capacity for one week (or a short time), the production planner has a number of options, including:

- Splitting an order to an earlier or later week
- Requesting overtime, an alternate (perhaps more ex-pensive) production process
- Subcontracting

(b) A consistent lack of capacity suggests a capital in-vestment to increase capacity, add a shift, or develop an outside source. Redesign of the product may also be an alternative.

9. The master schedule is expressed in terms of:

(1) End items in a continuous (make-to-stock) company;
(2) Customer orders in a job shop (make-to-order) compa-ny; and
(3) Modules in a repetitive (assemble-to-stock) company.

10. Virtually all functions of the firm impact an MRP system. For instance, purchasing performance affects delivery, changes in capacity (i.e., labor, maintenance, breakdowns) impact throughput, sales impact the master schedule as do financial issues such as capital expenditure for capacity, engineering per-formance such as meeting schedules and preference (or flexibil-ity) for particular approaches to design/processing.

11. The rationale for: (a) A phantom bill of material is a subas-sembly that exists only on the production line—say a mixture/ glue that only exists a few minutes and then must be used or discarded. Such items are never inventoried. (b) A planning bill of material may be used to issue a mixture of parts that only makes sense to reduce material handling—say the hardware for a washing machine assembly. (c) A pseudo bill of material is another name for planning bill to meet the same conditions.

Discussion Questions

13. The benefits of ERP include:
•Integration of production, supply chain, and admin.
•Increases collaboration between functions and locations
•Often has a common database
•Can add effectiveness and efficiency to organizations.

12. An effective MRP system requires:
•A good schedule of what is to be made
•An accurate BOM
•Accurate inventory records
•Accurate purchases data
•Lead times that will be met

14. Distinctions between MRP, DRP, and ERP, are: MRP is a set of software programs designed to schedule material require-ments. These programs include an integrated set of programs that determine an item master for each part, a bill of material.
explosion scheme, a lead-time file, an inventory status file, and vendor information. DRP is a time-phased stock-replenishment plan for all levels of the distribution network. Its focus is on retail and wholesale distribution network. On the other hand, enterprise resource planning (ERP) systems are systems that often integrate MRP and a variety of other accounting systems, human resource management, and communication with vendors and suppliers.

15. In MRP, **demand need not be constant.** Also, the demand for one item depends on the demand for others—in particular, the end item. (There are exceptions such as spare parts and maintenance orders.)

16. The disadvantages of ERP include:
•Expensive to purchase and even more costly to customize.
•Implementation may require major changes in the com-pany and its processes.
•So complex that many companies cannot adjust to it.
•Involves an ongoing process for implementation, which may never be completed.
•Expertise in ERP is limited, with staffing an ongoing problem.

••• **14.13** Electro Fans has just received an order for one thousand 20-inch fans due week 7. Each fan consists of a housing assembly, two grills, a fan assembly, and an electrical unit. The housing assembly consists of a frame, two supports, and a handle. The fan assembly consists of a hub and five blades. The electrical unit consists of a motor, a switch, and a knob. The following table gives lead times, on-hand inventory, and scheduled receipts.

a) Construct a product structure.
b) Construct a time-phased product structure.
c) Prepare a net material requirements plan. PX

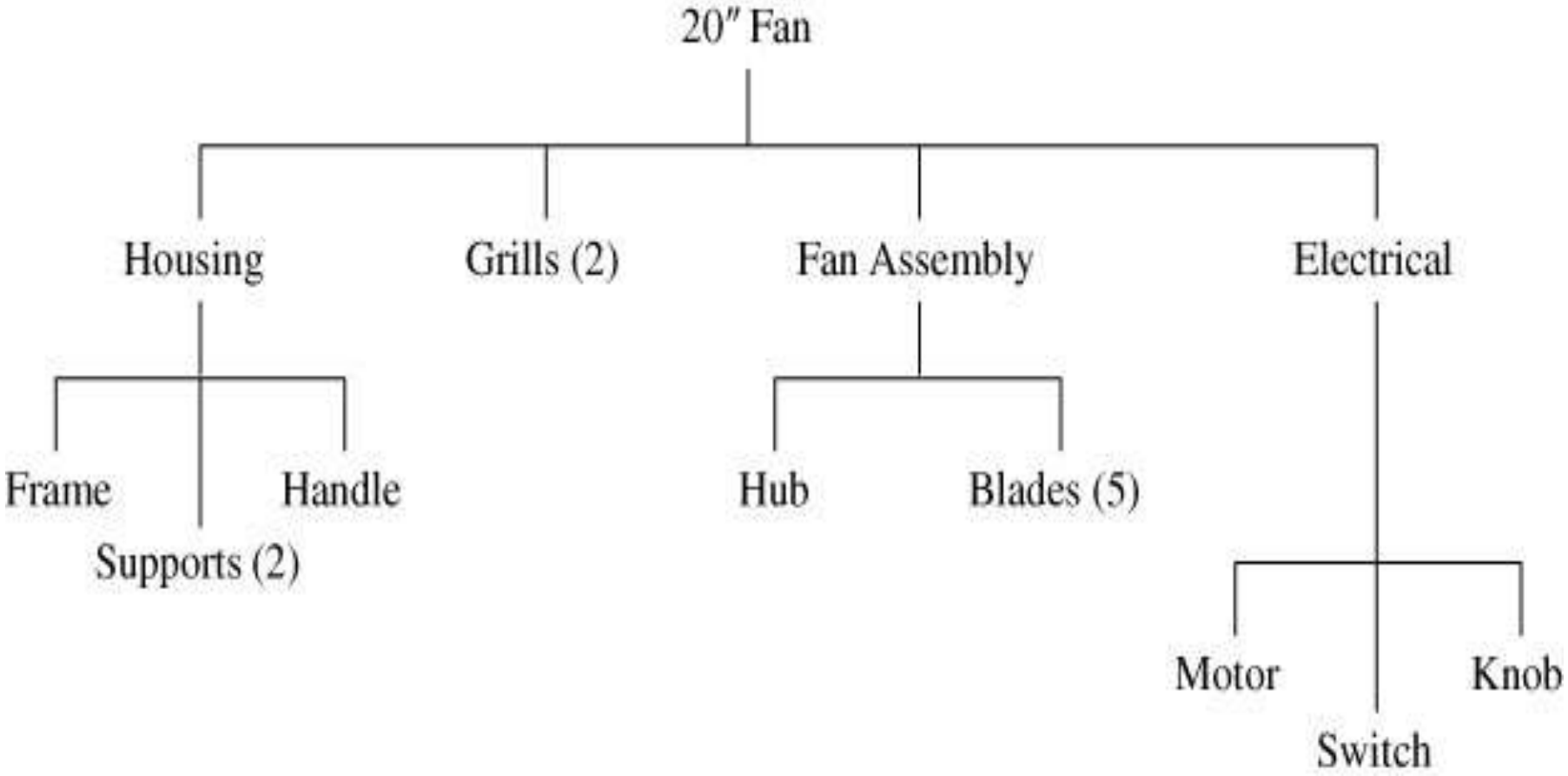
Data Table for Problem 14.13

Component	Lead Time	On Hand Inventory	Lot Size*	Scheduled Receipt
20" Fan	1	100	—	
Housing	1	100	—	
Frame	2	—	—	
Supports (2)	1	50	100	
Handle	1	400	500	
Grills (2)	2	200	500	
Fan Assembly	3	150	—	
Hub	1	—	—	
Blades (5)	2	—	100	
Electrical Unit	1	—	—	
Motor	1	—	—	
Switch	1	20	12	
Knob	1	—	25	200 knobs in week 2

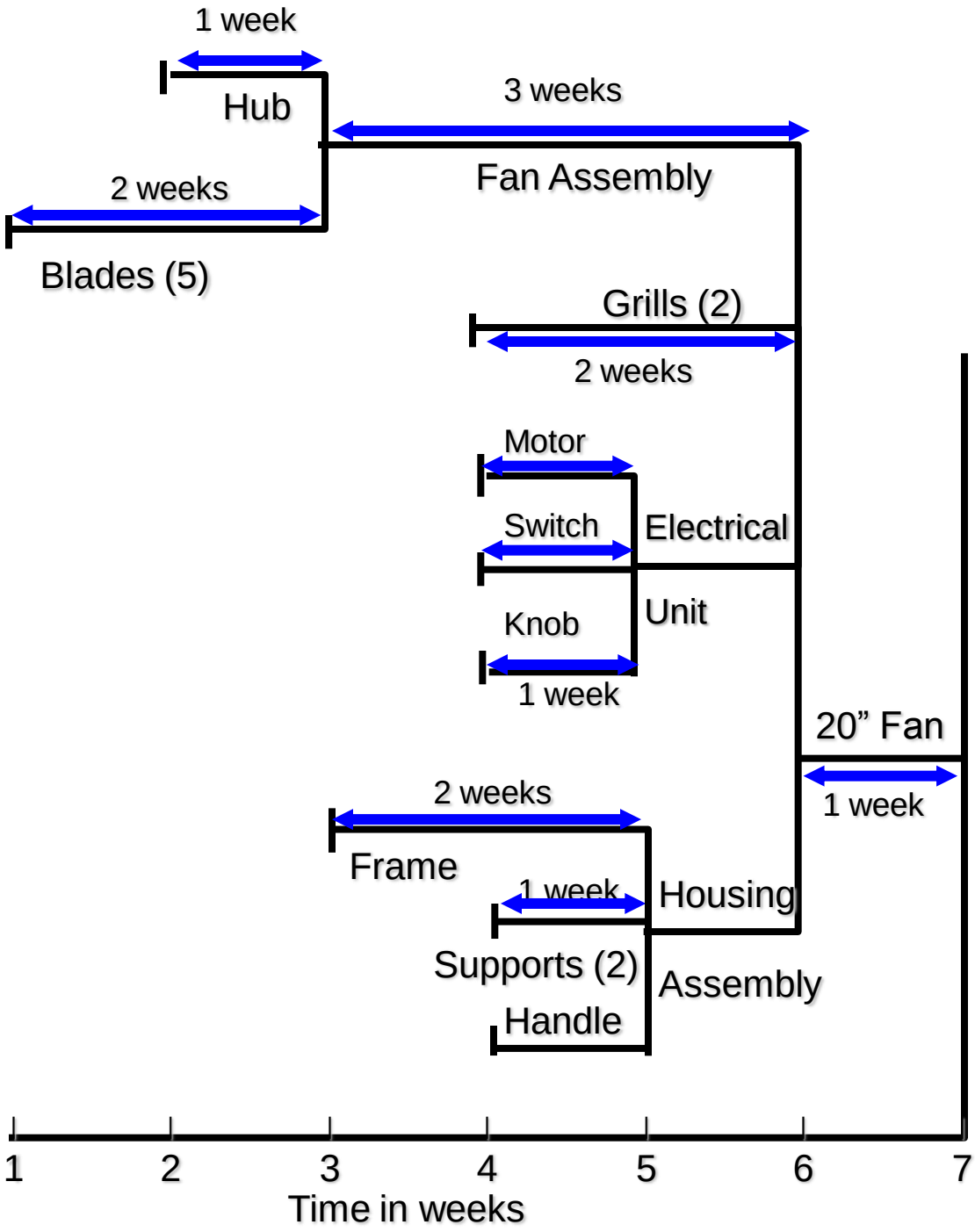
*Lot-for-lot unless otherwise noted

EXERCISE 14.13

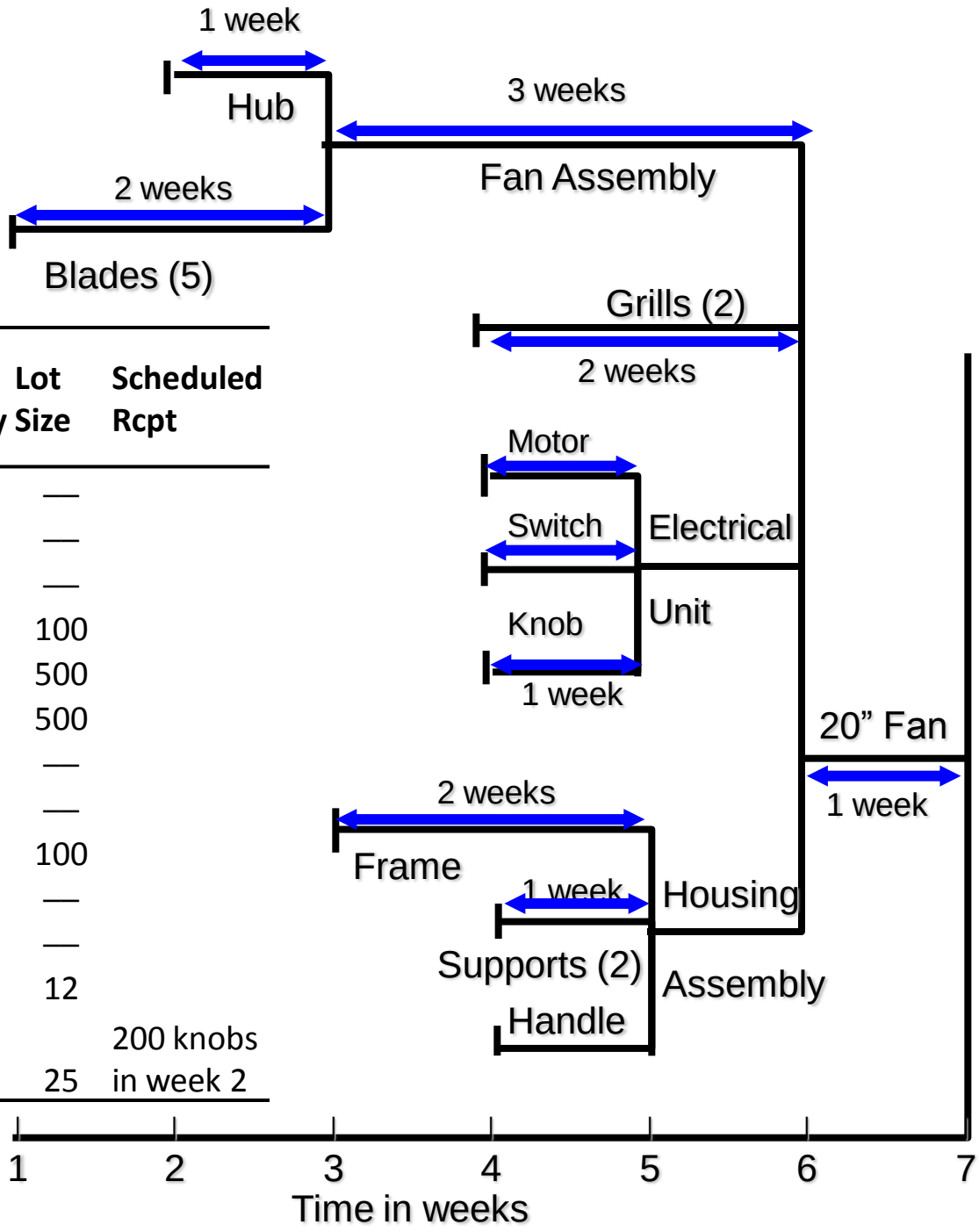
(a)



(b)


1 week
Hub
3 weeks
Fan Assembly
2 weeks
Blades (5)
Grills (2)
2 weeks
Motor
Switch
Electrical
Unit
Knob
1 week
20” Fan
1 week
2 weeks
Frame
1 week
Housing
Supports (2)
Assembly
Handle
1
2
3
4
5
6
7
Time in weeks

Component	Lead Time	On-Hand Inventory	Lot Size	Scheduled Rcpt
20" Fan	1	100	—	
Housing Assembly	1	100	—	
Frame	2	—	—	
Support (2)	1	50	100	
Handle	1	400	500	
Grill (2)	2	200	500	
Fan Assembly	3	150	—	
Hub	1	—	—	
Blades (5)	2	—	100	
Electrical Unit	1	—	—	
Motor	1	—	—	
Switch	1	20	12	
Knob	1	—	25	200 knobs in week 2



Component	20” Fan	
Period	6	7
Gross Requirement		1000
Scheduled receipts		
Projected on Hand		100
Net Requirement		900
Planned Order Receipts		900
Planned Order Releases	900	

Component	Grills (2)			
Period	4	5	6	7
Gross Requirement			1800	
Scheduled receipts				
Projected on Hand			200	400
Net Requirement			1600	
Planned Order Receipts			2000	
Planned Order Releases	2000			

Component	Switch		
Period	4	5	6
Gross Requirement		900	
Scheduled receipts			
Projected on Hand		20	8
Net Requirement		880	
Planned Order Receipts		888	
Planned Order Releases	888		

Component	Knob			
Period	2	3	4	5
Gross Requirement				900
Scheduled receipts	200			
Projected on Hand		200	200	200
Net Requirement				700
Planned Order Receipts				700
Planned Order Releases			700	

Component	Housing Assembly	
Period	5	6
Gross Requirement		900
Scheduled receipts		
Projected on Hand		100
Net Requirement		800
Planned Order Receipts		800
Planned Order Releases	800	

Component	Electrical Unit	
Period	5	6
Gross Requirement		900
Scheduled receipts		
Projected on Hand		
Net Requirement		900
Planned Order Receipts		900
Planned Order Releases	900	

Component	Motor	
Period	4	5
Gross Requirement		900
Scheduled receipts		
Projected on Hand		
Net Requirement		900
Planned Order Receipts		900
Planned Order Releases	900	

Component	Fan Assembly			
Period	3	4	5	6
Gross Requirement				900
Scheduled receipts				
Projected on Hand				150
Net Requirement				750
Planned Order Receipts				750
Planned Order Releases	750			

Component	Blades (5)			
Period	1	2	3	4
Gross Requirement			3750	
Scheduled receipts				
Projected on Hand				50
Net Requirement			3750	
Planned Order Receipts			3800	
Planned Order Releases	3800			

Component	Frame		
Period	3	4	5
Gross Requirement			800
Scheduled receipts			
Projected on Hand			
Net Requirement			800
Planned Order Receipts			800
Planned Order Releases	800		

Component	Supports (2)		
Period	4	5	6
Gross Requirement		1600	
Scheduled receipts			
Projected on Hand		50	50
Net Requirement		1550	
Planned Order Receipts		1600	
Planned Order Releases	1600		

Component	Handle		
Period	4	5	6
Gross Requirement		800	
Scheduled receipts			
Projected on Hand		400	100
Net Requirement		400	
Planned Order Receipts		500	
Planned Order Releases	500		

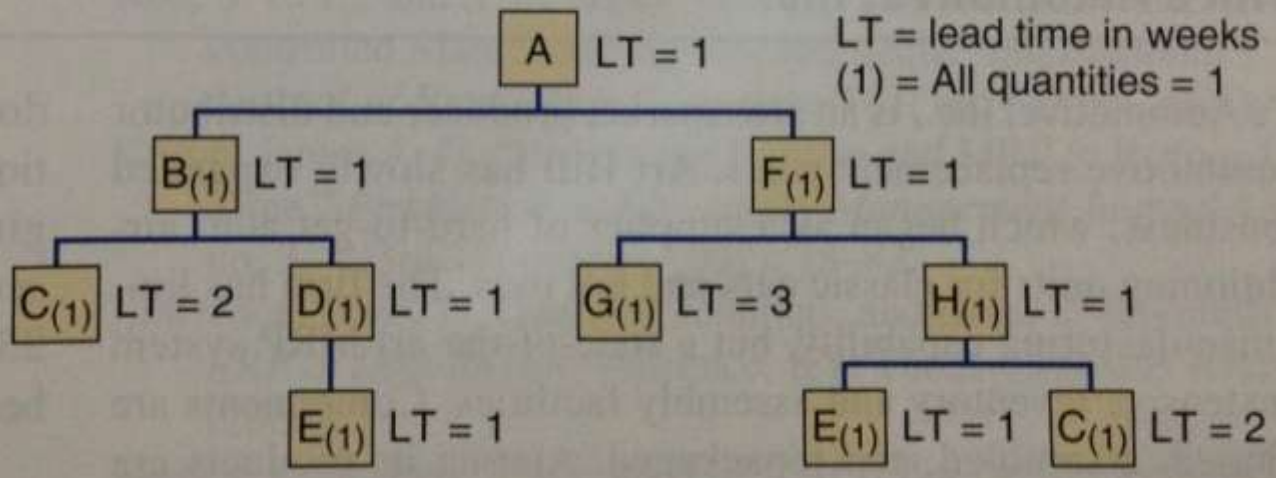
Component	Hub	
Period	2	3
Gross Requirement		750
Scheduled receipts		
Projected on Hand		
Net Requirement		750
Planned Order Receipts		750
Planned Order Releases	750	

••• **14.14** A part structure, lead time (weeks), and on-hand quantities for product A are shown in Figure 14.16. From the information shown, generate

a) An indented bill of material for product A (see Figure 5.9 in Chapter 5 as an example of a BOM).
b) Net requirements for each part to produce 10 As in week 8 using lot-for-lot. PX

PART	INVENTORY ON HAND
A	0
B	2
C	10
D	5
E	4
F	5
G	1
H	10

PART STRUCTURE TREE



EXERCISE 14.14

Lot Size	LT	POH	Safety Stock	Allocated	Low Level	Item ID	Period	1	2	3	4	5	6	7	8
LFL	1	4	___	___	3	E	**Gross Req.**						3 H,D		
							Sch. Rcpt.								
							POH	4	4	4	4	4	1	1	1
							Net Req.					0			
							Ordr Rcpt.								
							Ordr Reles.								

Data Table for Problems 14.17 through 14.19*

Period	1	2	3	4	5	6	7	8	9	10	11	12
Gross requirements	30		40		30	70	20		10	80		50

*Holding cost = $2.50/unit/week; setup cost = $150; lead time = 1 week; beginning inventory = 40.

••• **14.17** Develop a lot-for-lot solution and calculate total relevant costs for the data in the preceding table. PX

••• **14.18** Develop an EOQ solution and calculate total relevant costs for the data in the preceding table. Stockout costs equal $10 per unit. PX

••• **14.19** Develop a PPB solution and calculate total relevant costs for the data in the preceding table. PX

Component	Lot-for-Lot											
Period	1	2	3	4	5	6	7	8	9	10	11	12
Gross Requirement	30	0	40	0	30	70	20	0	10	80	0	50
Projected on Hand	40	10	10	0	0	0	0	0	0	0	0	0
Net Requirement	0	0	30	0	30	70	20	0	10	80	0	50
Planned Order Receipts			30		30	70	20		10	80		50
Planned Order Releases		30		30	70	20		10	80		50	

Setup Cost = 7*150 = $1050 , Holding Cost = (10+10)*2.5 = $50

Total Cost = 1050 + 50 = $1100

Component	EOQ											
Period	1	2	3	4	5	6	7	8	9	10	11	12
Gross Requirement	30	0	40	0	30	70	20	0	10	80	0	50
Projected on Hand	40	10	10	27	27	54	41	21	21	11	45	45
Net Requirement	0	0	30	0	3	16	0	0	0	69	0	5
Planned Order Receipts			57		57	57				114		57
Planned Order Releases		57		57	57				114		57	

EOQ = $\sqrt{(2DS)/H} = \sqrt{(2*330*150)/(2.5*12)} = 57.4$ or 57

Setup Cost = 5*150 = $750 , Holding Cost = (10+10+27+ …+45+45)*2.5 = $780

Total Cost = 750 + 780 = $1100

Economic Part Period (EPP) = Order Cost/ Holding Cost
= 150 / 2.5 = 60

Period	Cumulative Net Req.	Part Period
1	0	0
2	0	0
3	30	0
3,4	30	0
3,4,5	**60**	0 + 30*2 = **60**
~~3,4,5,6~~	~~130~~	~~0+30*2+70*3= 270~~
6	70	0
6,7	90	0 + 20*1 = 20
6,7,8	90	0 + 20*1 = 20
6,7,8,9	**100**	0+ 20*1+ 10*3 = **50**
~~6,7,8,9,10~~	~~180~~	~~0+20*1+10*3+80*4= 370~~
10	80	0
10,11	80	0
10,11,12	**130**	0 + 50*2 = **100**

Component	Part Period Balancing											
Period	1	2	3	4	5	6	7	8	9	10	11	12
Gross Requirement	30	0	40	0	30	70	20	0	10	80	0	50
Projected on Hand	40	10	10	30	30	0	30	10	10	0	50	50
Net Requirement	0	0	30	0	0	70	0	0	0	80	0	50
Planned Order Receipts			60		0	100				130		
Planned Order Releases		60		30	100				130			

Setup Cost = 3*150 = $450 , Holding Cost = (10+10+…+50)*2.5 = $575

Total Cost = 450 + 575 = $1025

OLD QUIZ

A product has the following gross requirements. Which is cheaper lot-for-lot, part period balance, or EOQ lot sizing ?

Week	1	2	3	4	5	6	7
Requirments	0	50	80	90	50	30	60

Setup cost= $250, Inventory holding cost= $2/unit/week, lead time is one week. There's no beginning inventory; there are no schedule receipts.

Component	Lot-for-Lot						
Period	1	2	3	4	5	6	7
Gross Requirement	0	50	80	90	50	30	60
Projected on Hand	0	0	0	0	0	0	0
Net Requirement	0	50	80	90	50	30	60
Planned Order Receipts		50	80	90	50	30	60
Planned Order Releases	50	80	90	50	30	60	

Setup Cost = 6*250 = $1500 , Holding Cost = 0*2 = $0

Total Cost = $1500

Component	EOQ						
Period	1	2	3	4	5	6	7
Gross Requirement	0	50	80	90	50	30	60
Projected on Hand	0	0	63	96	107	56	26
Net Requirement	0	50	17	6	57	0	34
Planned Order Receipts		113	113	113	113	0	113
Planned Order Releases	113	113	113	113	0	113	

EOQ = $\sqrt{(2DS)/H} = \sqrt{(2*360*250)/(2*7)} = 113.39$ or 113

Setup Cost = 5*250 = $1250 , Holding Cost = 348*2 = $696
Total Cost = $1250 + $696 = $1946

Economic Part Period (EPP) = Order Cost/ Holding Cost
= 250 / 2 = 125

Period	Cumulative Net Req.	Part Period
1	0	0
2	50	0
2,3	130	80*1 = 80
~~2,3,4~~	~~220~~	~~80*1 + 90*2 = 260~~
4	90	0
4,5	140	50*1 = 50
4,5,6	170	50 + 30*2 = 110
~~4,5,6,7~~	~~230~~	~~110 + 60*3 = 290~~
7	60	0

Component	PPB						
Period	1	2	3	4	5	6	7
Gross Requirement	0	50	80	90	50	30	60
Projected on Hand	0	0	80	0	80	30	0
Net Requirement	0	50	0	90	0	0	60
Planned Order Receipts		130		170			60
Planned Order Releases	130		170			60	

Setup Cost = 3*250 = $750 , Holding Cost = 190*2 = $380

Total Cost = $750+$380 = $1130

HW

14.15

14.16

14.20

14.21

14.25