

MRP II: Manufacturing Resource Planning Systems

IE 505: Production Planning Control
Lecture Notes*
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University at Buffalo

* Adapted in part from Lecture Notes of Dr. George Harhalakis, University of Maryland

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The Evolution of MRP II

- 1960's and 1970's
 - MRP: Material Requirement Planning
 - Assumed infinite capability
- 1980's
 - MRP II : Manufacturing Resource Planning
 - Assumed limited capability
 - Closed loop system
- 1990's
 - ERP: Enterprise Resource Planning

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The Fundamental Logic of MRP System

- What are we going to make ?
 - *The Master Production Schedule*
- What do we (already) have ?
 - *Inventory Record*
- What is it made up of ?
 - *The Bill Of Materials*
- How will it be made ?
 - *The Routings*

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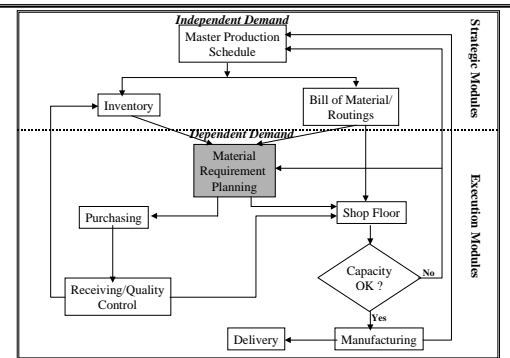
The Modules In MRP II System

- Master Production Scheduling
- Inventory
- Bill Of Materials (BOM)
- Material Requirements Planning (MRP)
- Purchasing
- Receiving/ Quality Control
- Shop Floor

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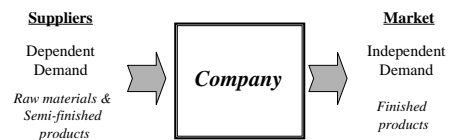
Typical MRP II Architecture



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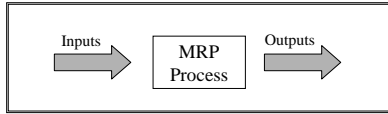
Dependent vs Independent Demand



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Material Requirements Planning (MRP)

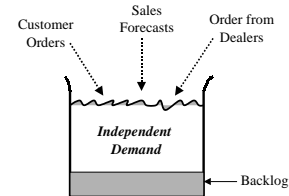


- Inputs
 - Master Production Schedule
 - Bill Of Materials
 - Inventory Data.
- Outputs
 - Replenishment Orders
 - Reschedule Notices

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Master Production Schedule



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Master Production Schedule

- Forward looking plan
- Objectives
 - To support sales
 - To run operations effectively
- Fundamental factors
 - What we intend to make
 - How much we intend to make
 - When we intend to make
- Input : sale plan
 - Must consider the capacities available by 'rough cut' routing

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Master Schedule

- Inputs
 - Sales forecasts
 - Customer orders
 - Orders from dealers or other distribution centers
 - Inventory of finished products
 - Currently produced and expected finished product delivers
 - Rough-cut routing
- Outputs
 - Quantities, types and due dates of required products

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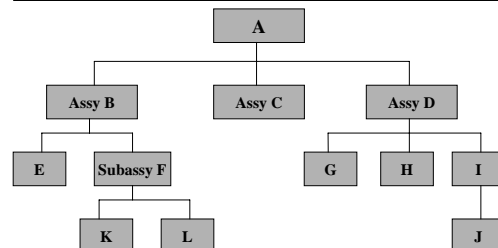
Bill Of Material (BOM)

- The list of the end items
- Characteristics
 - Part Numbering
 - Parents and Child Relationship
 - Bill Of Material Levels
 - Explosions and Implosions
 - Phantom Bills

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A Sample BOM Structure



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Part Numbering

- The unique identifier
 - Called a part number or item number
- Three ways to define the number
 - Random numbering
 - is used as an identifier only, not as a descriptor
 - Significant numbering
 - describes specific information about the item, such as source, material, shape, etc
 - Semi-significant numbering

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Example

Random Numbering

Part Number:	37-7213
Type of Item:	37 = Ink Cartridges
Four digit:	7213 = Random

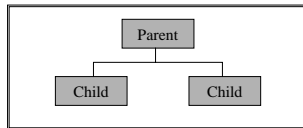
Significant Numbering

Part Number:	37-1-3-16-432
Type of item:	37 = Ink Cartridges
Type:	1 = Screw-in-type
Point type:	16 = Fine Line
Color:	16 = Blue
Length:	432 = 4.5 inches long

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Parents and Child Relationship

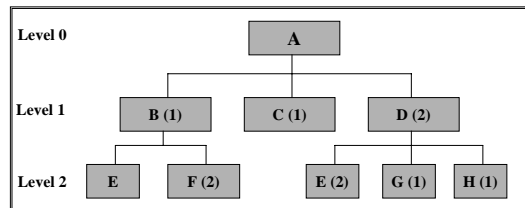


Children are the objects that are assembled together to make a parent object

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BOM Levels



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Explosions

- Two different way to display the BOM
 - Explosion and implosion
- Explosions: *going down the BOM*
 - Single level explosions
 - Displays the immediate component parts (children)
 - Indented explosion
 - Parent on left-hand side and each additional level indented farther to the right
 - Summarized explosion
 - Arranges an indented explosion into total quantity order or part number order
 - Adds together the total requirement for each part number

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Examples of Explosion Types

Single Level Explosion of D

Part #	Qty
E	2
G	1
H	1

Indented Explosion of A

Level	Part #	Qty
1	B	1
2	E	1
2	F	2
1	C	1
1	D	2
2	E	2
2	G	1
2	H	1

Summarized Explosion of A

Level	Part #	Qty
1	B	1
1	C	1
1	D	2
2	E	5
2	F	2
2	G	2
2	H	2

(Ordered by Part #)

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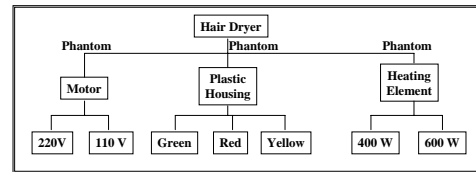
Implisions

- **Implisions:** *going up the BOM*
 - ◆ **Single level implision**
 - Displays the immediate parent of a given component
 - Called 'where used' list or 'goes into'
 - Useful when a design change for the 'imploded' part is under discussion
 - ◆ **Indented implision**
 - Displays all of the parent of a given component, all the way up to the top level part
 - Used for the two main reasons
 - ↳ To detect commonality of parts in different assemblies
 - ↳ To assess the impact of a design change made to a part on various assemblies that make use of it
 - ◆ **Summarized implision**

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Phantom BOM

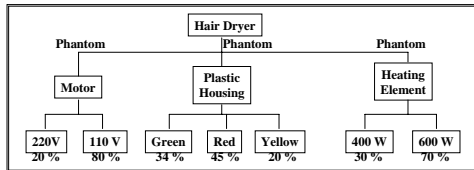


- The items 'Motor', 'Housing', and 'Heating Element' are Phantoms
- To create individual Bills of Materials we would need 12 different product structures
 - ◆ 2 motor types * 3 plastic housing types * 2 heating element types = 12
- Phantoms cost and lead time are always zero

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Product Planning BOM

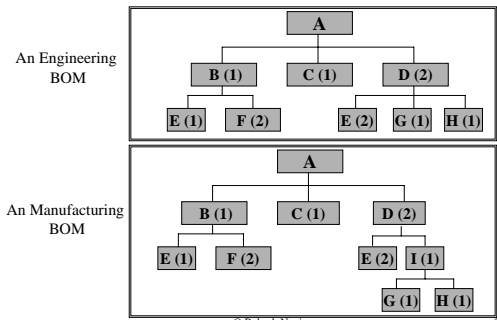


- Phantom items are transparent to MRP. They are completely ignored
- Based on the percentage figures associated with each option (from statistical data from past sales). MRP will generate the appropriate gross requirements
- For example, For 500 'Master Schedule' hair dryers MRP will generate a requirement for 100 200V motors and 400 110 V motors etc

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The Difference Between An Engineering BOM and Manufacturing BOM



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BOM Interfaces With

- **Inventory Control**
 - ◆ Uses part master data to identify inventory items
- **Material Requirements Planning (MRP)**
 - ◆ Uses product structure to translate independent into dependent demand
- **Purchasing and Receiving**
 - ◆ Use part master records to identify items on order, inspection and receipts
- **Shop Floor**
 - ◆ Uses part master records and product structure to monitor progress and completion of fabrication and assembly operations.

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Typical Characteristics Of A Routing

- Note that only manufacturing items may have a routing
- Each routing is identified by a unique routing number
- Necessary records for a routing
 - ◆ Manufacturing division
 - Work station
 - ↳ Group of machines or subdivision
 - ◆ Work center
 - ↳ Machine or assembly facility
 - ◆ Description of operation
 - ◆ Tooling
 - ◆ Labor craft code
 - ◆ Standard labor hours
 - ◆ Labor rates per hour by craft code

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Routing

- *Used for rough cut capacity planning*
- *Incorporates with master schedule for forecasting rough capacity requirement*
- *Detail routings (setup time, moving time, etc) are used for shop floor capacity*

•Assembly line:	#123
•Setup time:	5 hours
•List of tools and fixtures:	
•Tool ---	
•Fixture ---	
.	
.	
•Production rate:	42 assemblies/hr

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Basic Transactions in Inventory Control

- Receipts
 - ‡ Identified by part numbers
 - ‡ Purchased items, Manufacturing items, etc
 - ‡ Tow types:
 - Planned receipts: purchasing, manufacturing, subcontracting orders with vendors or subcontractors
 - Unplanned receipts:
- Issues
 - ‡ Related to raw materials, component parts and assemblies
 - Individual or sets of components for manufacturing or to the customer (finished goods) including shortages
 - ‡ Subtracted from on hand quantity
- Transfers
 - ‡ From one stores location to another or between warehouse

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Basic Transactions in Inventory Control (2)

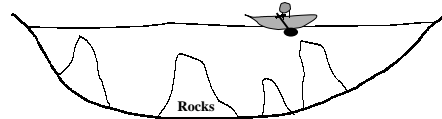
- Scrapping
 - ‡ Disposal of scrap purchased or manufactured items
- Adjustments
 - ‡ For quantities on hand after physical counts
- Reports
 - ‡ ABC class reports with quantities and/or dollar value, rate of consumption per item etc.

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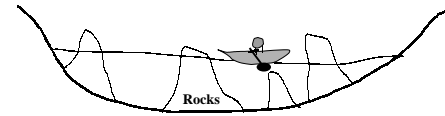
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Impact of Inventory Volume

> A. High Inventories



> B. Low Inventories



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Inventory Control Interfaces

- Provides MRP with on-hand balances to enable the computation of net requirement
- Obtains product structures from BOM to prepare kitting list
- Standard costs are furnished from purchasing and routings to evaluate stock holding
- Purchasing and manufacturing orders are signaled from MRP to prepare for upcoming receipts and issues respectively
- Completed manufacturing orders from Shop Floor Control module are received and closed

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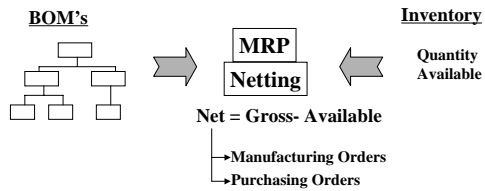
Material Requirements Planning (MRP)

- Basic Functions
 - ‡ The right parts
 - Identified in the BOM module
 - ‡ The right quantities
 - Identified in the BOM module, and then compares to the on-hand quantities held in inventory control
 - ‡ The right timing
 - Calculated within MRP, based on purchasing and manufacturing lead times held in the BOM/Routings module

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Material Requirements Planning



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Material Requirements Planning (MRP)

Example of MRP page 76, 77, and 78

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Regenerative MRP

- Regenerates all requirements
 - All material requirements are regenerated once every planning period (usually a week)
 - All previous plans are erased and replaced by new one
 - Several parts are planned although there has not been changed in their plans

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Net Change MRP

- A Transaction Driven System
 - Updates the changed data
 - Only those parts needing re-planning are affected
 - Computer processing time is significantly reduced
 - More frequent run is required

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Selection Criteria for Net Change and Regenerative MRP

- A Net Change System is best for:
 - Complicated product designs
 - Short production runs for many products
 - Frequent design changes
 - Unstable purchased part supplies
- A Regenerative System is best for:
 - Simple product designs
 - Long and stable production runs
 - few design changes
 - Stable purchased item supplies

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Key Points In MRP

- Maintain accurate data input
 - Forecasts, orders, on hand balances, and routing
- Proper treatment of expedited orders
 - e.g., the addition of extra resources
- Close collaboration between marketing and manufacturing
- Proper shop floor feed back and tracking
- Early notification of changes

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Fundamental Requirements To Successful Run MRP

- Absolute accuracy in Bill of Materials
- Design changes timely recorded together with their effectively start dates
- Accurate inventory records
- Accurate routings and purchasing records
- Full understanding of the system's algorithms and logic

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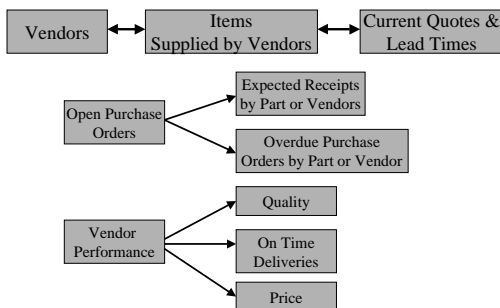
Purchasing

- Vendor information management
 - Retrieval by vendor number or name
 - Should get vendor record to evaluate
- Vendor/item cross reference
 - Price quotations, discounts and lead times should be available
 - Used by the receiving module for part recognition
- Purchase orders management
 - Vendor selection, order release, purchase order history, etc
- Vendor performance
 - Basic criteria
 - Quality of products supplied, On-time deliveries, price competitiveness, etc.

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Purchasing Module



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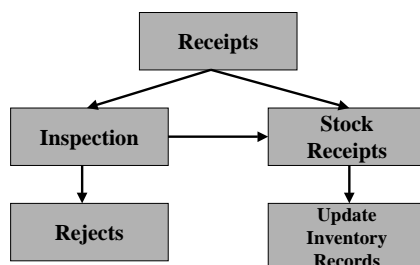
Receiving

- Material Receipts
 - Material recognition and count for purchase receipts
 - Matching with purchase or manufacturing orders
- Material transfers
- Order Closing and Interfaces
 - MRP, Purchasing and Shop Floor Control are notified and the appropriate records are updated
 - Updates stock quantities
- Updates MRP, Shop floor control, inventory control, etc

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Receiving Module



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Shop Floor Control

- Fundamental Functions
 - Input of manufacturing orders from MRP and execution
 - Maintenance of work-center and labor data
 - Capacity planning and control
 - Capacity over/under loading detection and reporting back to MS and MRP for rescheduling
 - Manufacturing order status reporting
 - Manufacturing order closing and reporting to MRP

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