Materials Requirements Planning

Module 11 July 23, 2014

Outline

Material Requirements Planning (MRP)

- ✓ What is it?
- ✓ When do we use it?
- Bill of Materials
- Lot sizing rules
- MRP Reports
- MRP Benefits
- MRP in Services

Computerized inventory control and production planning system

Helps us determine how much and when to produce component items

Material Requirements Planning (MRP)

1. MRP

- A. Computer-based system that develops plans for ordering and producing dependent demand items
- 2. Main MRP Principles
 - A. Requirements derived from production schedule of parent items and Production order offset to account for lead time
 - ✓ B. What Does This Mean?

Independent vs. Dependent Demand

1. Independent Demand

- A. Demand for "End Items"
- ✓ B. Examples:
 - a. Televisions
 - b. Refrigerators
- 2. Dependent Demand



- ✓ A. Demand for items used to make other items
- ✓ B. Examples:
 - a. Refrigerator \rightarrow Door, Motor, Drawers, ϵ
 - **b.** Bicycle \rightarrow Two wheels, frame, seat. etc.

MRP



When do we use it?

Dependent demand items



When do we use it?

- Dependent demand items
- Discrete demand items



When do we use it?

Dependent demand items

- Discrete demand items
- Complex products
- Job shop production
- Assemble-to-order environments

If we want to know how many and when to order table legs we need to know how demand for table legs is related to demand for tables

Overview of MRP



- Quantities derived from Sales & Operations Plans' production plan (product groups) [input]
- Drives MRP process with a schedule of finished products (actual items by week) [output]
- Quantities may consist of a combination of customer orders & demand forecasts
- Quantities represent what needs to be produced, not what can be produced

Master Schedule (MS)

Quantity of end items to be produced within a specified period of time

TABLE 7.1 Master Schedule for a Family of Bicycles								
		February			March			
	Feb. 1	Feb. 8	Feb. 15	Feb. 22	Mar. 1	Mar. 8	Mar. 15	Mar. 22
Aggregate production plan for bicycle family		600			500			
Mountain bike	200		100			80		80
Road bike		50		100	100		100	
Tandem bike		75		75		70		70

Master Production Schedule

One of three primary inputs in MRP;

states which end items are to be produced, when these are needed, and in what quantities.

Windows Defined by Time Fences

Frozen

- No schedule changes allowed within this window
- ----- Demand Time Fence ------
- Moderately Firm (slushy)
- Specific changes allowed within product groups as long as parts are available
- ----- Planning Time Fence ------

Flexible (liquid)

 Significant variation allowed as long as overall capacity requirements remain at the same levels

Sales and Operations Plan (S&OP) Relationship to the MPS and MRP

SALES AND OPERATIONS PLAN

Month	Jan	Feb	Mar	Apr		
Days	20	19	24	20		
Plan	20,000	19,000	24,000	20,000		
Master Production	Schedule					
Week	14	15	16	17		
Product A	750			500		
Product B		300				
Product Z	200		200			
Total	5,000	5,000	5,000	5,000		
Material Requirements Plan						
Subassembly A101 (2 required)						
	Week 14	1,500				
	Week 15	0				
	Week 16	0				
	Week 17	1,000				

Bill-of-Materials (BOM)

One of the three primary inputs of MRP;

a listing of all of the raw materials, parts, subassemblies, and assemblies needed to produce one unit of a product.

Bill of Materials (BOM)

Specifies the Following:

- a. Assemblies and Subassemblies
- b. Parts
- c. Raw Materials
- BOM Items Specify Amounts of above needed to Make a Single Unit of Finished Product

Example of BOM



BOM (Product Structure)

Table (End Item)1 week



MRP

Sample BOM



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A Physical BOM: Ford's Model T



A Physical BOM: Jet Engine

[\]High efficies exhaust mi

the big 30. We're coming

you for a chan

The PW600 revs times faster than a hi performance sports (

Reverse flow

Spe

Single stage, hi and low press turbin

Even planes h to make pit sto Fortunately, we have engine service centers arou the globe, unmatched

Engine nacelle

Iwo stage compressor

17 8 28 L

192 hours to

any competi

Not only are th new engines f they're breaking spo records in assem and test time. Ei days to eight hou

Advanced Idi

16 inches.

s.Dan S

The average fan diameter is only 16 inches, which fits in the overhead compartment of most airplanes.

Reduced noise.

The in-cabin noise of a VLJ's PW600s is about equal to that of a passing car.

Range.

You can hop on a jet taxi and fly nonstop from Miami to New York on a single tank of gas. **Small.** It fits in the trunk of a midsize car. Light. A weightlifter could easily lift 300 lbs., the equivalent of a PW600 engine.

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Bill-of-Materials

Product structure tree:

Visual depiction of the requirements in a bill of materials, where all components are listed by levels.

Product Structure





If we need to meet demand for 100 clipboards next January how many and when do we need to produce pressboards, clips, etc.?



 Start by using MRP to determine how many and when to produce the end item



2. Given those needs for clipboards, use MRP to determine how many and when to produce the pressboards, clip assemblies, and rivets



 Given those needs for clip assemblies, use MRP to determine how many and when to produce the clip assembly component items



Special Considerations of BOMs

- Finished Products May Have Hundreds or Thousands of Parts
 - Parts May Appear Multiple Times in a BOM
- Supply of Parts May Not be 100% Consistent
 - a. Longer Than Expected Lead Times
 - b. Quality Issues
- Timing is Critical! All Parts for a Parent Item MUST Be On-Hand to Produce Item!

Inventory Records

One of the three primary inputs in MRP

Includes information on the status of each item by time period

- Gross requirements
- Scheduled receipts
- Amount on hand
- Lead times
- Lot sizes
- ✓ And more ...

Consequences of Inaccurate Inventory Records

Too much (or too little) inventory.
Increased freight (shipping) costs.
Expediting and missed due dates.

Inventory Record

Specifies

- a. Order/Lot Size Policy
- b. Lead Times
- c. Records of All Transactions (Change in Inventory Levels)

Item	Descriptions	Code number	On-hand Inventory	Suppliers	Lead Time (weeks)
(A)	Woven Cotton	F123	5000 meters	001	2
(B)	Sewing threads	T803	100 cones (5000m/cone)	002	2
(C)	Elastic	E101	100 meters	003	2
(D)	Card board	C1	500	004	1
(E)	Cover paper	P2	Z 1	005	1
(F)	Plastic Bag	B1	2	006	1
(G)	Box	X1	-	007	2

Example

Let's say we produce file cabinets Each cabinet is made up of 2 side boards 3 shelves





Example

Let's say we produce file cabinets Each cabinet is made up of 2 side boards 3 shelves





MRP Processing

- Gross requirements
 - Total expected demand
- Scheduled receipts
 - ✓ Open orders scheduled to arrive
- Planned on hand
 - Expected inventory on hand at the beginning of each time period
MRP Processing

Net requirements

- ✓ Actual amount needed in each time period
- Planned-order receipts
 - Quantity expected to received at the beginning of the period
 - ✓ Offset by lead time
- Planned-order releases
 - Planned amount to order in each time period

Material Requirements Planning Note the following:

- Gross requirements in level 0 (Tables) come from the master schedule.
- Gross requirements in level 1 (and below) come from the planned order releases in the level above.
- Planned order releases are offset by the lead times.
- Planned order releases are planned! Actual order releases must take available capacity into account.
- Net requirements are the gross requirements minus the projected on-hand.

How many and when should we produce cabinets?

How many and when should we produce side boards and shelves?





MRP Matrix

Item: Description:							Sa Lo Le	fety Stocl t-Size = ad Time =	k = =			
Period	1	2	3	4	5	6	7	8	9	10	11	12
Gross Requirements												
Scheduled Receipts												
On Hand												
Net Requirements												
Planned Order Receipts												
Planned Order Releases												

Gross Requirements

Expected demand for item in each period

Item: Description:							Sa Lo Le	fety Stocl t-Size = ad Time =	κ = =			
Period	1	2	3	4	5	6	7	8	9	10	11	12
Gross Requirements												
Scheduled Receipts												
On Hand												
Net Requirements												
Planned Order Receipts												
Planned Order Releases												

Scheduled Receipts

Pre-existing orders for items

(scheduled to arrive at beginning of the period)

Item: Description:							Sa Lo Le	fety Stocl t-Size = ad Time =	k = =			
Period	1	2	3	4	5	6	7	8	9	10	11	12
Gross Requirements												
Scheduled Receipts												
On Hand												
Net Requirements												
Planned Order Receipts												
Planned Order Releases												

Net Requirements

Inventory needed to meet backorder and safety stock needs

Item: Description:							Sa Lo Le	fety Stocl t-Size = ad Time =	x = =			
Period	1	2	3	4	5	6	7	8	9	10	11	12
Gross Requirements												
Scheduled Receipts												
On Hand												
Net Requirements												
Planned Order Receipts												
Planned Order Releases												

Planned Order Receipts

Planned order arrivals of the item

(arriving at the beginning of the period)

Item: Description	1:							Sa Lo Le	fety Stocl t-Size = ad Time =	x = =			
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Requiren	nents												
Scheduled Rece	eipts												
On Hand													
Net Requirement	nts												
Planned Order	Receipts												
Planned Order	Releases												

Planned Order Releases

Planned order releases for the item (submitted at the beginning of the period)

Item: Description:							Sa Lo Le	fety Stocl t-Size = ad Time =	K = =			
Period	1	2	3	4	5	6	7	8	9	10	11	12
Gross Requirements												
Scheduled Receipts												
On Hand												
Net Requirements												
Planned Order Receipts												
Planned Order Releases												

MRP Matrix

Item: Description:							Sa Lo Le	fety Stocl t-Size = ad Time =	k = =			
Period	1	2	3	4	5	6	7	8	9	10	11	12
Gross Requirements												
Scheduled Receipts												
On Hand												
Net Requirements												
Planned Order Receipts												
Planned Order Releases												

Back to our cabinet example...

From our MPS system we know how many file cabinets need to be produced in the next 12 weeks

Item: Descriptio	n: File	Cabin	et					Sa Lo Le	fety Stocl ot-Size = ad Time =	∝ = 0 u Fix = 2 v	nits ked o veek	order s	qty (80
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ments		120	95		200			25		60		
Scheduled Rec	eipts												
On Hand													
Net Requireme	ents												
Planned Order	Receipts												
Planned Order	Releases												

Back to our cabinet example...

From our MPS system we know how many file cabinets need to be produced in the next 12 weeks

Item: Descriptio	n: File	Cabin	et					Sa Lo Le	fety Stoc ot-Size = ad Time	<pre>< 0 u Fix = 2 v</pre>	nits ked o veek	order s	qty (8
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Requirer	ments		120	95		200			25		80		
Scheduled Rec	eipts		160										
On Hand	20	?											
Net Requireme	ents												
Planned Order	Receipts												
Planned Order	Releases												

Additionally, we have 20 cabinets on hand now

And 160 more are scheduled to be ready in week 2

Item: Descriptio	on: File	Cabin	et					Sa Lo Le	fety Stoc ot-Size = ad Time	k = 0 u Fix = 2 v	nits (ed c veek	order s	qty (80
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ements		120	95		200			25		80		
Scheduled Red	ceipts		160										
On Hand	20	20	?										
Net Requirem	ents												
Planned Order	Receipts												
Planned Order	Releases												

Item: Description: File	Cabin	et					Sa Lo Le	fety Stoc ot-Size = ad Time	k = 0 u Fix = 2 v	nits ked c veek	order s	qty (80
Period	1	2	3	4	5	6	7	8	9	10	11	12
Gross Requirements		120	95		200			25		80		
Scheduled Receipts		160	2									
On Hand 20	20	?										
Net Requirements												
Planned Order Receipts												
Planned Order Releases												

My convention... sum of cells in red – sum of cells in blue

Item: Description: F	ile (Cabin	et					Sa Lo Le	fety Stoc ot-Size = ead Time	k = 0 u Fix = 2 v	nits (ed c veek	order s	qty (80
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Requirements			120	95		200			25		80		
Scheduled Receipts			160										
On Hand	20	20	60	?									
Net Requirements													
Planned Order Receipt	ts												
Planned Order Release	es												

Item: Descriptio	on: File	Cabin	et					S L L	afety Stoc .ot-Size = .ead Time	ck = 0 F = 2	units ixed c week	order s	qty (8
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ements		120	95		200			25		80		
Scheduled Re	ceipts		160	\frown									
On Hand	20	20	60	-35	We o	d <mark>on't</mark> w	ant b	ackor	ders				
Net Requirem	ents			35									
Planned Order	r Receipts												
Planned Order	Releases												

Item: Descriptio	on: File	Cabin	et					Sa Lo Le	fety Stoc ot-Size = ead Time	k = 0 u Fix = 2 v	nits ked c veek	order s	qty (8
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ements		120	95		200			25		80		
Scheduled Red	ceipts		160										
On Hand	20	20	60	-35									
Net Requirem	ents			35									
Planned Order	Receipts			?									
Planned Order	r Releases												

Item: Descriptio	on: File	Cabin	et					Sa Lo Le	ifety Stoc ot-Size = ead Time	k = 0 u Fix = 2 v	nits (ed c veek	order s	qty (8
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ments		120	95		200			25		80		
Scheduled Rec	ceipts		160	\sim									
On Hand	20	20	60	-35									
Net Requireme	ents			35									
Planned Order	Receipts			?									
Planned Order	Releases												

Item: Description	on: File	Cabin	et					S L L	afety Stoc ot-Size = ead Time	ck = 0 F = 2	units ixed c week	order	qty (8
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Requir	rements		120	95		200			25		80		
Scheduled Re	eceipts		160										
On Hand	20	20	60	-35									
Net Requirem	nents			35									
Planned Orde	er Receipts			80									
Planned Orde	er Releases	80 🗲	2 we	ek									
<u> </u>		•	lead	time	•	•	<u>*</u>	<u> </u>	•		•		<u> </u>

Item: Descriptio	on: File	Cabin	et					Sa Lo Lo	afety Stoc ot-Size = ead Time	k = 0 u Fi = 2	units xed c week	order	qty (80
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ments		120	95		200			25		80		
Scheduled Red	ceipts		160										
On Hand	20	20	60	-35	*								
Net Requirem	ents			35	\geq	80-35	= 45						
Planned Order	Receipts			80 -									
Planned Order	Releases	80											

Since an order for 80 units is now arriving in week 3 what is the on-hand inventory?

Item: Descriptio	on: File	Cabin	et					S: La La	afety Stoc ot-Size = ead Time	k = 0 l Fi = 2	units xed c week	order	qty (80
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ments		120	95		200			25		80		
Scheduled Red	ceipts		160										
On Hand	20	20	60	45	*								
Net Requirem	ents			35	\geq	80-35	= 45						
Planned Order	Receipts			80 -									
Planned Order	Releases	80											

Item: Descriptio	on: File	Cabin	et					Sa Lo Le	ifety Stoc ot-Size = ead Time	k = 0 u Fiz = 2 v	inits xed c week	order s	qty (8
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ements		120	95		200			25		80		
Scheduled Red	ceipts		160		\sim								
On Hand	20	20	60	45	?								
Net Requirem	ents			35									
Planned Order	r Receipts			80									
Planned Order	r Releases	80											

Item: Descriptio	on: File	Cabin	et					Sa Lo Lo	afety Stoc ot-Size = ead Time	k = 0 U Fiz = 2 V	inits xed c week	order s	qty (8
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ements		120	95		200			25		80		
Scheduled Red	ceipts		160										
On Hand	20	20	60	45	45	?							
Net Requirem	ents			35									
Planned Order	r Receipts			80									
Planned Order	r Releases	80											

Item: Descriptio	on: File	Cabin	et					S L L	Safety Stock Lot-Size = Lead Time =	Fi	units xed o weeks	rder	qty (8
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ments		120	95		200			25		80		
Scheduled Red	ceipts		160			\square							
On Hand	20	20	60	45	45	-155	*						
Net Requirem	ents			35		155	\geq	160-	155 = 5				
Planned Order	Receipts			80		160							
Planned Order	Releases	80		160	2 wee	e k							

lead time

Item: Descriptio	on: File	Cabin	et					Sa Lo Le	ifety Stock ot-Size = ead Time =	κ = 0ι Fiz = 2ν	inits xed c week	order s	qty (80
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ements		120	95		200			25		80		
Scheduled Re	ceipts		160			\frown							
On Hand	20	20	60	45	45	5	*						
Net Requirem	ents			35		155	\supset	160-	155 = 5				
Planned Order	r Receipts			80		160							
Planned Order	r Releases	80		160									

Item: Descriptio	on: File	Cabin	et					Sa L L	afety Stoc ot-Size = ead Time	k = 0 u Fix = 2 v	nits ked k veek	order s	qty (8
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ements		120	95		200			25		80		
Scheduled Re	ceipts		160				\frown						
On Hand	20	20	60	45	45	5	?						
Net Requirem	ients			35		155							
Planned Orde	r Receipts			80		160							
Planned Orde	r Releases	80		160									

Item: Descriptio	on: File	Cabin	et					Sa La La	afety Stoc ot-Size = ead Time	k = 0 u Fix = 2 v	nits (ed c veek	order s	qty (8
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ements		120	95		200			25		80		
Scheduled Re	ceipts		160				\frown						
On Hand	20	20	45	45	5	5							
Net Requirem	ents			35		155							
Planned Orde	r Receipts			80		160							
Planned Orde	r Releases	80		160									

Item: Descriptio	on: File	Cabin	et					Sa Lo Le	fety Stoc ot-Size = ad Time	k = 0 u Fiz = 2 v	inits xed c week	order s	qty (80
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ements		120	95		200			25		80		
Scheduled Red	ceipts		160					\frown					
On Hand	20	20	60	45	45	5	5	?					
Net Requirem	ents			35		155							
Planned Order	Receipts			80		160							
Planned Order	Releases	80		160									

Item: Descriptio	on: File	Cabin	et					Sa Lo Le	fety Stoc t-Size = ad Time	k = 0 u Fix = 2 v	nits ked c veek	order s	qty (8
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ements		120	95		200			25		80		
Scheduled Re	ceipts		160					\frown					
On Hand	20	20	60	45	45	5	5	5	?				
Net Requirem	ents			35		155							
Planned Order	r Receipts			80		160							
Planned Order	r Releases	80		160									

Item: Description	on: File	Cabin	et					Sa Lo Le	fety Stocl t-Size = ad Time =	k = 0 ι Fiz = 2 ι	inits xed c week	order s	qty (8
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Requir	rements		120	95		200			25		80		
Scheduled Re	eceipts		160						\frown				
On Hand	20	20	60	45	45	5	5	5	-20	*			
Net Requiren	nents	Î.		35		155			20	\geq	80-2	20 = 0	60
Planned Orde	er Receipts			80		160			80				
Planned Orde	er Releases	80		160			80 4	2 we	ek				
			•		•		•	load	timo		•	•	

lead time

Item: Description	on: File	Cabin	et					Sa Lo Le	fety Stoc t-Size = ad Time	k = 0 L Fiz = 2 V	inits xed o week	order s	qty (8
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Requir	ements		120	95		200			25		80		
Scheduled Re	eceipts		160						\frown				
On Hand	20	20	60	45	45	5	5	5	60	*			
Net Requiren	nents	T		35		155			20	\sum	80-2	20 = 0	60
Planned Orde	er Receipts			80		160			80				
Planned Orde	er Releases	80		160			80 🔦	2 we	ek				
		•	•	•	•	•	•	bool	timo				•

lead time

Item: Descriptio	on: File	Cabin	et					Sa L L	afety Stoc ot-Size = ead Time	k = 0 u Fix = 2 v	nits ked c week	order s	qty (80
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ements		120	95		200			25		80		
Scheduled Red	ceipts		160										
On Hand	20	20	60	45	45	5	5	5	60	?			
Net Requirem	ents			35		155			20				
Planned Order	r Receipts			80		160			80				
Planned Order	Releases	80		160			80						

Item: Descriptio	on: File	Cabin	et					S L L	afety Stock ot-Size = ead Time	k = 0 u Fix = 2 v	nits (ed c veek	order s	qty (80)
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ements		120	95		200			25		80		
Scheduled Re	ceipts		160							\frown			
On Hand	20	20	60	45	45	5	5	5	60	?			
Net Requirem	ents			35		155			20				
Planned Orde	r Receipts			80		160			80				
Planned Orde	r Releases	80		160			80						

Item: Descriptio	on: File	Cabin	et					S L L	afety Stoc ot-Size = ead Time	k = 0 u Fix = 2 v	nits (ed c veek	order s	qty (80
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ements		120	95		200			25	\bigcirc	80		
Scheduled Re	ceipts		160							\sim			
On Hand	20	20	60	45	45	5	5	5	60	60			
Net Requirem	ents			35		155			20				
Planned Orde	r Receipts			80		160			80				
Planned Orde	r Releases	80		160			80						

Item: Descriptio	on: File	Cabin	et					Sa L L	afety Stoc ot-Size = ead Time	k = 0 u Fix = 2 v	nits ked o veek	order s	qty (80
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ements		120	95		200			25	(80		
Scheduled Red	ceipts		160									2	
On Hand	20	20	60	45	45	5	5	5	60	60	60		
Net Requirem	ents			35		155			20				
Planned Order	Receipts			80		160			80				
Planned Order	Releases	80		160			80						

Item: Descriptio	on: File	Cabin	et					Sa La La	afety Stoc ot-Size = ead Time	k = 0 u Fix = 2 v	nits ked o veek	order s	qty (8		
Period		1	2	3	4	5	6	7	8	9	10	11	12		
Gross Require	ements		120	95		200			25		80				
Scheduled Re	ceipts		160												
On Hand	20	20	60	45	45	5	5	5	60	60	60	60			
Net Requirem	nents			35		155			20		20				
Planned Orde	r Receipts			80		160			80		80				
Planned Orde	r Releases	80		160			80								
Item: Descriptio	tem: Description:File CabinetSafety Stock = Lot-Size = Lead Time =0 units 														
---------------------	--	----	-----	-----	----	-----	----	---	----	----	----	----	----	--	--
Period		1	2	3	4	5	6	7	8	9	10	11	12		
Gross Require	ements		120	95		200			25		80				
Scheduled Red	ceipts		160												
On Hand	20	20	60	45	45	5	5	5	60	60	60	60	60		
Net Requirem	ents			35		155			20		20				
Planned Order	Receipts			80		160			80		80				
Planned Order	Releases	80		160			80								

Item: Description	on: File	Cabin	et					Sa La La	afety Stoc ot-Size = ead Time	k = 0 u Fix = 2 v	nits ked o veek	order s	qty (8
Period 1 2 3 4 5 6 7 8 9 10 11 12													
Gross Requirements 120 95 200 25											80		
Scheduled Re	eceipts		160										
On Hand	20	20	60	45	45	5	5	5	60	60	60	60	60
Net Requiren	nents			35		155			20		20		
Planned Orde	er Receipts			80		160			80		80		
Planned Orde	er Releases	80		160			80						



How many and when should we produce the sideboards?

```
Sideboards:
```

currently 30 on hand 300 scheduled to arrive in week 1 produced LFL require a safety stock of 10 units lead time of one week

								Cabi	net			
olution					Sie	de boa	ards (2)		She	elves	(3
Item: Description: File	e Cabin	et					Sa Lo Le	fety Stoo ot-Size = ead Time	ck = 0 u FC = 2 v	inits DQ (8 weeks	0) s	
Period	1	2	3	4	5	6	7	8	9	10	11	1
Gross Requirements		120	95		200			25		80		
Scheduled Receipts		160										
On Hand 20	20	60	45	45	5	5	5	60	60	60	60	(
Net Requirements			35		160			20		20		
Planned Order Receipts			80		160			80		80		
Planned Order Releases	80		160			80		80				
Item: Description: Sid Period	e boar	d	3	4	5	6	Sa Lo Le 7	afety Stoo ot-Size = ead Time 8	$\mathbf{k} = 10$ = \mathbf{LF} 9	units L week	11	1
Gross Requirements												
Scheduled Receipts	300											
On Hand 30												
Net Requirements												
Planned Order Receipts												

								Cabi	net			
						_						
olution					Sie	de boa	rds (2)		She	elves	; (3
Item: Description: File	Cabin	et					Sa Lo Le	fety Stoc ot-Size = ead Time	k = 0 u FC = 2 v	inits DQ (8 week	<mark>0)</mark> s	
Period	1	2	3	4	5	6	7	8	9	10	11	12
Gross Requirements		120	95		200			25		80		
Scheduled Receipts		160										
On Hand 20	20	60	45	45	5	5	5	60	60	60	60	6
Net Requirements			35		155			20		20		
Planned Order Receipts			80		160			80		80		
Planned Order Releases	80		160			80		80				
Item: Description: Side Period	e board	2	3	4	5	6	Sa Lo Le	fety Stoc ot-Size = ead Time 8	k = 10 = 1 9	units L week	11	12
Gross Requirements	160		320			160		160				
Scheduled Receipts	300											T
On Hand 30												
Net Requirements												
Planned Order Receipts												
Planned Order Releases												



Item: Descriptio	n: Side	board	ł					Sa Lo Le	fety Stock t-Size = ad Time =	c= 10 LF = 1 v	units L veek	;	
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Requirer	ments	160		320			160		160				
Scheduled Rec	eipts	300											
On Hand	30												
On Hand 30 Net Requirements													
Planned Order	Receipts												
Planned Order	Releases												

Item: Description: Side	board						Sa Lo Le	fety Stocl t-Size = ad Time =	∝=10 u LFL = 1 w	inits eek		
Period	1	2	3	4	5	6	7	8	9	10	11	12
Gross Requirements	160		320			160		160				
Scheduled Receipts	300											
On Hand 30	?											
Net Requirements												
Planned Order Receipts												
Planned Order Releases												

My convention... sum of cells in red – sum of cells in blue

Item: Description:	Side	boarc	1					Sa Lo Le	fety Stocl t-Size = ad Time =	k= 10 LF = 1 v	units L veek	5	
Period 1 2 3 4 5 6 7 8 9 10 11											12		
Gross Requireme	ents	160		320			160		160				
Scheduled Receip	pts	300											
On Hand	30	170	?										
Net Requirement	S												
Planned Order Re	eceipts												
Planned Order Re	eleases												

Item: Description: Side	board	1					Sa Lo Le	fety Stocl t-Size = ad Time =	k= 10 LF = 1 v	units L veek	5	
Period 1 2 3 4 5 6 7 8 9 10 11 12												
Gross Requirements	160		320			160		160				
Scheduled Receipts	300											
On Hand 30	170	?										
Net Requirements												
Planned Order Receipts												
Planned Order Releases												

Item: Description: Si	de b	board	I					Sa Lo Le	fety Stocl t-Size = ad Time =	<pre>< 10 LF </pre>	units L veek	5	
Period 1 2 3 4 5 6 7 8 9 10 11 12										12			
Gross Requirements		160		320			160		160				
Scheduled Receipts		300		\frown									
On Hand 3	0	170	170	?									
Net Requirements													
Planned Order Receipts													
Planned Order Releases													

Item: Description: Side	board						Sa Lo Le	fety Stoc t-Size = ad Time	k 10 uı LFL = 1 we	nits eek		
Period	1	2	3	4	5	6	7	8	9	10	11	12
Gross Requirements	160		(320)			160	1	160				
Scheduled Receipts	300		\square									
On Hand 30	170	170	-150	We do	n't wa	nt bac	kordeı	S				
Net Requirements)		150									
Planned Order Receipts												
Planned Order Releases												

Item: Description: Side	board	b					Sa Lo Le	afety Stoc ot-Size = ead Time	k = 10 LF = 1 v	units L veek		
Period	1	2	3	4	5	6	7	8	9	10	11	12
Gross Requirements	160		320			160		160				
Scheduled Receipts	300		\square									
On Hand 30	170	170	-150									
Net Requirements			150 -	+ 10 =	160							
Planned Order Receipts			160									
Planned Order Releases		160	1 wee	k								

lead time

Item: Descriptio	on: Side	board	k					S L L	afety Stoc ot-Size = ead Time	k = 0 u LF = 1 v	nits L veek		
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ements	160		320			160		160				
Scheduled Red	ceipts	300											
On Hand	30	170	170	-150	Ļ								
Net Requirem	On Hand 30 170 170 Net Requirements				\frown	160-1	50 = 10	0					
Planned Order	Receipts			160									
Planned Order	Releases		160										

Since an order for 150 units is now arriving in week 3 what is the on-hand inventory?

Item: Descriptio	on: Side	board	k						Safety Stock Lot-Size = Lead Time	k = 0 u LF = 1 v	inits L week		
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ments	160		320			160		160				
Scheduled Rec	ceipts	300											
On Hand	30	170	170	10	Ł								
Net Requireme	ents			160	\supset	160-1	50 = 1	D					
Planned Order	Receipts			160									
Planned Order	Releases		160										

Item: Descriptio	on: Side	board	k					Sa Lo Le	fety Stoc ot-Size = ead Time	k = 10 LF = 1 v	units L veek	5	
Period 1 2 3 4 5 6 7 8 9 10 11 12													12
Gross Require	ements	160		320			160		160				
Scheduled Red	ceipts	300											
On Hand	30	170	170	10	~								
Net Requirem	ents			160									
Planned Order	r Receipts			160									
Planned Order	r Releases		160										

Item: Descriptio	on: Side	board	k					Sa Lo Le	fety Stocl ot-Size = ad Time =	k= 10 LF = 1 v	units L veek	5	
Period 1 2 3 4 5 6 7 8 9 10 11												11	12
Gross Require	ements	160		320		\bigcirc	160		160				
Scheduled Red	ceipts	300				\frown							
On Hand	30	170	170	10	10	?							
Net Requirem	ents			160									
Planned Order	Receipts			160									
Planned Order	Releases		150										

Item: Descriptio	on: Side	board	k					Sa Lo Le	fety Stocl ot-Size = ad Time =	k= 10 LF = 1 v	units L veek	5	
Period 1 2 3 4 5 6 7 8 9 10 11												12	
Gross Require	ments	160		320		\bigcirc	160		160				
Scheduled Red	ceipts	300				\frown							
On Hand	30	170	170	10	10	10							
Net Requireme	ents			160									
Planned Order	Receipts			160									
Planned Order	Releases		160										

Item: Descriptio	on: Side	board	k					Si L L	afety Stoc ot-Size = ead Time	k = 10 LF = 1 v	units L veek	5	
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ements	160		320			160		160				
Scheduled Red	ceipts	300					\square						
On Hand	30	170	170	10	10	10	?						
Net Requirem	ents			160									
Planned Order	Receipts			160									
Planned Order	Releases		160										

Item: Descriptio	on: Side	e board	k					Sa Lo Le	fety Stoc ot-Size = ad Time	k = 10 LF = 1 v	units L veek	5	
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ements	160		320			160		160				
Scheduled Red	ceipts	300					\frown						
On Hand	30	170	170	10	10	10	-150	*					
Net Requirem	ents			160			150	+10	160-	150 =	10		
Planned Order	Receipts			160			160						
Planned Order	Releases		160			160	1 wee	k					

lead time

Item: Descriptio	on: Side	board	k					Sa Lo Le	fety Stoc t-Size = ad Time	k= 10 LF = 1 v	units L veek	5	
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ements	160		320			160		160				
Scheduled Red	ceipts	300					\frown						
On Hand	30	170	170	10	10	10	10	*					
Net Requirem	ents			160			160		160-	150 =	10		
Planned Order	Receipts			160			160						
Planned Order	Releases		160			160							

Item: Descriptio	on: Side	board	k					Sat Lo Le	fety Stocl t-Size = ad Time =	<pre>x = 10 LF = 1 v</pre>	units L veek	5	
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Requirements 160 320 160 160													
Scheduled Red	ceipts	300						\frown					
On Hand	30	170	170	10	10	10	10	?					
Net Requirem	ents			160			160						
Planned Order	Receipts			160			160						
Planned Order	Releases		160			160							

Item: Descriptio	on: Side	board	k					Sat Lo Le	fety Stoci t-Size = ad Time	k= 10 LF = 1 v	units L veek	5	
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ments	160		320			160		160				
Scheduled Red	ceipts	300						\frown					
On Hand	30	170	170	10	10	10	10	10	?				
Net Requireme	ents			160			160						
Planned Order	Receipts			160			160						
Planned Order	Releases		160			160							

Item: Descriptio	n: Side	board	b					Sa Lo Le	fety Stoc ot-Size = ead Time	k = 10 LF = 1 v	units L veek	5	
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ments	160		320			160		160				
Scheduled Rec	ceipts	300							\frown				
On Hand	30	170	170	10	10	10	10	10	-150	*			
Net Requireme	ents			160			160		150 ·	10	160	150	= 10
Planned Order	Receipts			160			160		160				
Planned Order	Releases		160			160		160	1 we	ek			

lead time

Item: Descriptio	on: Side	board	k					Sa Lo Le	fety Stocl t-Size = ad Time =	<pre>< 10 LF 1 v</pre>	units L veek	5	
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Requirements 160 320 160 160 160 160													
Scheduled Red	ceipts	300							\frown				
On Hand	30	170	170	10	10	10	10	10	10				
Net Requireme	ents			160			160		160				
Planned Order	Receipts			160			160		160				
Planned Order	Releases		160			160		160					

Item: Descriptio	on: Side	board	k					Sa Lo Le	fety Stoc ot-Size = ad Time	k = 10 LF = 1 v	units L veek	3	
Period 1 2 3 4 5 6 7 8 9 10 11 12													
Gross Requirements 160 320 160 160 160 160													
Scheduled Red	ceipts	300											
On Hand	30	170	170	10	10	10	10	10	10	?			
Net Requirem	ents			160			160		160				
Planned Order	Receipts			160			160		160				
Planned Order	Releases		160			160		160					

Item: Descriptio	on: Side	board	k					Sa Lo Le	fety Stoc ot-Size = ad Time	k= 10 LF = 1 v	units L veek	5	
Period 1 2 3 4 5 6 7 8 9 10 11													12
Gross Require	ments	160		320			160		160				
Scheduled Red	ceipts	300								\frown			
On Hand	30	170	170	10	10	10	10	10	10	?			
Net Requirem	ents			160			160		160				
Planned Order	Receipts			160			160		160				
Planned Order Releases 160 160 160 160													

Item: Descriptio	on: Side	board	k					Sa Lo Le	fety Stoc ot-Size = ad Time	k= 10 LF = 1 v	units L veek	5	
Period 1 2 3 4 5 6 7 8 9 10 11													12
Gross Require	ments	160		320			160		160				
Scheduled Red	ceipts	300								\frown			
On Hand	30	170	170	10	10	10	10	10	10	?			
Net Requirem	ents			160			160		160				
Planned Order	Receipts			160			160		160				
Planned Order Releases 160 160 160 160													

Item: Descriptio	on: Side	board	k					Sa Lo Le	fety Stoc ot-Size = ead Time	k= 10 LF = 1 v	units L veek	3	
Period 1 2 3 4 5 6 7 8 9 10 11													12
Gross Require	ments	160		320			160		160	\bigcirc			
Scheduled Red	ceipts	300								\frown			
On Hand	30	170	170	10	10	10	10	10	10	10			
Net Requirem	ents			160			160		160				
Planned Order	Receipts			160			160		160				
Planned Order Releases 160 160 160													

Item: Descriptio	on: Side	board	b					Sa Lo Le	fety Stoc ot-Size = ad Time	k = 10 LF = 1 v	units L veek	5	
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ements	160		320			160		160	(\bigcirc		
Scheduled Red	ceipts	300										2	
On Hand	30	170	170	10	10	10	10	10	10	10	10		
Net Requirem	heduled Receipts			160			160		160				
Planned Order	Receipts			160			160		160				
Planned Order	Releases		160			160		160					

Item: Descriptio	on: Side	board	k					Sa Lo Le	fety Stocl ot-Size = ad Time =	k= 10 LF = 1 v	units L veek	5	
Period 1 2 3 4 5 6 7 8 9 10 11 12 0 D 160 220 160 11 12 160													
Gross Require	Description:Side boardPeriod1Gross Requirements160Scheduled Receipts300On Hand30Net Requirements170Net Requirements1Planned Order Receipts1			320			160		160				1
Scheduled Red	ceipts	300)
On Hand	30	170	170	10	10	10	10	10	10	10	10	10	
Net Requirem	ents			160			160		160				
Planned Order	Receipts			160			160		160				
Planned Order	Releases		160			160		160					

Item: Descriptio	n: Side	board	1					Sa Lo Le	fety Stocl t-Size = ad Time =	<pre>< 10 LF 1 v</pre>	units L veek	5	
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ments	160		320			160		160				\bigcirc
Scheduled Rec	ceipts	300											
On Hand	30	170	170	10	10	10	10	10	10	10	10	10	10
Net Requireme	ents			160			160		160				
Planned Order	Receipts			160			160		160				
Planned Order	Releases		160			160		160					

Item: Descriptio	on: Side	board	b					Sa Lo Le	fety Stocl t-Size = ad Time =	k= 10 LF = 1 v	units L veek	5	
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ements	160		320			160		160				
Scheduled Red	ceipts	300											
On Hand	30	170	170	10	10	10	10	10	10	10	10	10	10
Net Requirem	Gross Requirements 160 Scheduled Receipts 300 On Hand 30 170 170 Jet Requirements			160			160		160				
Period 1 2 3 4 5 6 7 8 9 10 11 Gross Requirements 160 320 160 160 160 Gross Requirements 160 320 160 <td></td>													
Planned Order	Releases		160			160		160					

Cost of this policy?

440 x \$2 + 3 x \$100

880 + 300 = **\$1180**

Item: Descriptio	on: Side	boar	d					Sa Lo Le	fety Stoc ot-Size = ad Time	k = 10 LF = 1 v	units L veek	5		_
Period		1	2	3	4	5	6	7	8	9	10	11	12	
Gross Require	ements	160		320			160		160				4	4
Scheduled Re	ceipts	300											S	U
On Hand	30	170	170	10	10	10	10	10	10	10	10	10	10	
Net Requirem	ients			160			160		160					
Planned Orde	r Receipts			160			160		160					
Planned Orde	r Releases		160			160		160					cοι	JΝ
Planned Orde	r Releases	<u> </u>	100			160		100					UOL]



We could determine how many and when to produce shelves similarly

Shelves:

currently 20 on hand 260 scheduled to arrive in week 1 produced LFL require a safety stock of 20 units lead time of one week

								Cabi	net			
olution					Sie	de boa	ards (2	2)		She	elves	(3)
Item: Description: File	Cabin	et					S L L	afety Stoc ot-Size = ead Time	k = 10 FC = 2 v	units DQ (8 week	5 0) s	
Period	1	2	3	4	5	6	7	8	9	10	11	12
Gross Requirements		120	95		200			25		80		
Scheduled Receipts		160										
On Hand 20	20	60	45	45	5	5	5	60	60	60	60	60
Net Requirements			35		160			20		20		
Planned Order Receipts			80		160			80		80		
Planned Order Releases	80		160			80		80				\square
Item: Description: She Period	elves	2	3	4	5	6	S L L 7	afety Stoc ot-Size = ead Time 8	k = 20 LF = 1 v	units L week	11	12
Gross Requirements												
Scheduled Receipts	260											
On Hand 20												
Net Requirements	Ĩ											
Planned Order Receipts												
Planned Order Releases												

		Cabinet Side boards (2) Side boards (2) Safety Stock = 0 Lot-Size = 1 Lead Time = 2 1 2 3 4 5 6 7 8 9 1 2 3 4 5 5 5 60 60 20 60 45 45 5 5 5 60 60 20 60 45 45 5 5 5 60 60 20 60 45 45 5 5 5 60 60 35 155 20 80 80 80 80 80 80 Safety Stock = 20 Lead Time = 1 1 2 Safety Stock = 20 Lead Time = 1 1 2 2 Safety Stock = 20 Lead Time = 1										
olution					Sid	de boa	rds (2))		She	elves	\$ (3)
Item: Description: File	Cabin	et					Sa Lo Le	fety Stoc ot-Size = ead Time	k = 0 L FC = 2 V	units DQ (8 week	6 0) (S	
Period	1	2	3	4	5	6	7	8	9	10	11	12
Gross Requirements		120	95		200			25		80		
Scheduled Receipts		160										
On Hand 20	20	60	45	45	5	5	5	60	60	60	60	60
Net Requirements			35		155			20		20		
Planned Order Receipts			80		160			80		80		
Planned Order Releases	80		160			80		80				
Item: Description: She Period	lves	2	3	4	5	6	Sa Lo Le	ifety Stoc ot-Size = ead Time	k = 20 = 1	units L week	S	12
	-	-	400		5	240	,	° 240	-	10		12
Scheduled Respirate	260		480			240		240			+	+
On Hand 20											+	+
Net Requirements	<u> </u>										+	+
Planned Order Passinta											+	+
Planned Order Delegers											+	+
Planned Order Releases												


Item: Descriptio	n: Shel	ves						Sa Lo Le	fety Stocl t-Size = ad Time =	κ = 20 LF = 1 ν	units L veek	;	
Period 1 2 3 4 5 6 7 8 9 10 11 12												12	
Gross Requirer	ments	240		480			240		240				
Scheduled Rec	eipts	260											
On Hand	20												
Net Requireme	ents												
Planned Order	Receipts												
Planned Order	Releases												

Item: Description: Shelv	/es						Sa Lo Le	fety Stocl ot-Size = ad Time =	∝=20 u LFL = 1 w	inits eek		
Period	1	2	3	4	5	6	7	8	9	10	11	12
Gross Requirements	240		480			240		240				
Scheduled Receipts	260											
On Hand 20	?											
Net Requirements												
Planned Order Receipts												
Planned Order Releases												

My convention... sum of cells in red – sum of cells in blue

Item: Descriptio	on: She l	ves						Sa Lo Le	fety Stocl t-Size = ad Time =	∝ ₌ 20 LF = 1 v	units L veek	5	
Period 1 2 3 4 5 6 7 8 9 10 11 12												12	
Gross Require	ements	240		480			240		240				
Scheduled Red	ceipts	260											
On Hand	20	40	?										
Net Requirem	ents												
Planned Order	Receipts												
Planned Order	Releases												

Item: Description: She	lves						Sa Lo Le	fety Stocl t-Size = ad Time =	ς = 20 LF = 1ν	units L veek	5	
Period	Period 1 2 3 4 5 6 7 8 9 10 11 12											
Gross Requirements 240 480 240 240 240 0												
Scheduled Receipts	260		2									
On Hand 20	40	?										
Net Requirements												
Planned Order Receipts												
Planned Order Releases												

Item: Description: She	lves						Sa Lo Le	fety Stocl t-Size = ad Time =	k= 20 LF = 1 v	units L veek	5	
Period 1 2 3 4 5 6 7 8 9 10 11 12											12	
Gross Requirements	240		480			240		240				
Scheduled Receipts	240		\sim									
On Hand 20	40	40	?									
Net Requirements												
Planned Order Receipts												
Planned Order Releases												

Item: Description: She	lves						Sa Lo Le	fety Stoc ot-Size = ead Time	k = 20 u LFL = 1 w	inits eek		
Period 1 2 3 4 5 6 7 8 9 10 11 1 Grass Page/imments 240 240												12
Gross Requirements	240		480			240		240				
Scheduled Receipts	260											
On Hand 20	40	40	-440	We de	n't wa	nt ba	ckorde	rs				
Net Requirements												
Planned Order Receipts												
Planned Order Releases												

												<u> </u>	
Item: Descriptio	n: She l	ves						Sa Lo Le	ifety Stoc ot-Size = ead Time	k = 20 LF = 1 v	units L veek	•	
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ments	240		480			240		240				
Scheduled Rec	ceipts	260		\square									
On Hand	20	40	40	-440									
Net Requireme	ents			440 -	⊦ 20 ⁼	460							
Planned Order	Receipts			460									
Planned Order	Releases		460	1 wee	k								

lead time

Item: Descriptio	on: She l	lves						Sa Lo Le	fety Stocl ot-Size = ad Time =	k= 20 LF = 1 v	units L veek	5	
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ments	240		480			240		240				
Scheduled Red	ceipts	260											
On Hand	20	40	40	-440	Ļ								
Net Requireme	ents			460	\frown	460-4	40 = 2	0					
Planned Order	Receipts			460									
Planned Order	Releases		460										

Since an order for 460 units is now arriving in week 3 what is the on-hand inventory?

Item: Descriptio	on: She l	lves						Sa La La	afety Stock ot-Size = ead Time	k= 20 LF = 1 v	units L veek	5	
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ements	240		480			240		240				
Scheduled Red	ceipts	260											
On Hand	20	40	40	20	ł								
Net Requirem	On Hand 20 40 Net Requirements				\frown	460-4	50 = 2	0					
Planned Order	Receipts			460									
Planned Order	Releases		460										

Item: Descriptio	on: She	lves						Sa Lo Le	fety Stocl ot-Size = ad Time	ς = 20 LF = 1ν	units L veek	•	
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ments	240		480			240		240				
Scheduled Red	ceipts	260											
On Hand	20	40	40	20	?								
Net Requirem	ents			460									
Planned Order	Receipts			460									
Planned Order	Releases		460										

Item: Descriptio	on: She	lves						Sa Lo Le	fety Stocl ot-Size = ad Time =	k= 20 LF = 1 v	units L veek	5	
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ments	240		480		\bigcirc	240		240				
Scheduled Red	ceipts	260				\bigcirc							
On Hand	20	40	40	20	20	?							
Net Requirem	ents			460									
Planned Order	Receipts			460									
Planned Order	Releases		460										

Item: Descriptio	on: She	lves						Sa Lo Le	fety Stocl ot-Size = ad Time =	k= 20 LF = 1 v	units L veek	5	
Period	8	9	10	11	12								
Gross Require	ments	240		480		\bigcirc	240		240				
Scheduled Red	ceipts	260				\frown							
On Hand	20	40	40	20	20	20							
Net Requirem	ents		460										
Planned Order	Receipts			460									
Planned Order	Releases		460										

Item: Descriptio	on: She l	ves						S L L	afety Stoc ot-Size = ead Time	k = 20 LF = 1 v	units L veek	5	
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ments	240		480			240		240				
Scheduled Re	ceipts	260					\frown						
On Hand	20	40	40	20	20	20	~						
Net Requirem	ents			460									
Planned Order	Receipts			460									
Planned Order	Releases		460										

Item: Descriptio	on: She l	lves						S L L	afety Stoc .ot-Size = .ead Time	k = 20 LF = 1 v	units L veek)	
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ements	240		480			240		240				
Scheduled Re	ceipts	260					\frown						
On Hand	20	40	40	20	20	20	-220	*					
Net Requirem	ents		460			240	-20	240-	220 =	20			
Planned Order	Receipts			460			240						
Planned Order	Releases		460			240	1 wee	k					

lead time

Item: Descriptio	on: She	lves						Sa Lo Le	fety Stoc ot-Size = ead Time	k = 20 LF = 1 v	units L veek	5	
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ements	240		480			240		240				
Scheduled Re	ceipts	260					\frown						
On Hand	20	40	40	20	20	20	20	*					
Net Requirem	On Hand 20 40 Net Requirements			460			240		240-	220 =	20		
Planned Order	Receipts			460			240						
Planned Order	Releases		460			240							

Item: Descriptio	on: She	lves						Sat Lo Le	fety Stocl t-Size = ad Time =	k = 20 LF = 1 v	units L veek	5	
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ments	240		480			240		240				
Scheduled Rec	ceipts	260						\sim					
On Hand	20	40	40	20	20	20	20	?					
Net Requirem	Net Requirements						240						
Planned Order	Receipts			460			240						
Planned Order	Releases		460			240							

Item: Descriptio	on: She	lves						Sa Lo Le	fety Stoc t-Size = ad Time	k= 20 LF = 1 v	units L veek	•	
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ements	240		480			240		240				
Scheduled Red	ceipts	260						\square					
On Hand	20	40	40	20	20	20	20	20	?				
Net Requirem	On Hand 2U 4U Net Requirements Image: Constraint of the second s			460			240						
Planned Order	Receipts			460			240						
Planned Order	Releases		460			240							

Item: Descriptio	n: Shel	ves						Sa Lo Le	fety Stoc ot-Size = ead Time	k = 20 LF = 1 v	units L veek	5	
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ments	240		480			240		240				
Scheduled Rec	eipts	260							\square				
On Hand	20	40	40	20	20	20	20	20	-220	*			
Net Requireme	ents			460			240		220 ·	20	240	-220	= 20
Planned Order	Receipts			460			240		240				
Planned Order	Releases		460			240		240	1 we	ek			

lead time

Item: Descriptio	n: She l	ves						Sa Lo Le	fety Stocl t-Size = ad Time =	ς = 20 LF = 1 ν	units L veek	5	
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ments	240		480			240		240				
Scheduled Rec	ceipts	260							\frown				
On Hand	20	40	40	20	20	20	20	20	20				
Net Requirem	ents			460			240		240				
Planned Order Receipts 460 240 240													
Planned Order	Releases		460			240		240					

Item: Descriptio	n: She l	ves						Sa Lo Le	fety Stocl t-Size = ad Time =	ς = 20 LF = 1 ν	units L veek	5	
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ments	240		480			240		240				
Scheduled Rec	ceipts	260							\frown				
On Hand	20	40	40	20	20	20	20	20	20				
Net Requirem	ents			460			240		240				
Planned Order Receipts 460 240 240													
Planned Order	Releases		460			240		240					

Item: Descriptio	n: She l	ves						Sa Lo Le	fety Stocl ot-Size = ad Time =	κ = 20 LF = 1 ν	units L veek	6	
Period		1	2	3	4	5	6	7	8	9	10	11	12
Gross Require	ments	240		480			240		240				
Scheduled Red	ceipts	260							\frown				
On Hand	20	40	40	20	20	20	20	20	20	20	20	20	20
Net Requirem	Net Requirements						240		240				
Planned Order Receipts 460 240 240													
Planned Order	Releases		460			240		240					

MRP Example: The Alpha Beta Company



MRP 'Explosion' For A & B

Item: A	LLC: 0					Period				
Lot size: 1	LT: 3	PD	1	2	3	4	5	6	7	8
Gross require	ements									100
Scheduled re	ceipts									
Projected on	hand	10	10	10	10	10	10	10	10	0
Net requirem	ents									90
Planned orde	Net requirements Planned order receipts									90
Planned orde	r releases						90			

Item: B	LLC: 0					Period				
Lot size: 1	LT: 2	PD	1	2	3	4	5	6	7	8
Gross requiren	nents							200		
Scheduled reco	eipts									
Projected on h	and	5	5	5	5	5	5	0	0	0
Net requirement	nts							195		
Planned order	receipts							195		
Planned order	releases					195				

- At Level Zero: gross requirements come from the master production schedule (MPS)
- Below level zero: gross requirements come from planned order releases for the next level above.
- Net requirements are gross requirements plus scheduled receipts minus inventory on-hand

MRP 'Explosion' For C & D

Item: C	LLC: 1					Period				
Lot size: 150	LT: 4	PD	1	2	3	4	5	6	7	8
Gross require	ments						270			
Scheduled red	ceipts									
Projected on h	nand	140	140	140	140	140	20	20	20	20
Net requireme	ents						130			
Planned order	r receipts						150			
Planned order	r releases		150							

Item: D LLC	: 1	Period								
Lot size: 250 LT:	2 PD		1	2	3	4	5	6	7	8
Gross requirements						585	180			
Scheduled receipts				250						
Projected on hand	20	0 2	00	450	450	115	185	185	185	185
Net requirements						135	65			
Planned order rece	eipts					250	250			
Planned order releases				250	250					

Alpha Beta Planned Order Release Report

Period	Item	Quantity			
1	С	150			
2	D	250			
3	D	250			
4	В	195			
5	А	90			

What if we made PRODUCTS X AND Y...



What if we made PRODUCTS X AND Y...

"Low Level Coding"



In MRP same items should always be on the same level (lower)

What if we made PRODUCTS X AND Y...



In MRP same items should always be on the same level (lower)

What if we made PRODUCTS X AND Y...



What if we made PRODUTS X AND Y...



How many D's do we need to build 10 Y's?

What if we made PRODUTS X AND Y...



How many A's do we need to build for 20 X's and 5 Y's?

MRP (Definitions)

- 1. Planning factors: three parameters—lot size, lead time, and safety stock—that are chosen by managers utilizing the MRP system
 - A. Lot size: the quantity of a part to be produced or ordered when additional inventory is required
 - B. Lead time: the time between when an order is placed and when it is expected to arrive or be finished
 - C. Safety stock: excess inventory that a company holds to guard against uncertainty in demand, lead time, and supply

MRP (More Definitions)

- D. Time buckets: the periods of time into which an MRP record is divided
- E. Planning horizon: the time period in the future that the MRP system plans for
- F. Beginning inventory: the amount of inventory that was physically in stock at the end of the most recent time bucket
- **G. Gross requirements**: Total number of units required
- H. Scheduled receipts: Orders that have been placed, but not yet received/completed

MRP (One More Definition)

- E. Projected on-hand inventory: Estimated inventory that will be available after the gross requirements have been satisfied, plus any planned or scheduled receipts for that time bucket.
 - Abbreviated: OH
 - Adjusted with every inventory transaction

How to Calculate:

 $OH_{end t+1} = OH_{end t} + Sched Receipts_{t+1} - Gross$ Requirements_{t+1}

MRP

MRP Record for Single Item (Bicycle Wheel, #B100)

TABLE 7.3	Illustration of Projected On-Hand Inventory						
Week	Starting Inventory	Scheduled Receipts	Gross Requirements	Projected On-Hand Inventory			
February 1	40	+0	-0	= 40			
February 8	40	+200	-124	= 116			
February 15	116	+0	-0	= 116			
February 22	116	+0	-176	= -60			
March 1	-60	+0	-100	= -160			
March 8	-160	+0	-70	= -230			
March 15	-230	+0	-100	= -330			
March 22	-330	+0	-70	= -400			
March 29	-400	+0	-0	= -400			
MRP (Two More Definitions)

- F. Planned Receipts Future Orders That Have Not Yet Been Released, but are Planned
 - ✓ a. Used to Avoid Shortages/Backlogs
 - b. Determine Amount for Planned Receipts By Calculating Projected OH Inventory Until We See a Shortage (Shortage Occurs When Planned OH Inventory Falls Below Safety Stock Level)
 - c. Develop a Planned Receipt (Based Upon Lot Sizing Policy) To Raise Projected OH Inventory to At Least Safety Stock Level)
 - **G. Planned Order Release** Shows When An Order Must Be Released In Order to Offset Lead Time

- 1. Determining the Planning Factors
- 2. Lot Size → Size of Orders Placed → Many Different Rules; We'll look at three different rules:
 - ✓ A. Fixed Order Quantity (FOQ)
 - ✓ B. Periodic Order Quantity (POQ)
 - ✓ C. Lot for Lot (L4L)

1. Fixed Order Quantity (FOQ) Lot Size Rule

- 2. Characteristics
 - ✓ A. Mimics the EOQ Policy
 - ✓ B. Same Quantity Ordered Each Time
 - C. Quantity Often Governed by Equipment Capacity
 - ✓ D. Helps to Make Planning Consistent
 - E. May Be Used to Help Achieve Quantity/Transportation Discounts

MRP Record for Fixed Order Quantity

ltem:	B100	Lot Size: 200 (Fixed)
Description:	Bicycle wheel	Lead Tim 2 weeks
Begin Invy:	40	Safety St 15

Week	Feb. 1	Feb. 8	Feb. 15	Feb. 22	Mar. 1	Mar. 8	Mar. 15	Mar. 22	Mar. 29
Gross Require.	0	124	0	176	100	260	100	70	0
Sched. Receipts	0	200	0	0	0	0	0	0	0
Planned OH	40	116	116	140	40	180	80	210	210
Planned Receipts				200		400		200	
Planned Order Release		200		400		200			
				1					
				/					

Order Two Lots of Size 200

1. Periodic Order Quantity (POQ)

2. Lot Size Rule With a Variable Lot Size Designed to Order Exactly the Amount Required for a Specified Period of Time (I.e. When We Need to Place An Order, Order Enough to Cover P Periods of Gross Requirements)

Periodic Order Quantity (POQ) (P=3)

Item:	B100		Lot Size:	200 (Fixe	d)				
Description:	Bicycle wheel		Lead Tim 2 weeks						
Begin Invy:	40		Safety St	15					
Week	Feb. 1	Feb. 8	Feb. 15	Feb. 22	Mar. 1	Mar. 8	Mar. 15	Mar. 22	Mar. 29
Gross Require.	0	124	0	176	100	70	100	70	0
Sched. Receipts	0	200	0	0	0	0	0	0	0
Planned OH	40	116	116	185	85	15	85	15	15
Planned Receipts				245			170		
Planned Order Release		245			170				

- 1. Lot for lot (L4L): a lot size rule that is a special case of the periodic order quantity with the period equal to 1
- 2. Equation:

L4L Lot Size to Arrive in Period t =

(Gross Requirements in Period *t*)

- (Projected On-Hand Inventory at End of Period t-
- 1) + (Safety Stock)



Lot for Lot (L4L)

Item:	B100	Lot Size: L4L	
Description:	Bicycle wheel	Lead Tim 2 w	veeks
Begin Invy:	40	Safety St	15

Week	Feb. 1	Feb. 8	Feb. 15	Feb. 22	Mar. 1	Mar. 8	Mar. 15	Mar. 22	Mar. 29
Gross Require.	0	124	0	176	100	70	0	70	100
Sched. Receipts	0	200	0	0	0	0	0	0	0
Planned OH	40	116	116	15	15	15	15	15	15
Planned Receipts				75	100	70		70	100
Planned Order Release		75	100	70		70	100		

Lot Size Rules Summary

- 1. The FOQ rule has the highest average inventory because its fixed nature creates inventory remnants.
- 2. The POQ rule reduces the amount of OH inventory by matching gross requirements with planned receipts.
- **3**. The L4L rule always minimizes inventory, but also requires more frequent setups/orders.

Safety Stock

It may seem that an MRP inventory system should not require safety stock.

Why is safety stock necessary?

- 1. There may be bottlenecks or blockages that prevent orders from being complete on a timely basis.
- 2. Quality problems often arise
- 3. Humans may enter incorrect information into the system.
- 4. There is variability in demand, and the master schedule is made to match forecasts.

MRP Primary Reports

- Planned orders schedule indicating the amount and timing of future orders.
- Order releases Authorization for the execution of planned orders.
- Changes revisions of due dates or order quantities, or cancellations of orders.

Inventory status data

MRP Secondary Reports

Performance-control reports:

used to determine agreement between actual and programmed usage and costs

Planning reports: for example, forecasting inventory requirements over a period of time

Exception reports: used to point out serious discrepancies, such as late or overdue orders



Benefits of MRP

- Low levels of in-process inventories
- Ability to track material requirements
- Ability to evaluate capacity requirements
- Means of allocating production time
- Ability to easily determine inventory usage.

Requirements of a successful MRP system

- Computer and necessary software
- Accurate and up-to-date
 - Master schedules
 - Bills of materials
 - Inventory records
- Integrity of data

MRP in Services

Can be used when demand for service or service items is directly related to or derived from demand for other services

MRP in Services

- Service applications such as:
 - Professional services
 - Postal services
 - Retail
 - Banking
 - Healthcare
 - Higher education
 - Engineering
 - Logistical services
 - Real estate

MRP in Services

Food catering service

- End item => catered food
- Dependent demand => ingredients for each recipe, i.e. bill of materials
- Hotel renovation
 - Activities and materials "exploded" into component parts for cost estimation and scheduling

Summary

What is MRP?

- What are the three primary inputs to MRP?
- MRP (Definitions)
- Lot size rules
- Why is safety stock necessary
- Does it have a place for service firms