

Material Requirements Planning (MRP)

for Dependent Demand Systems

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General Scenario

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 - A manufacturing company is making several products
 - Products are made up of components
 - Some of which are purchased from outside
 - Some are produced in batches
 - Different products may use the same components

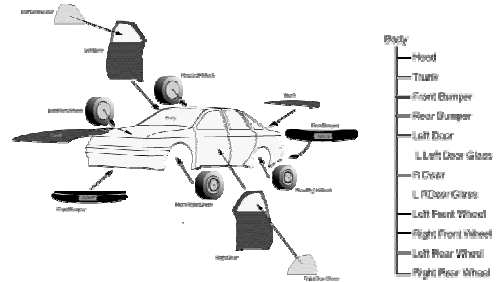
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Types of Demand

- Independent demand
 - Demand for an item generated by forces outside the firm's control
 - Example: finished goods
- Dependent demand
 - Demand for parts, raw materials, and subassemblies dependent on finished-goods demand
 - Example: demand for 4 tires for each manufactured car

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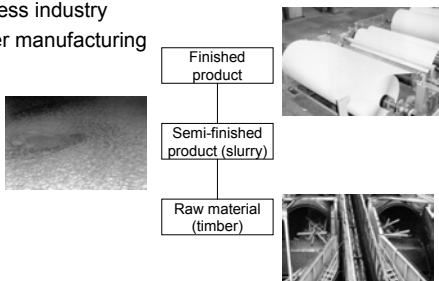
Automobile Parts Explosion



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Example Dependent Relationships

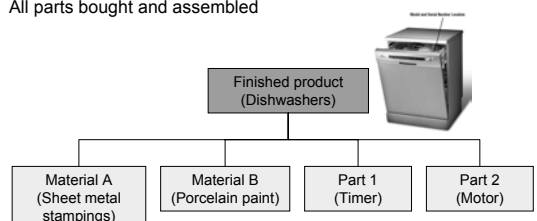
- Process industry
- Paper manufacturing



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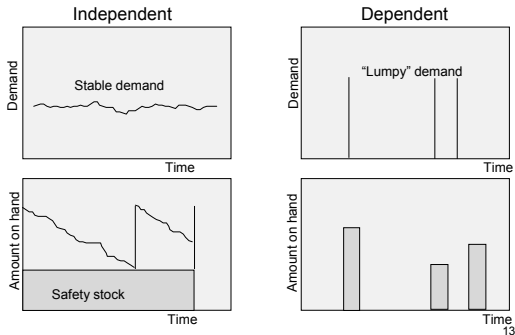
Non-integrated Appliance Mfg.

- All parts bought and assembled



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Demand Patterns



How to Manage Inventories?

- Two types of systems for planning and controlling parts and materials with demand dependent on finished goods
 - Type 1: Reorder-point systems
 - Example: EOQ
 - Type 2: Explosion-based
 - Also called: Requirements planning
 - Example: MRP

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Type 1: Re-order Point Systems

In dependent-demand setting:

- Advantages
 - Simple planning and control
 - Data collection and decision-making easy
 - Straightforward execution
 - No computation costs
- Disadvantages
 - Treats demand as independent of production
 - "Lumpy" demand leads to excess inventories, poor service, high costs
 - Decisions decoupled from aggregate plans

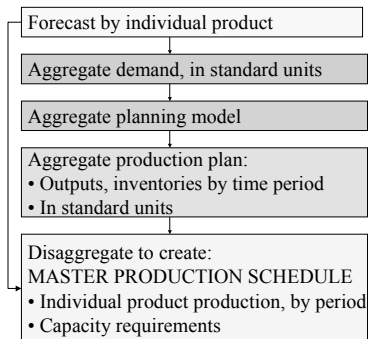
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Type 2: Requirements Planning

- Planning and controlling the inputs to the production of finished goods
- All such planning efforts begin with the Aggregate Scheduling Plan

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Review: Aggregate Scheduling



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Aggregate Scheduling

- Provides a central focus for manufacturing control
- Concerns how factory output, inventory, and workforce levels should vary over time
- Is based on standard units
- Focuses on end-products
- Disregards elements of finished goods that must be managed to create end products:
 - Raw materials
 - Components
 - Subassemblies

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Partial Item Master File

Part no.	0820000	0270018	0278818
Item	Treadle subassembly	Treadle pivot	Casting
Lead time	3 weeks	3 weeks	5 weeks
Std. cost	\$110	\$55	\$42
Setup cost	\$20	\$37	0
Order quant	15 units	15	25
Safety stock	0	0	0
Where used	Model 1050020	No. 00820000	No. 0270015
On hand	10	0	11
On order	0	10, due period 2	25, due period 2

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MRP System Output

Material Requirements Planning (MRP) System

Material Requirements Plan

- Set of "Planned Releases" (orders) for all components
- Based on requirements explosions (dependencies)
- Takes lead times into account
- Basically, how much of what to order and when

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Dependent Demands

Master schedule:

Period	1	2	3	4	5	6	7	8	9	10	11	12
Marking machine #1050020		3						8		10		

Level 0:
(L=3)

Treadle subassembly # 0820000		Lot size: 15	Lead time: 3 weeks	Level: 0
Gross requirements				
Scheduled receipts				
On hand	10	7	7	7
Planned release			15	

Level 1:
(L=3)

Treadle pivot # 0270018		Lot size: 15	Lead time: 3 weeks	Level: 1
Gross requirements			15	
Scheduled receipts				
On hand	0	0	-15	-15
Planned release		15		

Level 2:
(L=6)

Casting # 0278818		Lot size: 25	Lead time: 6 weeks	Level: 2
Gross requirements	15			
Scheduled receipts		25		
On hand	11	-4	21	21
Planned release				

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MRP Requirements from All Sources

Computer Product A

Computer Product B

Planned orders	5	7	7	Planned orders	5	5
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Keyboard

Gross requirements	5	5	12	20	7
Scheduled receipts				20	
On-hand	5	0	0	8	-12
Planned orders				20	

Independent demand
20, period 5

Faceplate, 1/kb

Gross requirements			20
Scheduled receipts			

Mounting brackets, 2/kb

Gross requirements			40
Scheduled receipts			

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MRP Calculations

and Example Problem

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MRP Example: Delta Computers

MASTER PRODUCTION SCHEDULE

Week	Volume Out	
	A400	A800
1	2,000	1,000
2	5,000	-
3	-	6,000
4	10,000	2,000
5	-	4,000
6	8,000	-
7	5,000	2,000
8	-	2,000
9	10,000	-

BILL OF MATERIALS

A400	Model A400 ValUline computer
0100	Laptop chassis (1)
2200	Motherboard A (1)
2205	Circuit board with CPU (1)
3000	Memory modules (8)
4722	Mounting screws (8)
A800	Model A800 Towerbox computer
0110	Tower chassis (1)
2201	Motherboard B (1)
2205	Circuit board with CPU (1)
3000	Memory modules (24)
4722	Mounting screws (8)

INVENTORY STATUS RECORDS

Item Number	Item Description	No. on order (due date)	On-hand units	Lead time (weeks)	Order Quantity
A400	Model A400 computer	0	8,000	1	10,000
A800	Model A800 computer	0	2,000	1	5,000
0100	Laptop chassis	0	5,000	2	4,000
0110	Tower chassis	0	5,000	2	4,000
2200	Motherboard A	0	-	1	10,000
2201	Motherboard B	5,000 (wk 2)	-	1	5,000
4722	Mounting screws	80,000 (wk 3)	150,000	1	200,000
2205	Circuit board	0	14,000	1	10,000
3000	Memory modules	150,000 (wk 1)	130,000	2	150,000

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MRP Calculations

1. Begin with the master schedule,
 - a) Create a separate schedule for each product
 - b) Fill in headings, requirements, scheduled receipts, and initial units on hand (Level 0)
2. For each schedule at this level, do:
 - a) Determine a set of "planned releases" (orders) based on lead times, requirements, scheduled receipts, and anticipated amounts on hand
 - b) From the Bill of Materials:
 - Create the next level, with separate schedules for each component,
 - Fill in scheduled receipts and initial on-hand
 - Previous level's orders become new level's gross requirements. Repeat step 2 for this new level.

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Lot-Sizing and Summary

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Lot-Sizing Rules

Rules for determining order quantities:

- Fixed order quantity
 - Based on EOQ, adjusted for large requirements?
 - Remnants lead to higher inventory levels
- Periodic order quantity
 - Quantities may vary, but are placed at regular time intervals, rather than as needed
- Lot-for-lot (L4L)
 - Lot size covers one week's gross requirements
 - Minimizes inventories
 - Can yield a large number of orders

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Key Functions of MRP Systems

- Inventory control
- Priority planning – resolving conflicts
- Basis for capacity planning
 - Translating aggregate plan's standard units into actual components
 - Ensuring sufficient production capacity for individual components
 - Capacity Requirements Planning systems deal with this

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Prerequisites for MRP

- A master production schedule
 - The number of end items to produce and when
- Bill of materials
 - Documents end product to its components
- Unique identification code for each item
- Accurate inventory records: current status, planned issues
- Database integrity
- Dependable lead times for all items

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