Introduction to Operations Management
运营管理概论

3- Planning

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Planning Flow

Capacity Planning
(Long term; years)
Changes in Facilities
Changes in Equipment

Capacity Plan for New Facilities
Adjust capacity to the demand suggested by strategic plan

Aggregate Planning
(Intermediate term; quarterly or monthly)
Facility utilization
Personnel changes
Subcontracting

Aggregate Production Plan for All Bikes
(Determine personnel or subcontracting necessary to match aggregate demand to existing facilities/capacity)

Month	1	2
Bike Production	800	850

Master Schedule
(Intermediate term; weekly)
Material requirements planning
Disaggregate the aggregate plan

Master Production Schedule for Bike Models
(Determine weekly capacity schedule)

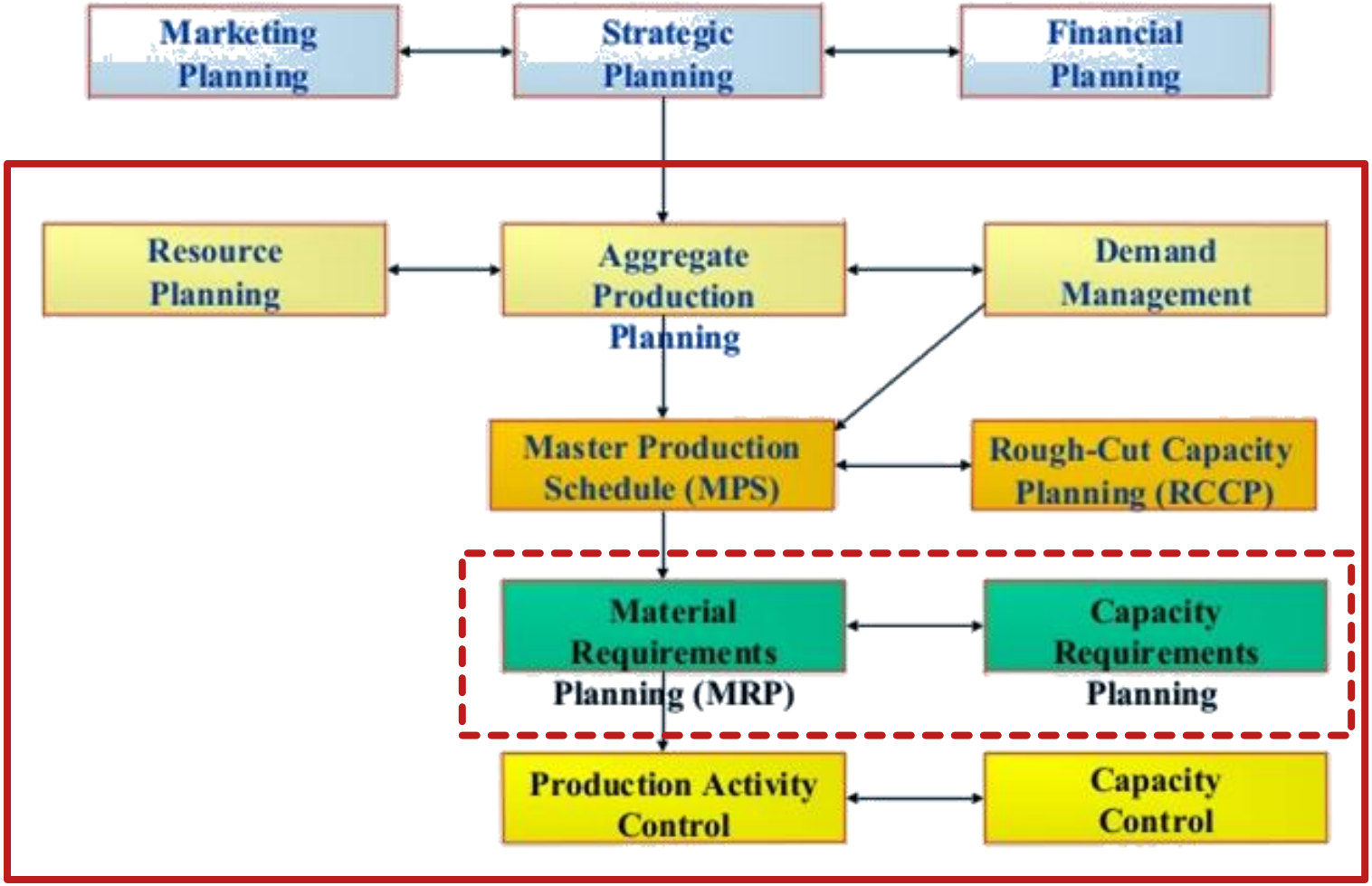
	Month 1				Month 2			
Week	1	2	3	4	5	6	7	8
Model 22		200		200		200		200
Model 24	100		100		150		100	
Model 26	100		100		100		100	

Short Term Scheduling
(Short term; days, hours, minutes)
Work center loading
Job sequencing/dispatching

Work Assigned to Specific Personnel and Work Centers
Make finite capacity schedule by matching specific tasks to specific people and machines

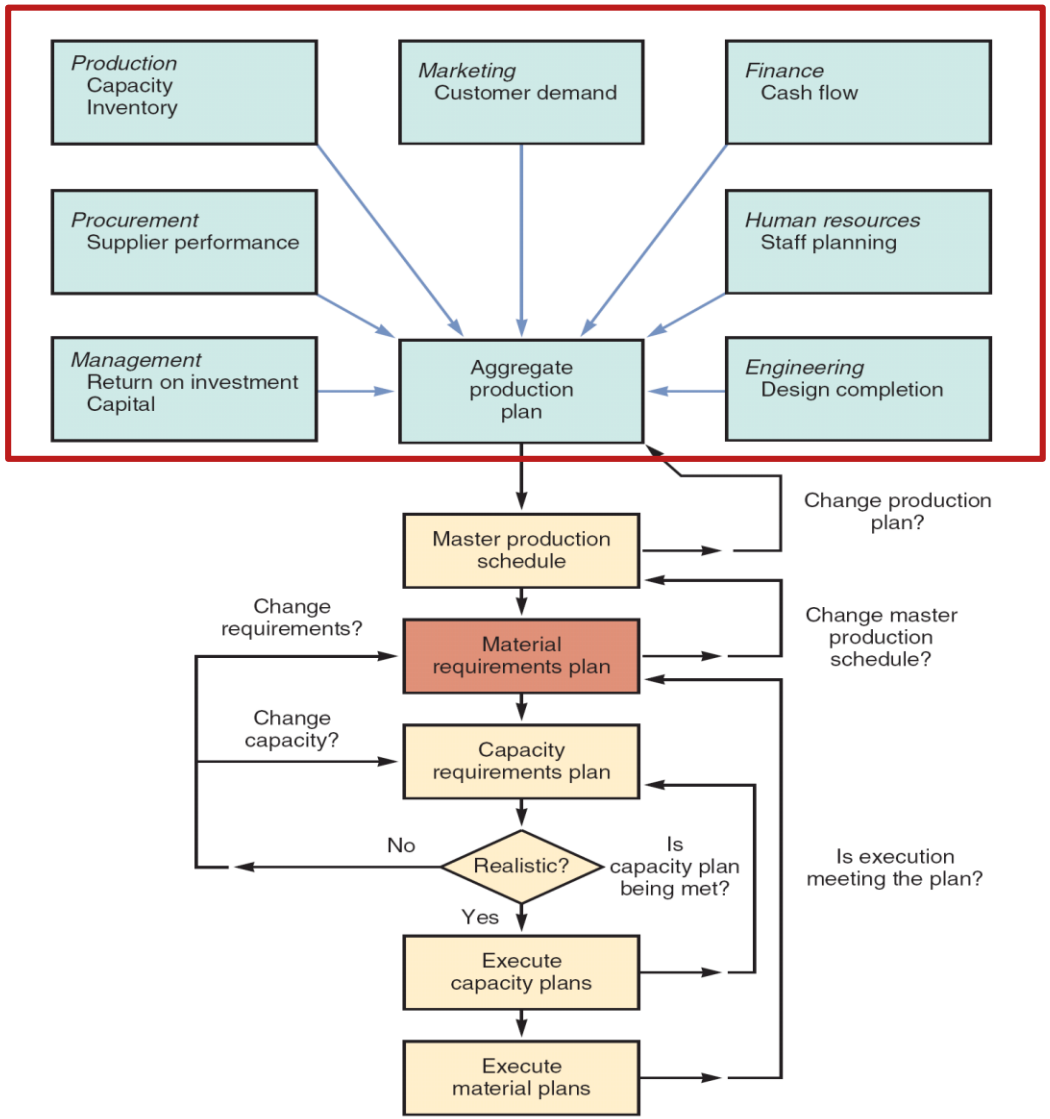
Assemble Model 22 in work center 6

MRP, Closed Loop MRP, MPR II



The Planning Process

Sales & operations planning



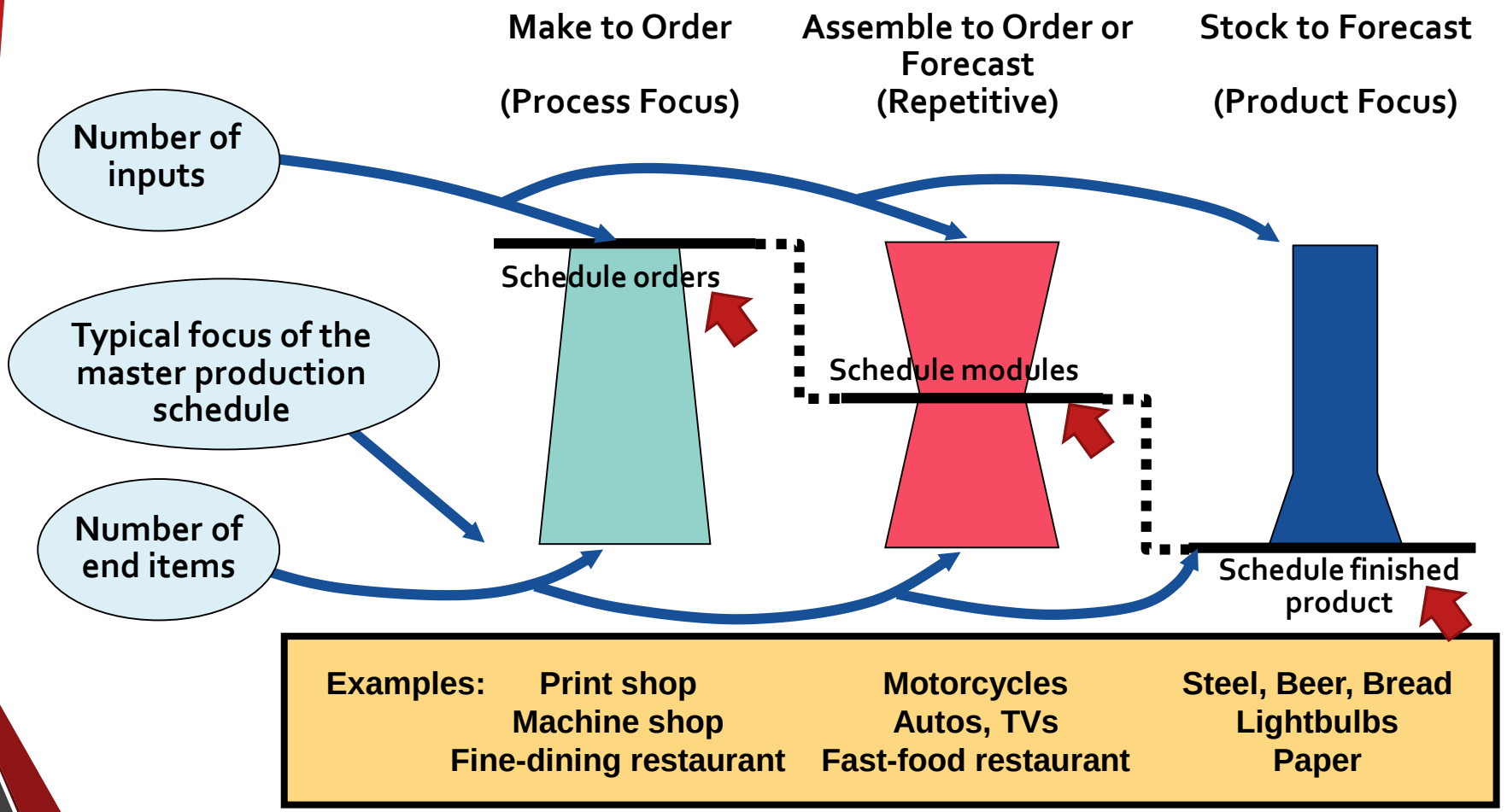
Master Production Schedule (MPS)

- Specifies **what** is to be made and **when**
- Must be in accordance with the aggregate production plan
- Inputs from financial plans, customer demand, engineering, supplier performance
- As the process moves from planning to execution, each step must be tested for **feasibility**
- The MPS is the result of the **production planning process**
- MPS is established in terms of **specific products**
- Schedule must be followed for a reasonable length of time
- The MPS is quite often **fixed or frozen** in the near term part of the plan
- The MPS is a **rolling schedule**
- The MPS is a **statement of what is to be produced, not a forecast of demand**

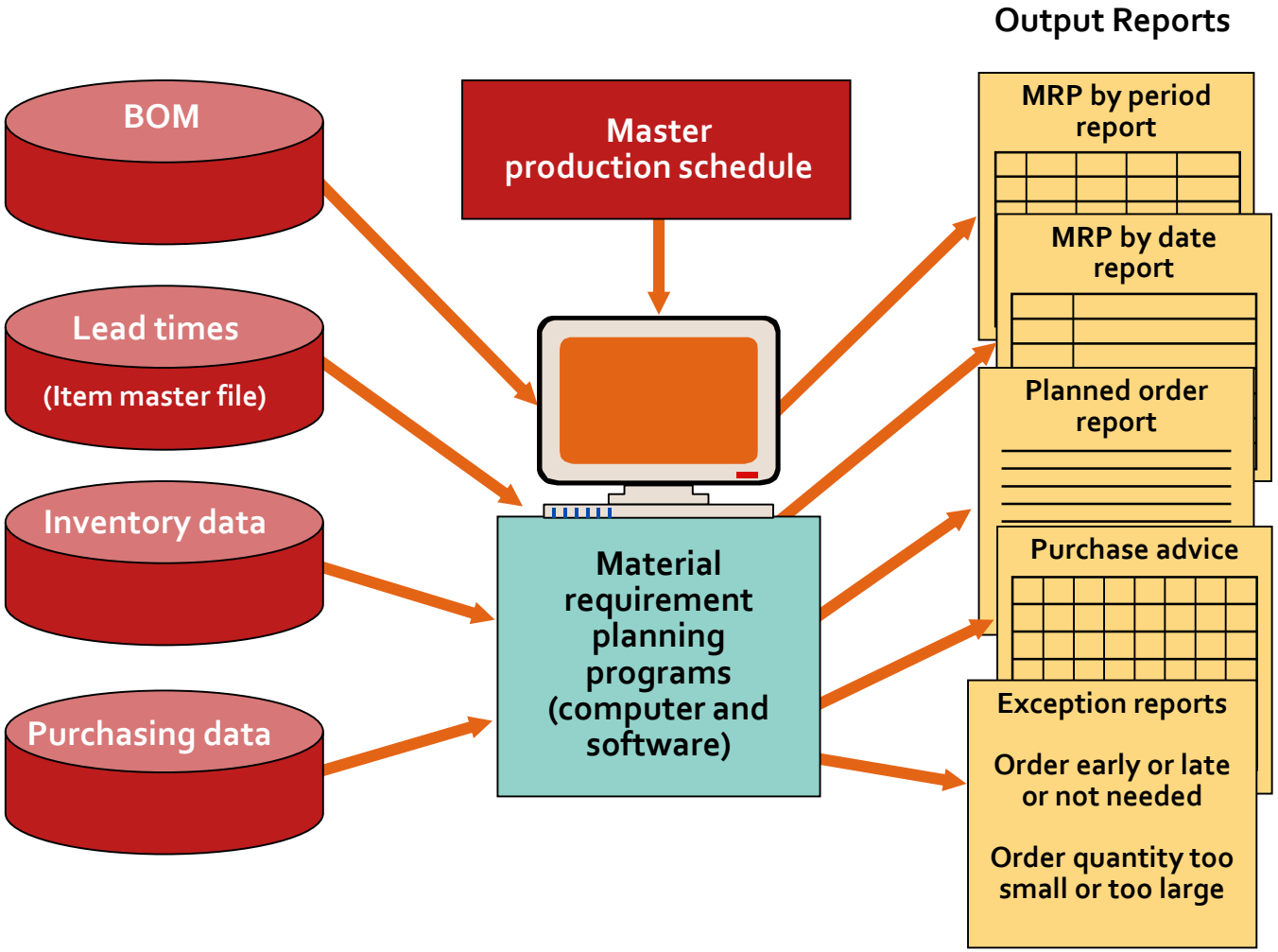
Aggregate Production Plan VS MPS

Months	January				February			
Aggregate Production Plan (Shows the total quantity of amplifiers)	1,500				1,200			
Weeks	1	2	3	4	5	6	7	8
Master Production Schedule (Shows the specific type and quantity of amplifier to be produced								
240-watt amplifier	100		100		100		100	
150-watt amplifier		500		500		450		450
75-watt amplifier			300				100	

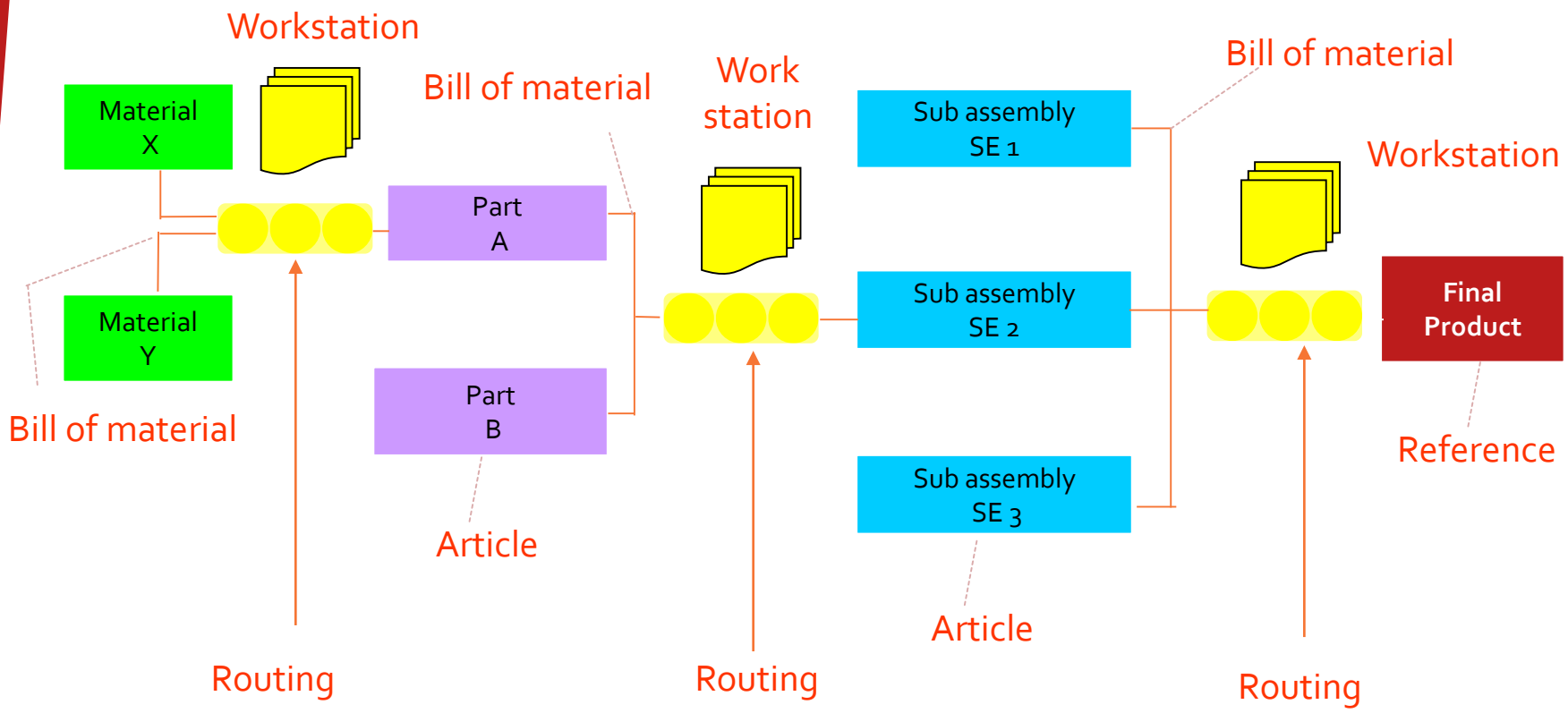
Focus for Different Process Strategies



MRP Structure

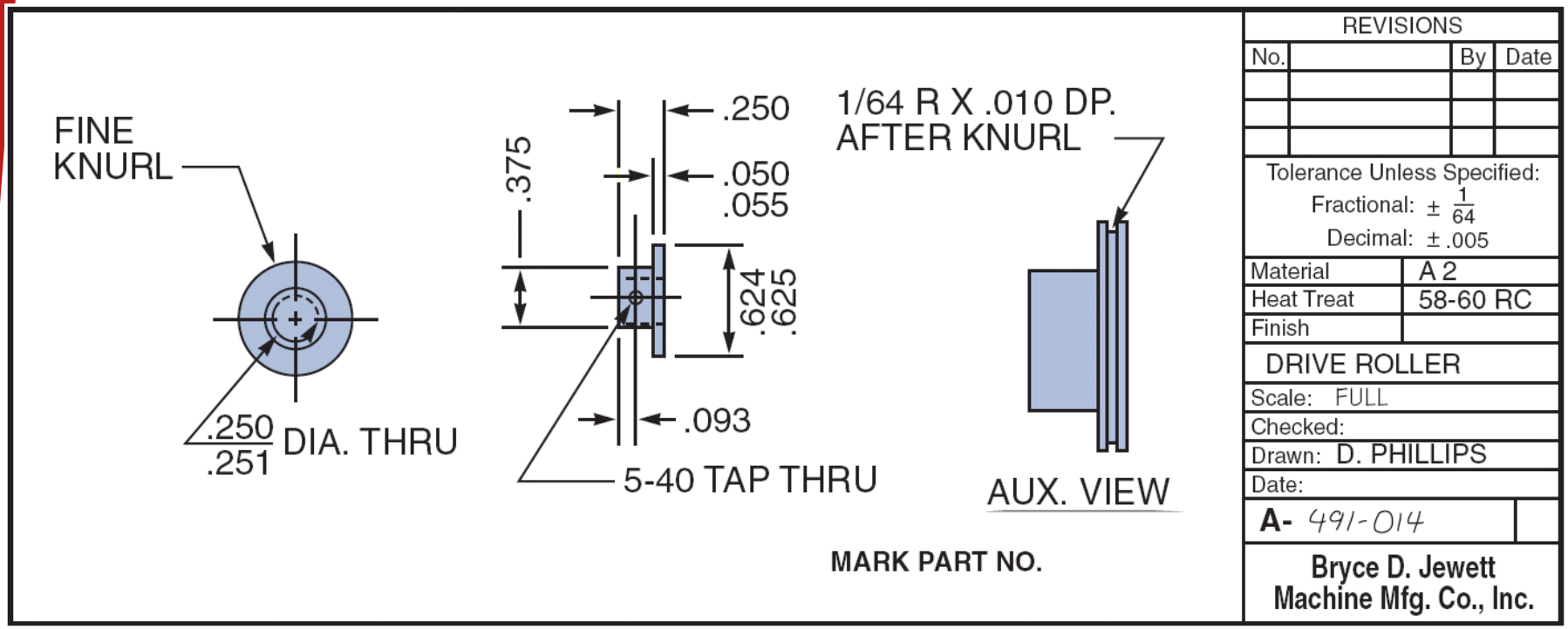


Technical data

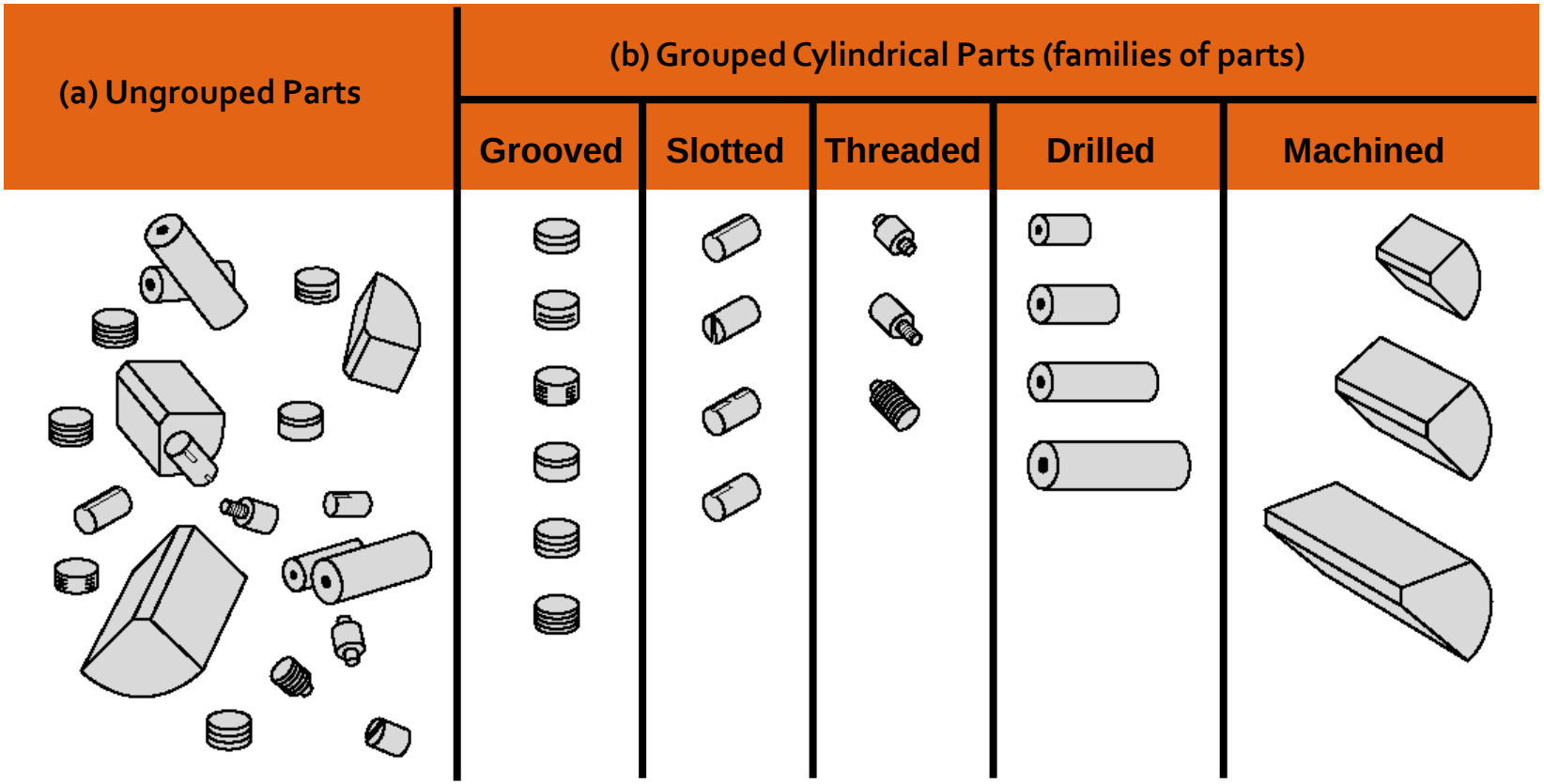


- What for?
- From which material?
- How?
- Who, on which machine?

Engineering Drawings

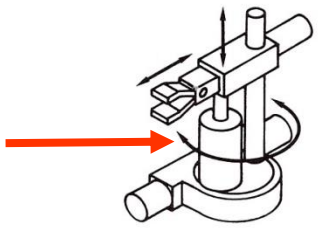


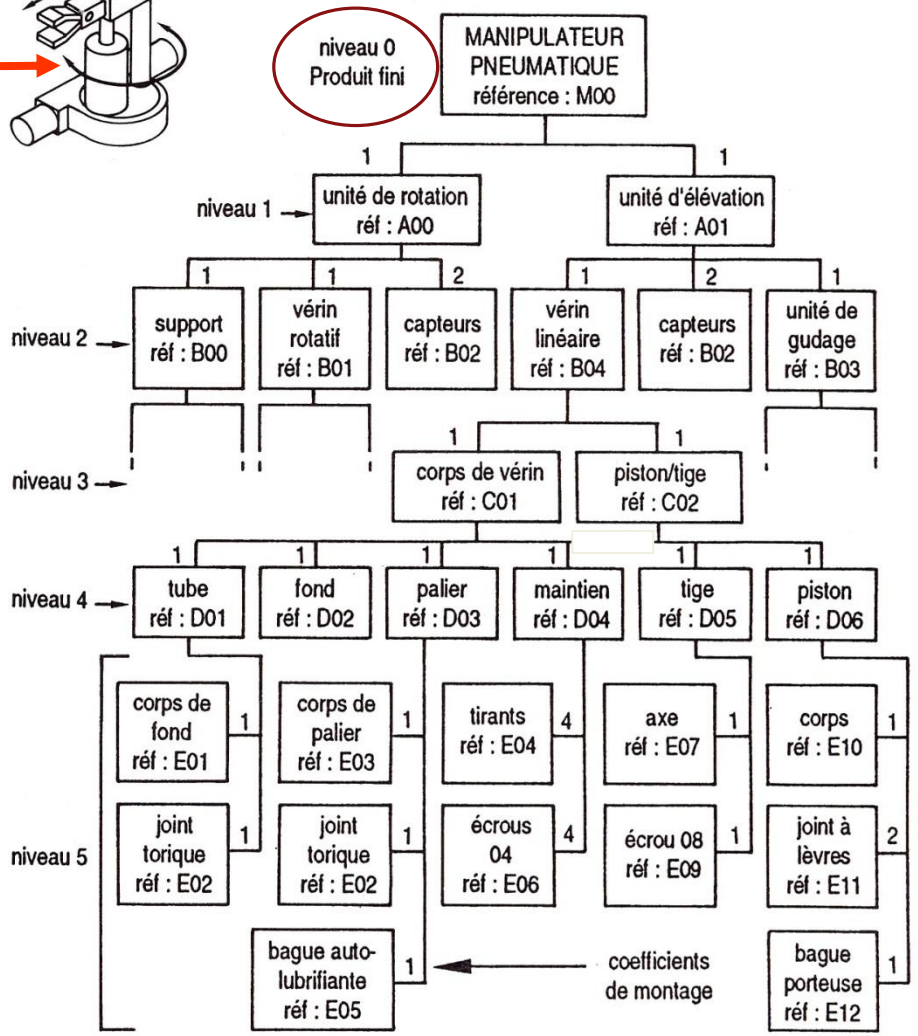
Group Technology Scheme



Multi level Bill of Material

Finished product

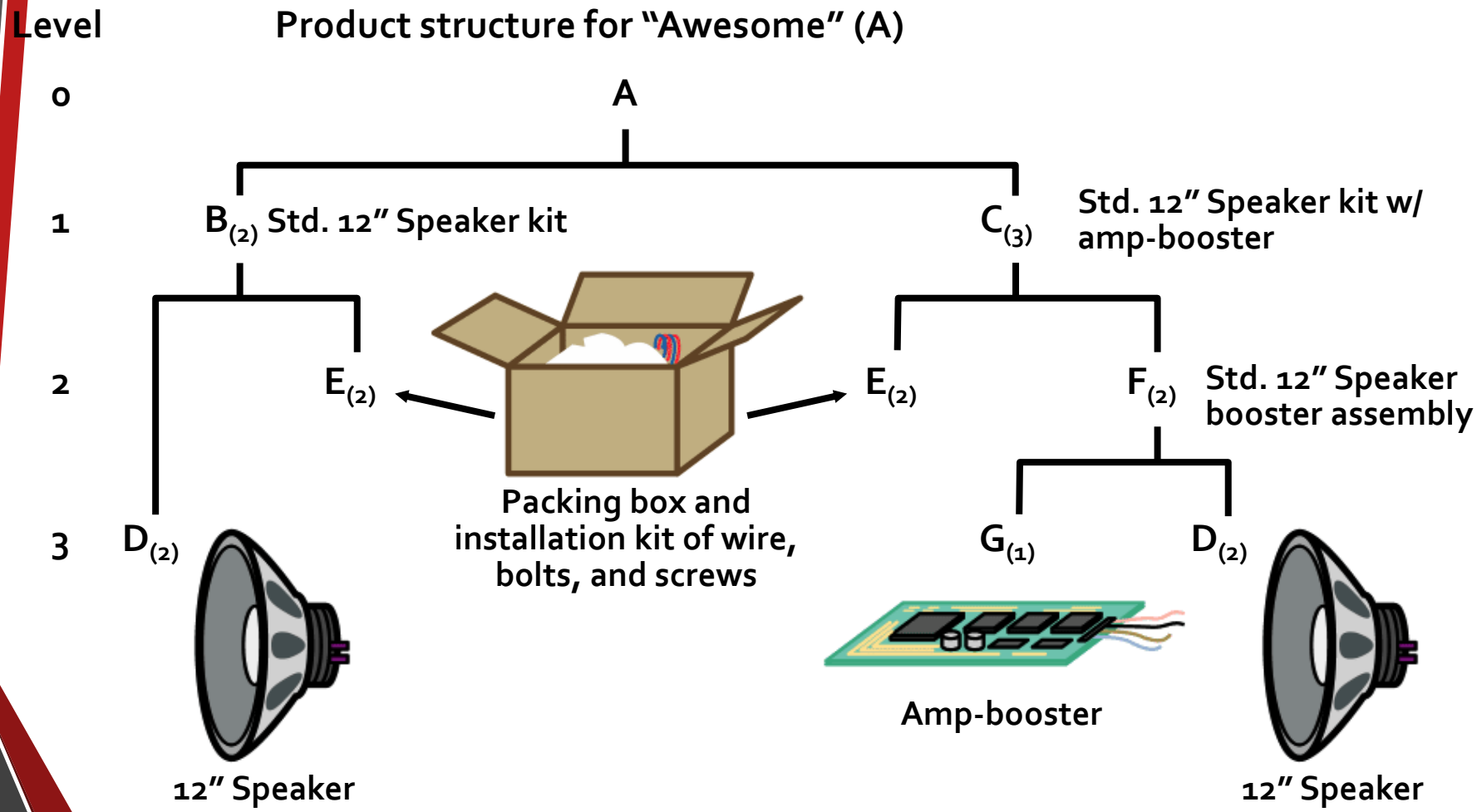




Bills of Material

- List of components, ingredients, and materials needed to make product
- Provides product structure
  - Items above given level are called parents
  - Items below given level are called children

BOM Example


Level
Product structure for "Awesome" (A)
0
A
1
B(2) Std. 12" Speaker kit
C(3)
Std. 12" Speaker kit w/ amp-booster
2
E(2)
E(2)
F(2)
Std. 12" Speaker booster assembly
3
D(2)
Packing box and installation kit of wire, bolts, and screws
G(1)
D(2)
Amp-booster
12" Speaker
12" Speaker

BOM Example

Level

Product structure for "Awesome" (A)

0

1

2

3 D

Part B:	2 x number of As =	(2)(50) =	100
Part C:	3 x number of As =	(3)(50) =	150
Part D:	2 x number of Bs		
	+ 2 x number of Fs =	(2)(100) + (2)(300) =	800
Part E:	2 x number of Bs		
	+ 2 x number of Cs =	(2)(100) + (2)(150) =	500
Part F:	2 x number of Cs =	(2)(150) =	300
Part G:	1 x number of Fs =	(1)(300) =	300

12" Speaker

Amp-booster

12" Speaker

Bills of Material

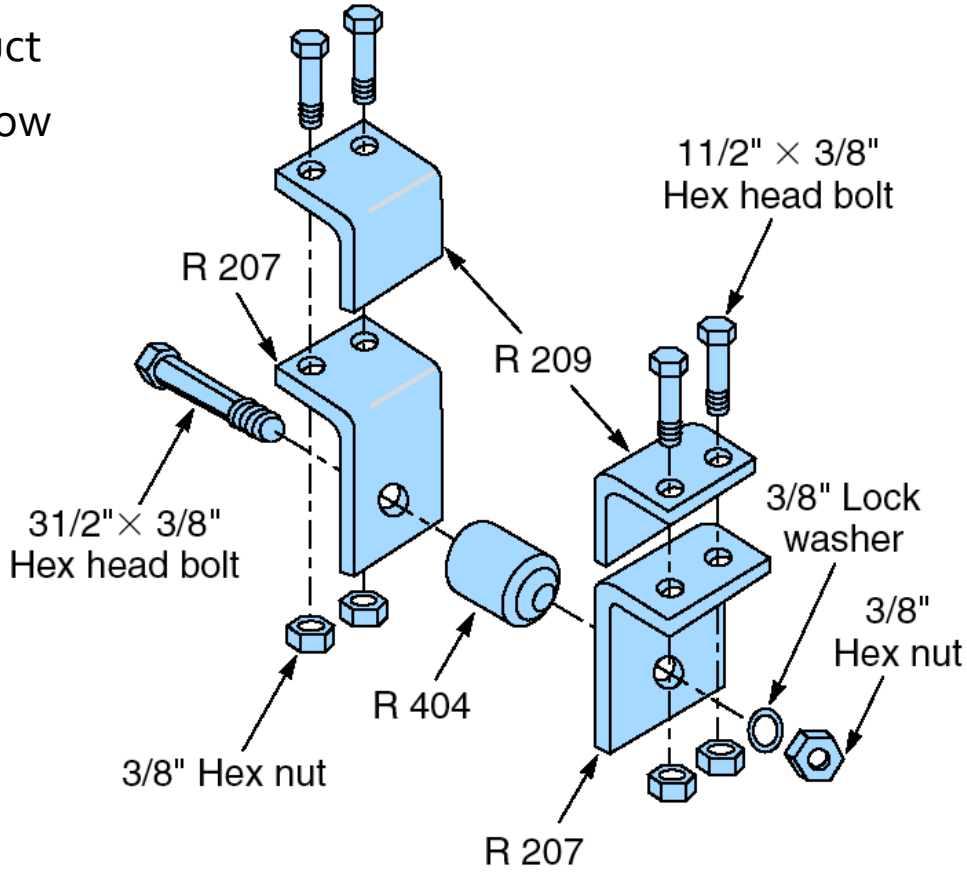
- **Modular Bills**
  - Modules are not final products but components that can be assembled into multiple end items
  - Can significantly simplify planning and scheduling
- **Planning Bills**
  - Also called "pseudo" or super bills
  - Created to assign an artificial parent to the BOM
  - Used to group subassemblies to reduce the number of items planned and scheduled
  - Used to create standard "kits" for production
- **Phantom Bills**
  - Describe subassemblies that exist only temporarily
  - Are part of another assembly and never go into inventory
- **Low-Level Coding**
  - Item is coded at the lowest level at which it occurs
  - BOMs are processed one level at a time

Accurate Records

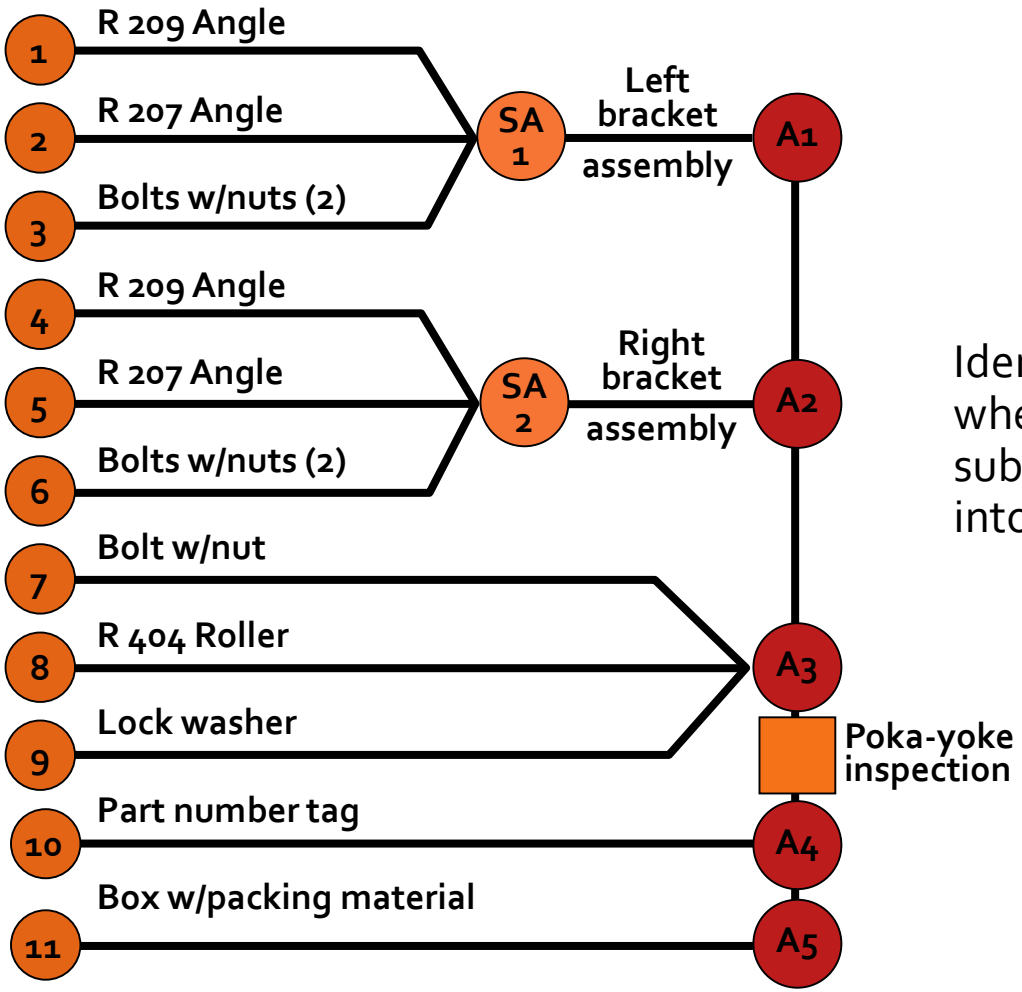
- **Accurate inventory records are absolutely required for MRP (or any dependent demand system) to operate correctly**
- **Generally MRP systems require more than 99% accuracy**
- **Outstanding purchase orders must accurately reflect quantities and scheduled receipts**

Assembly Drawing

- Shows exploded view of product
- Details relative locations to show how to assemble the product



Assembly Chart



Identifies the point of production where components flow into subassemblies and ultimately into the final product

Route Sheet

Lists the operations and times required to produce a component

Process	Machine	Operations	Setup Time	Operation Time/Unit
1	Auto Insert 2	Insert Component Set 56	1.5	.4
2	Manual Insert 1	Insert Component Set 12C	.5	2.3
3	Wave Solder	Solder all components to board	1.5	4.1
4	Test 4	Circuit integrity test 4GY	.25	.5

Work Order

Instructions to produce a given quantity of a particular item, usually to a schedule

Work Order			
Item	**Quantity**	**Start Date**	**Due Date**
157C	125	5/2/08	5/4/08
Production Dept		**Delivery Location**	
F32		Dept K11	

Lead Times

- **The time required to purchase, produce, or assemble an item**
  - **For production – the sum of the order, wait, move, setup, store, and run times**
  - **For purchased items – the time between the recognition of a need and the availability of the item for production**

Time-Phased Product Structure

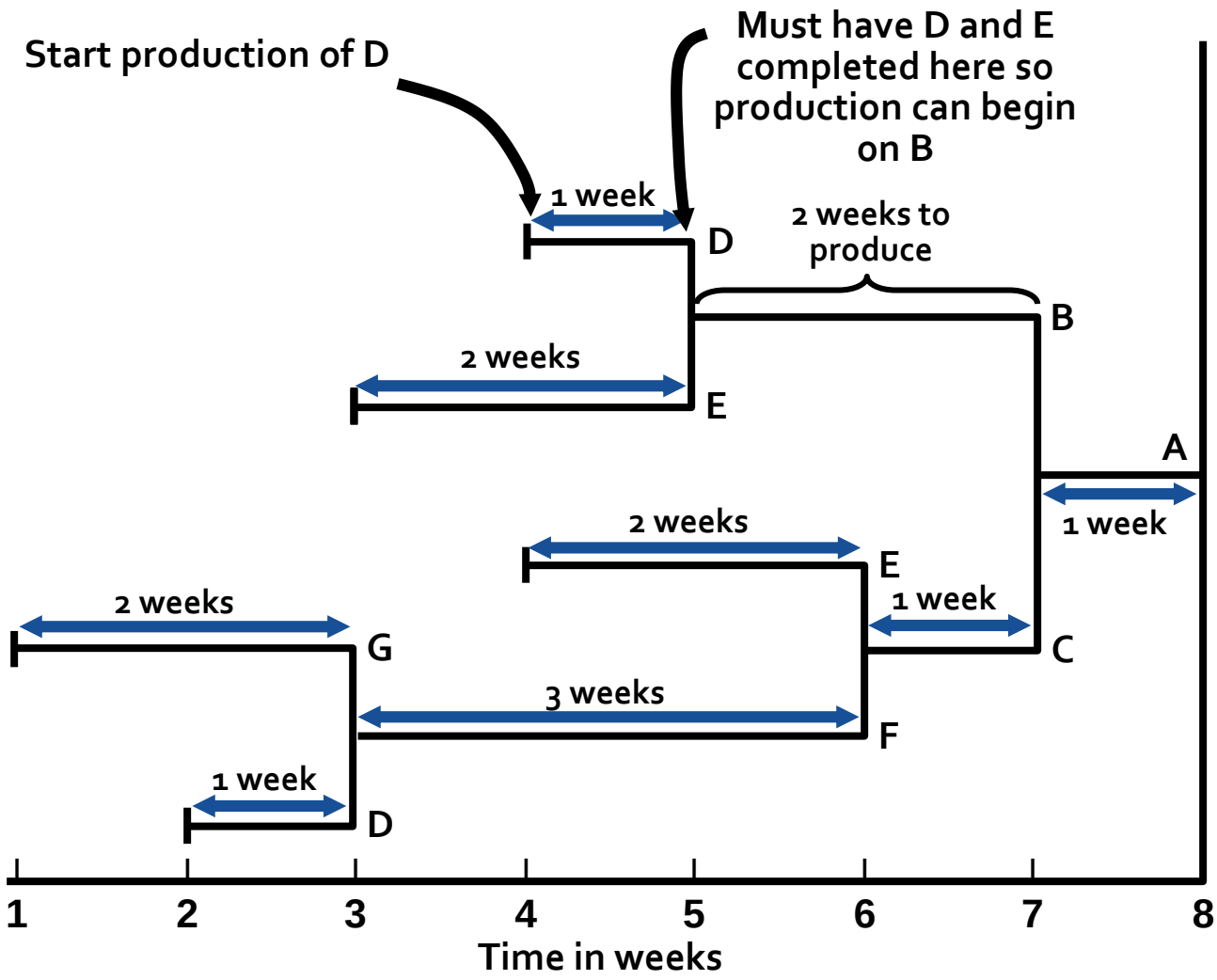


Figure 14.4

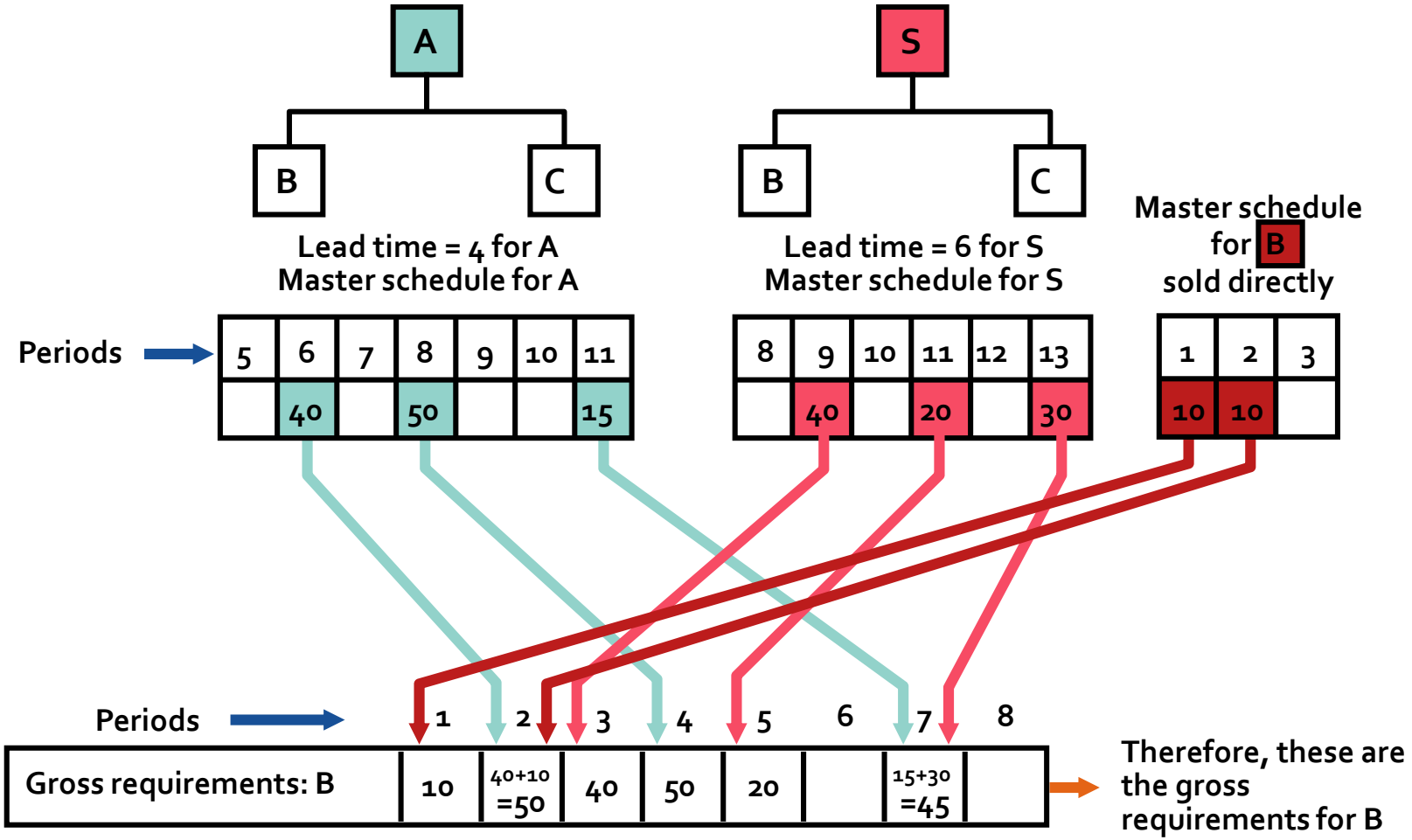
Determining Gross Requirements

- Starts with a production schedule for the end item
- Using the lead time for the item, determine the week in which the order should be released

➢ This step is often called "lead time offset" or "time phasing"

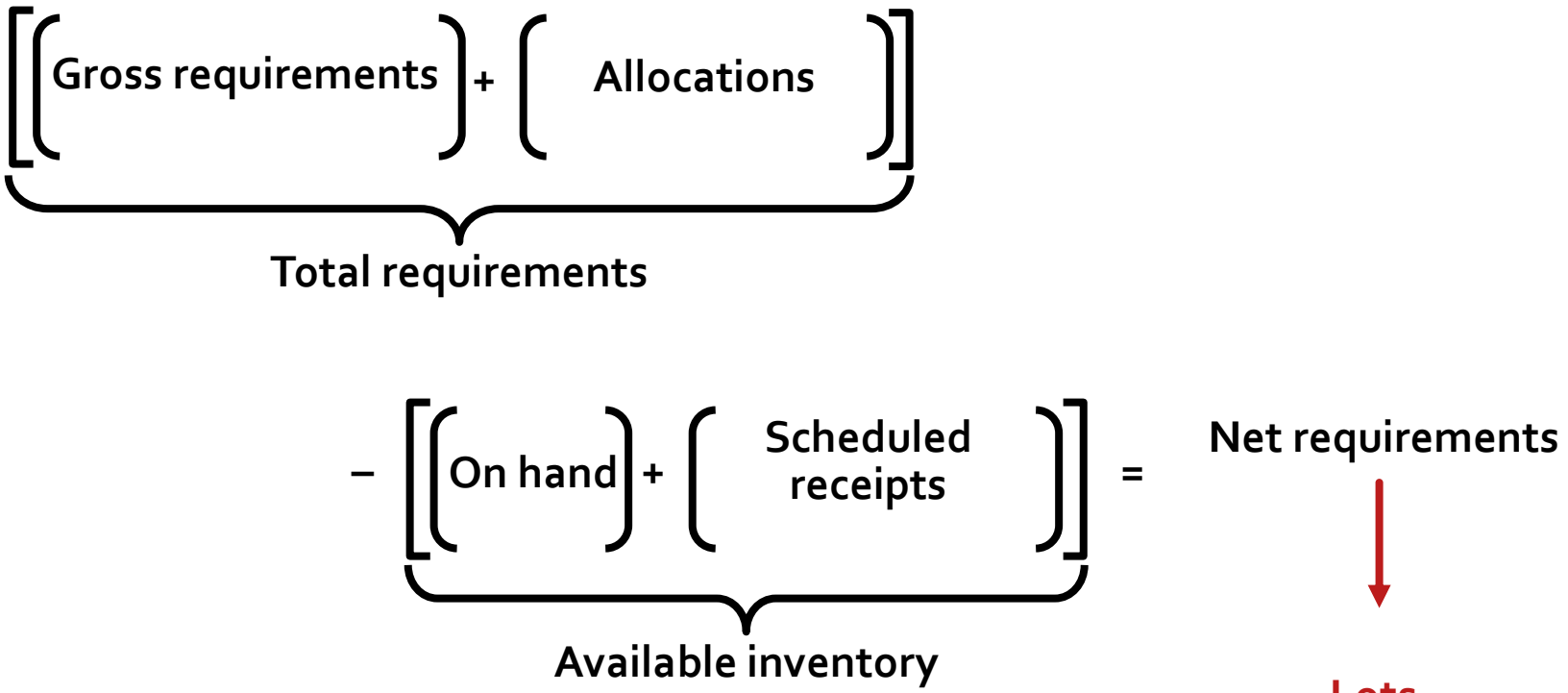
- The process continues through the entire BOM one level at a time – often called "explosion"
- By processing the BOM by level, items with multiple parents are only processed once, saving time and resources and reducing confusion
- Low-level coding ensures that each item appears at only one level in the BOM

Gross Requirements Schedule



Net Requirements Plan

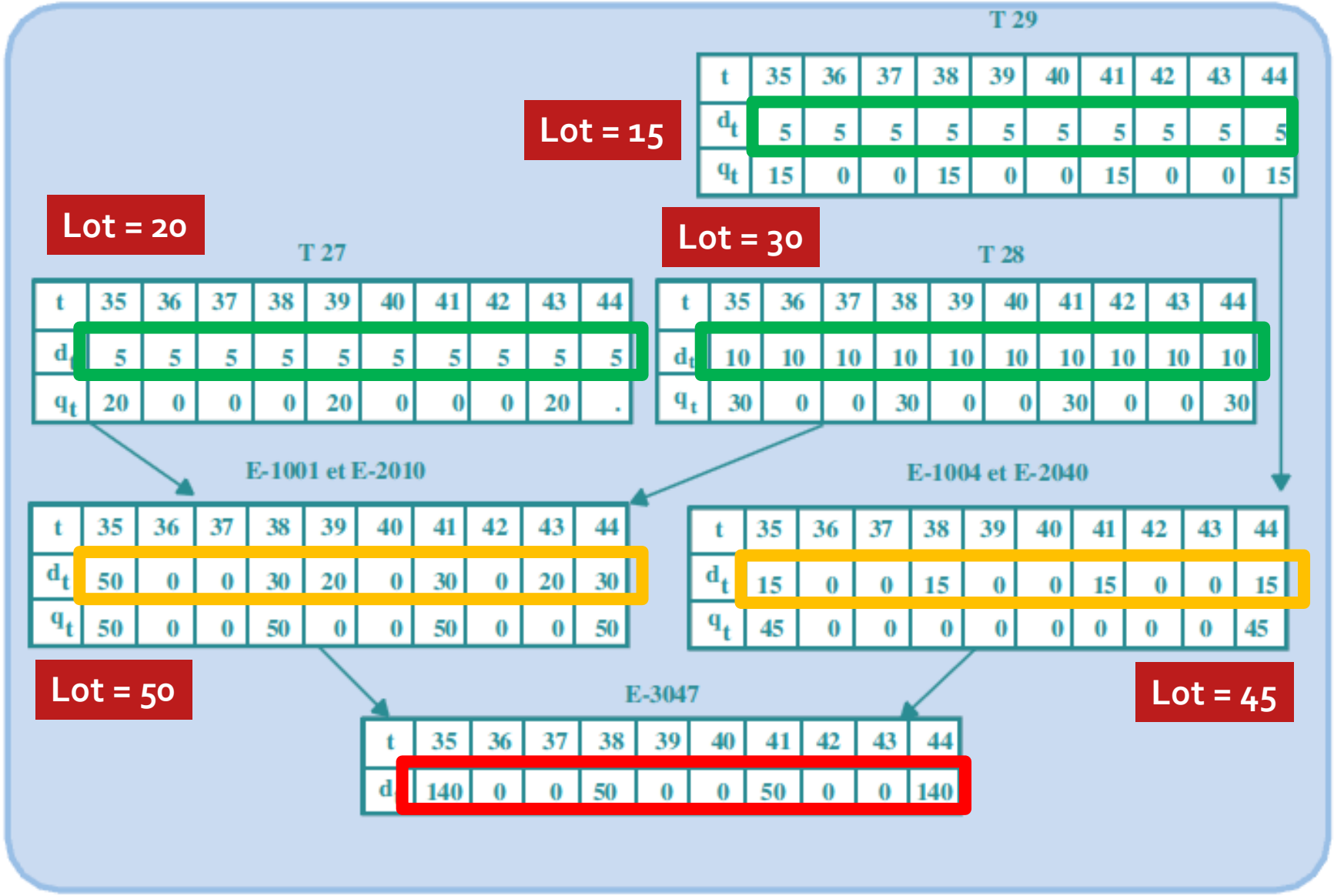
The logic of net requirements



MRP Management

- MRP is a dynamic system
- Facilitates replanning when changes occur
  - Regenerating
  - Net change
- **System nervousness can result from too many changes**
- **Time fences** put limits on replanning (**frozen, slushy, liquid**)
- **Pegging** links each item to its parent allowing effective analysis of changes
- BOMs, inventory records, purchase and production quantities may not be perfect
  - Consideration of **safety stock** may be prudent
  - Should be minimized and ultimately eliminated
  - Typically built into projected on-hand inventory

Bullwhip effect



t	35	36	37	38	39	40	41	42	43	44
d_t	5	5	5	5	5	5	5	5	5	5
q_t	15	0	0	15	0	0	15	0	0	15

t	35	36	37	38	39	40	41	42	43	44
d	5	5	5	5	5	5	5	5	5	5
q_t	20	0	0	0	20	0	0	0	20	.

t	35	36	37	38	39	40	41	42	43	44
d_t	10	10	10	10	10	10	10	10	10	10
q_t	30	0	0	30	0	0	30	0	0	30

t	35	36	37	38	39	40	41	42	43	44
d_t	50	0	0	30	20	0	30	0	20	30
q_t	50	0	0	50	0	0	50	0	0	50

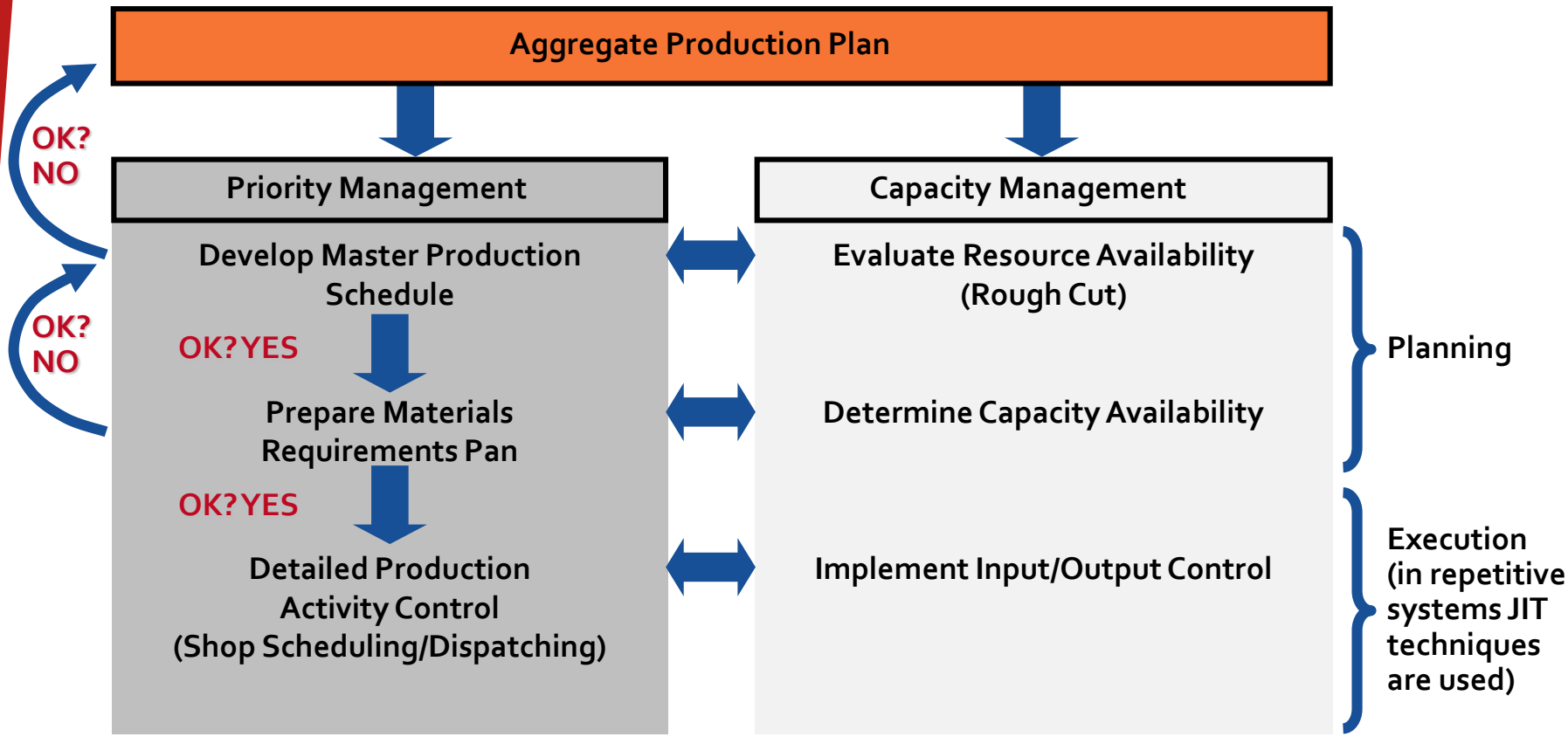
t	35	36	37	38	39	40	41	42	43	44
d_t	15	0	0	15	0	0	15	0	0	15
q_t	45	0	0	0	0	0	0	0	0	45

t	35	36	37	38	39	40	41	42	43	44
d	140	0	0	50	0	0	50	0	0	140

Extensions of MRP

- **MRP II**
- **Closed-Loop MRP**
  - **MRP system provides input to the capacity plan, MPS, and production planning process**
- **Capacity Planning**
  - **MRP system generates a load report which details capacity requirements**
  - **This is used to drive the capacity planning process**
  - **Changes pass back through the MRP system for rescheduling**

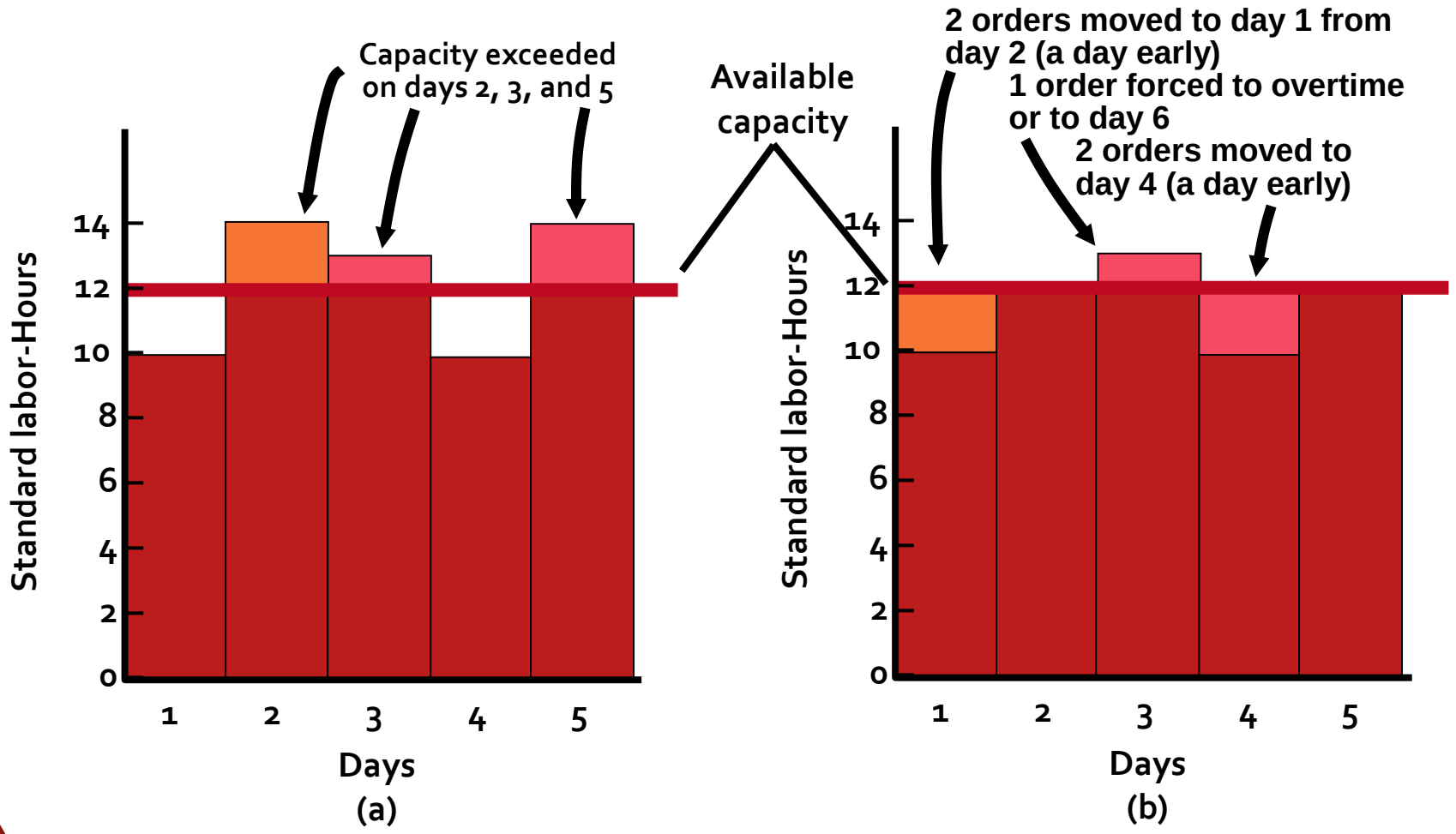
Closed-Loop MRP System



Smoothing Tactics

1. **Anticipation**
   - Sends part of the work before the original scheduled date if capacity is available
   - Increases inventory, reduces overload
2. **Overlapping**
   - Sends part of the work to following operations before the entire lot is complete
   - Reduces lead time
3. **Operations splitting**
   - Sends the lot to two different machines for the same operation
   - Shorter throughput time but increased setup costs
4. **Order or lot splitting**
   - Breaking up the order into smaller lots and running part earlier (or later) in the schedule

Order Splitting

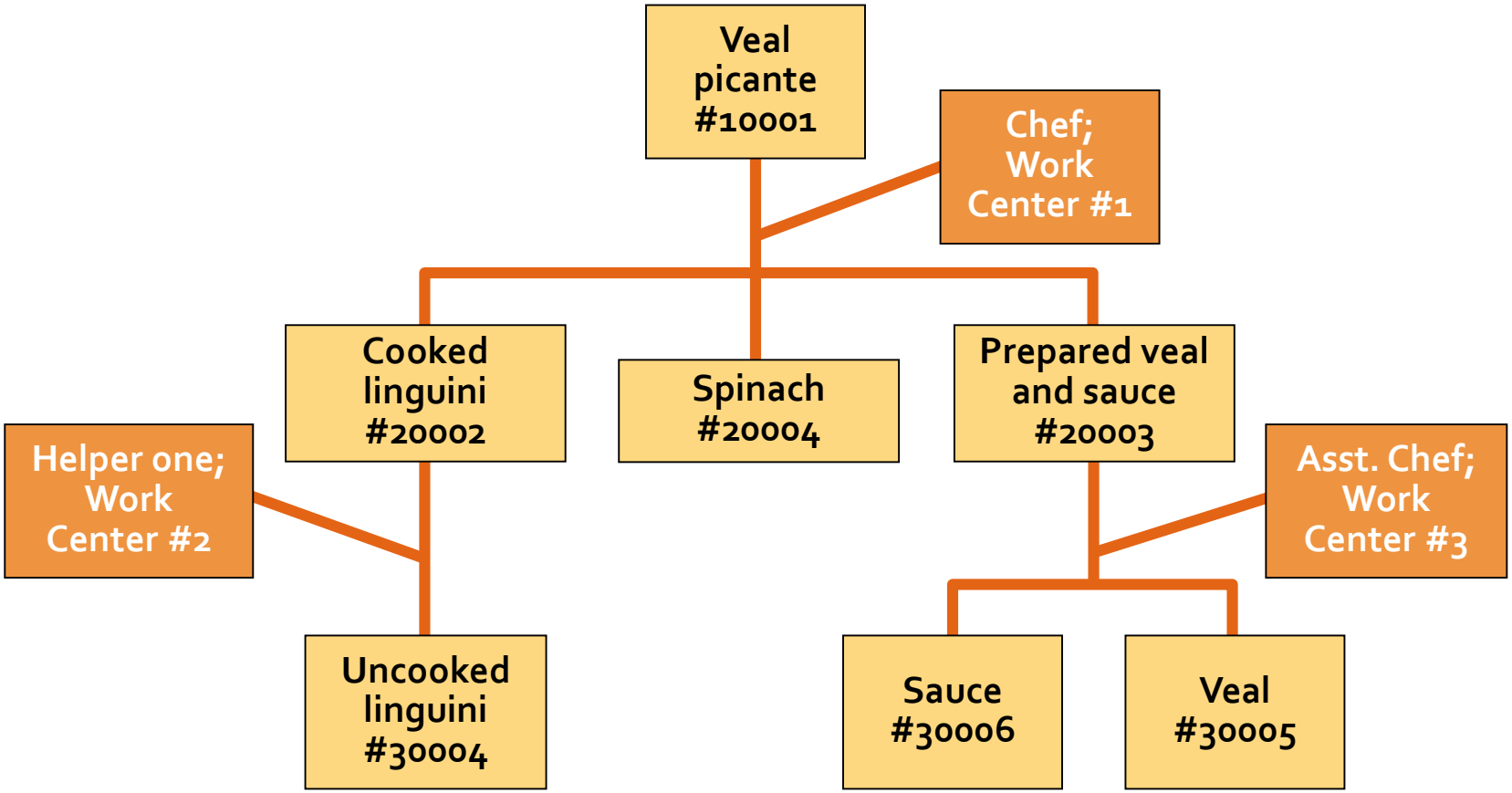


MRP in Services

- **Some services or service items are directly linked to demand for other services**
- **These can be treated as dependent demand services or items**
  - **Restaurants**
  - **Hospitals**
  - **Hotels**

MRP in Services

(a) PRODUCT STRUCTURE TREE



MRP in Services

(b) BILL OF MATERIALS

Part Number	Description	Quantity	Unit of Measure	Unit cost
10001	Veal picante	1	Serving	—
20002	Cooked linguini	1	Serving	—
20003	Prepared veal and sauce	1	Serving	—
20004	Spinach	0.1	Bag	0.94
30004	Uncooked linguini	0.5	Pound	—
30005	Veal	1	Serving	2.15
30006	Sauce	1	Serving	0.80

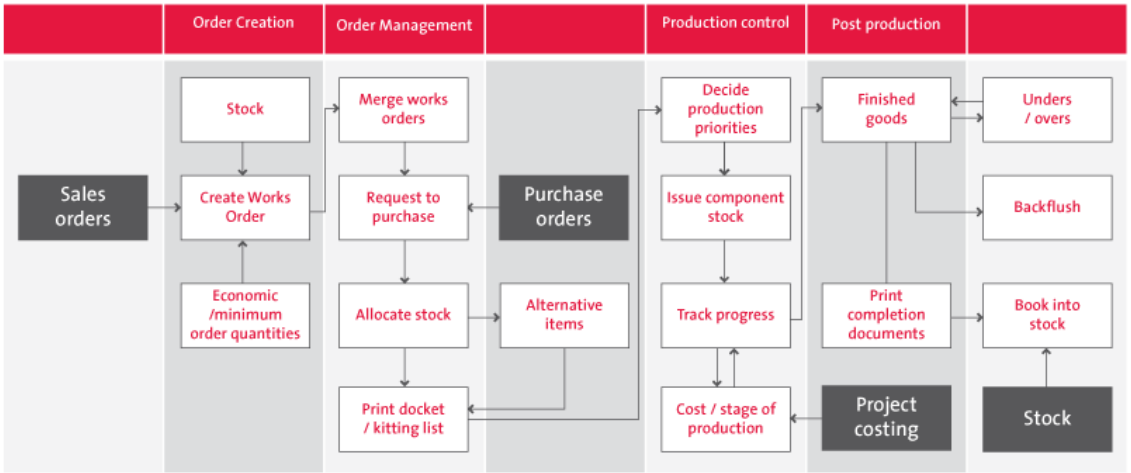
MRP in Services

(c) BILL OF LABOR FOR VEAL PICANTE

Work Center	Operation	Labor Type	Labor Hours	
			Setup Time	Run Time
1	Assemble dish	Chef	.0069	.0041
2	Cook linguini	Helper one	.0005	.0022
3	Cook veal and sauce	Assistant Chef	.0125	.0500

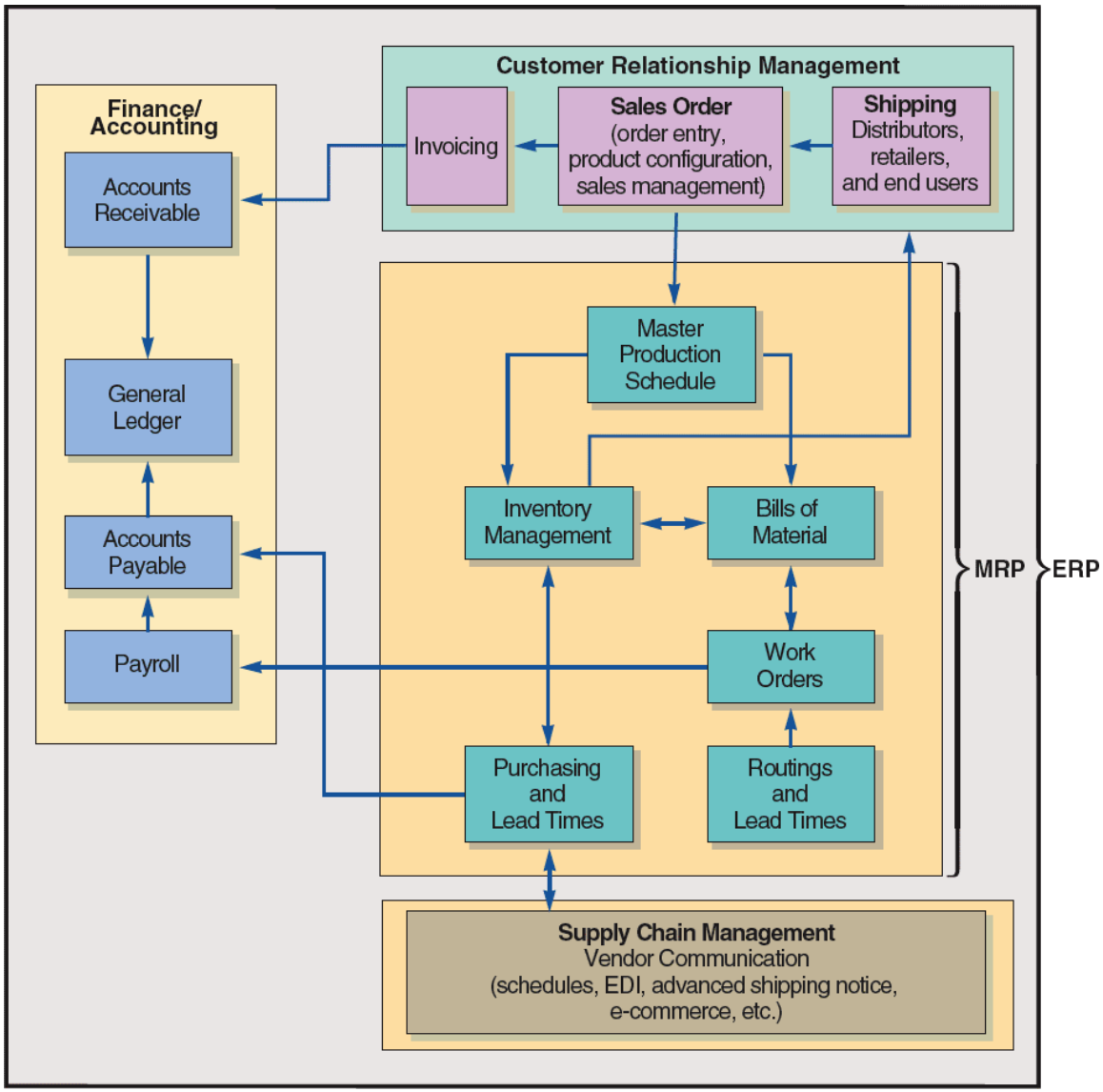
Enterprise Resource Planning (ERP)

- MRP II uses a LOT of product related information, leading to orders and thus a LOT of financial information



- ERP modules include
  - Basic MRP
  - Finance
  - Human resources
  - Supply chain management (SCM)
  - Customer relationship management (CRM)

ERP and MRP


Customer Relationship Management
Invoicing
Sales Order
(order entry,
product configuration,
sales management)
Shipping
Distributors,
retailers,
and end users
Finance/
Accounting
Accounts
Receivable
General
Ledger
Accounts
Payable
Payroll
Master
Production
Schedule
Inventory
Management
Bills of
Material
Work
Orders
Purchasing
and
Lead Times
Routings
and
Lead Times
MRP
ERP
Supply Chain Management
Vendor Communication
(schedules, EDI, advanced shipping notice,
e-commerce, etc.)

SAP's ERP Modules

CASH TO CASH

Covers all financial related activity:

- Accounts receivable
- Accounts payable
- General ledger
- Treasury
- Cash management
- Asset management

PROMOTE TO DELIVER

Covers front-end customer-oriented activities:

- Marketing
- Quote and order processing
- Transportation
- Documentation and labeling
- After sales service
- Warranty and guarantees

DESIGN TO MANUFACTURE

Covers internal production activities:

- Design engineering
- Production engineering
- Plant maintenance
- Shop floor reporting
- Contract/project management
- Subcontractor management

RECRUIT TO RETIRE

Covers all HR- and payroll-oriented activity:

- Time and attendance
- Travel and expenses
- Payroll

PROCURE TO PAY

Covers sourcing activities:

- Vendor sourcing
- Purchase requisitioning
- Purchase ordering
- Purchase contracts
- Inbound logistics
- Supplier invoicing/matching
- Supplier payment/ settlement
- Supplier performance

DOCK TO DISPATCH

Covers internal inventory management:

- Warehousing
- Distribution planning
- Forecasting
- Replenishment planning
- Physical inventory
- Material handling

Advantages of ERP Systems

1. Provides integration of the supply chain, production, and administration
2. Creates commonality of databases
3. Can incorporate improved best processes
4. Increases communication and collaboration between business units and sites
5. Has an off-the-shelf software database
6. May provide a strategic advantage

Disadvantages of ERP Systems

1. Is very expensive to purchase and even more so to customize
2. Implementation may require major changes in the company and its processes
3. Is so complex that many companies cannot adjust to it
4. Involves an ongoing, possibly never completed, process for implementation
5. Expertise is limited with ongoing staffing problems