Industrial & Management Engineering Department

Industrial Relations

IM 111

Lecture 4: Production Planning and Control

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Production Planning and Control

- Concerned with the logistics problems in manufacturing:
  - Managing the details of what, when, and how many products to produce.
  - And obtaining the raw materials, parts, and resources to produce them.
- PPC solves these logistics problems by managing information.
- PPC is the integrator in computer integrated manufacturing.

Production Planning

- Concerned with:

1. Deciding which products to make, how many of each, and when they should be completed.
2. Scheduling the delivery and/or production of the parts and products.
3. Planning the manpower and equipment resources needed to accomplish the production plan.

Activities in Production Planning

- Aggregate production planning – planning the production output levels for major product lines
  - Must be coordinated with product design, production, marketing, and sales.
- Master production planning – specific schedule (master production schedule) of the quantities of individual models in each major product line.
- Material requirements planning (MRP) – detailed schedule of raw materials and parts production for models in master schedule.
- Capacity planning – planning labor and equipment resources to achieve the master schedule.

Aggregate Production Planning

Planning the production output levels for major product lines

- High-level corporate planning activity.
- Must be coordinated with the plans of the sales and marketing departments.
  - Includes products that are currently in production
    - Must consider current and future inventory levels of those products.
  - Also includes new products currently being developed.
- Marketing plans for current and new products must be reconciled (settled) against total capacity resources of the company.

Aggregate Production Plan

	Week									
Product line	1	2	3	4	5	6	7	8	9	10
M model line	200	200	200	150	150	120	120	100	100	100
N model line	80	60	50	40	30	20	10			
P model line							70	130	25	100

- Indicates production output levels for the major product lines of the company.

Master Production Schedule

The specific schedule of individual products and models that is derived from the aggregate production plan.

- It is a list of the products to be manufactured, when they should be completed and delivered, and in what quantities.
- Master production schedule includes three categories of items:
  1. Firm customer orders
  2. Forecasted demand
  3. Spare parts

Master Production Schedule

	Week									
Product line	1	2	3	4	5	6	7	8	9	10
M model line	200	200	200	150	150	120	120	100	100	100
N model line	80	60	50	40	30	20	10			
P model line							70	130	25	100

	Week									
Product line models	1	2	3	4	5	6	7	8	9	10
Model M3	120	120	120	100	100	80	80	70	70	70
Model M4	80	80	80	50	50	40	40	30	30	30
Model N8	80	60	50	40	30	20	10			
Model P1								50		100
Model P2							70	80	25	

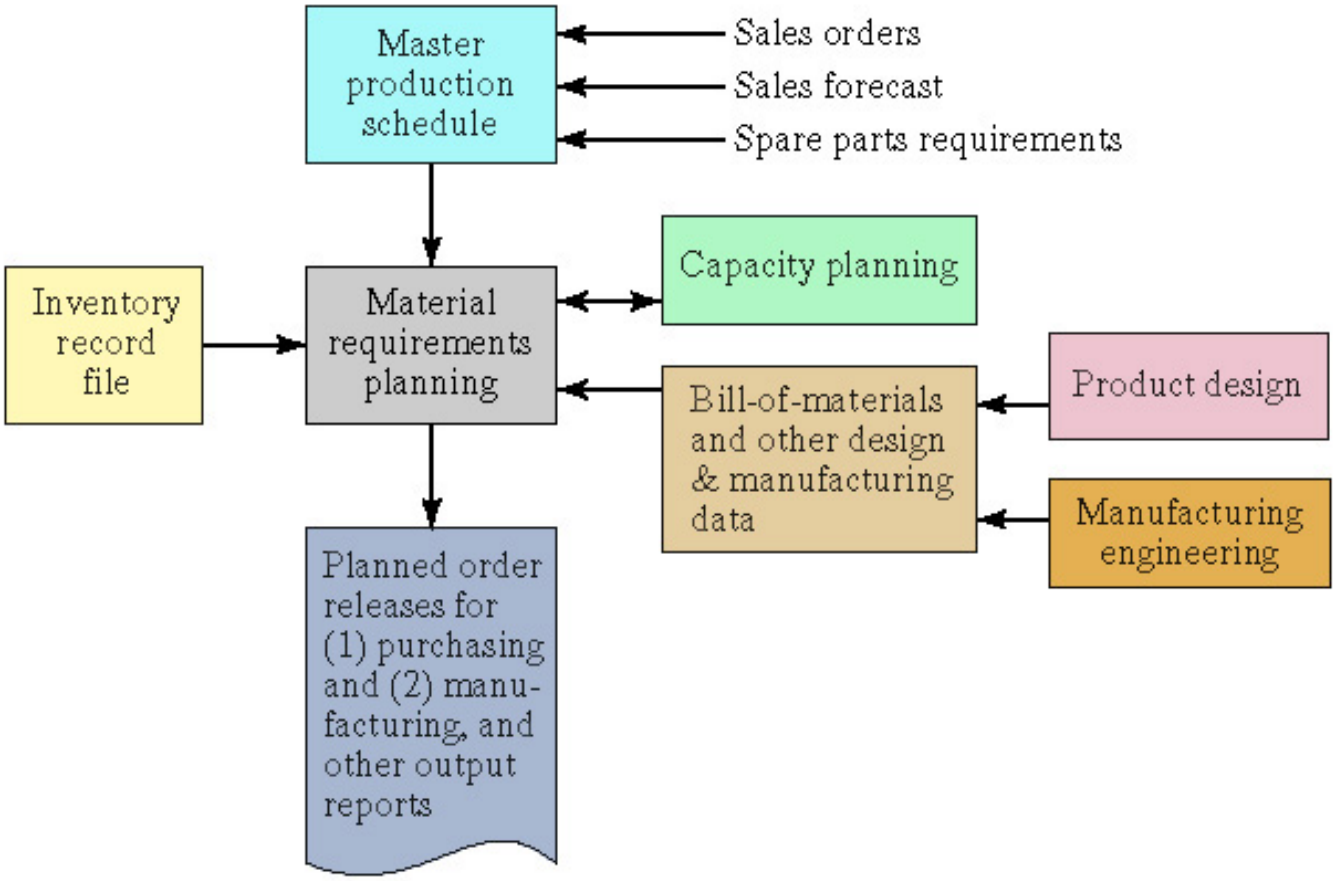
Specific schedule of individual products, quantities and times

Material Requirements Planning (MRP)

Computational technique that converts the master production schedule for end products into a detailed schedule for the raw materials and components used in the end products.

- Useful for dependent demand items, not independent demand items.
  - Independent demand items
    - Final products and spare parts
  - Dependent demand items
    - Component parts used in final products

Structure of MRP System

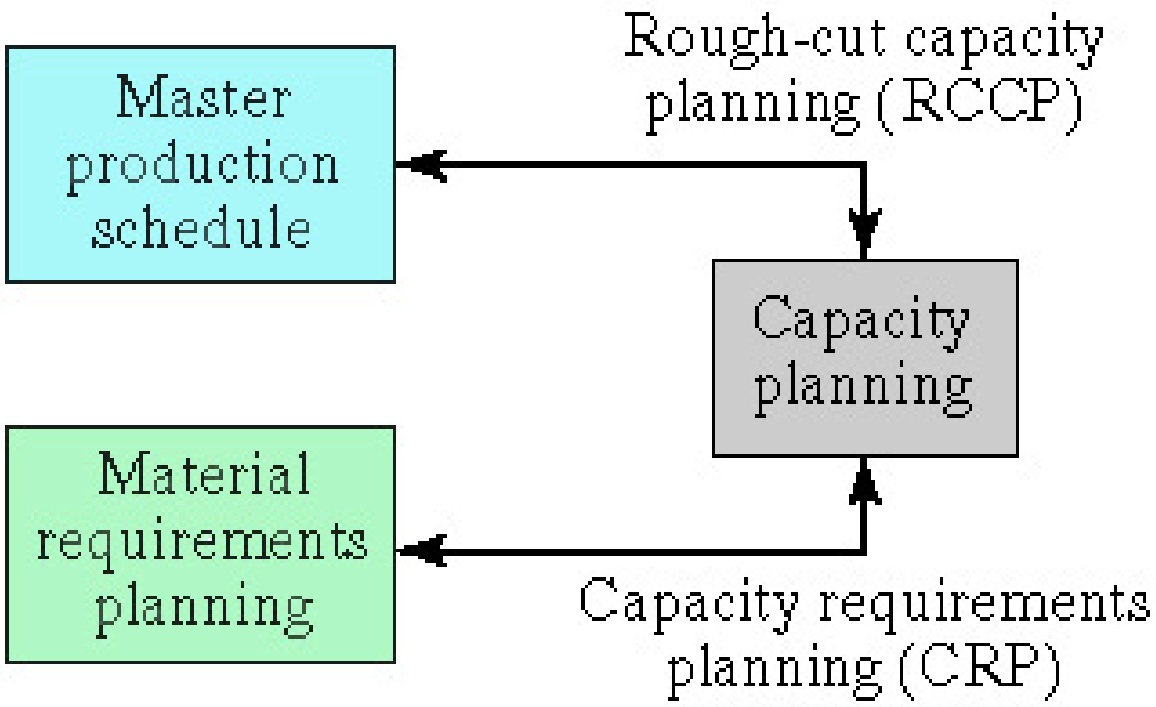


Capacity Planning

Concerned with determining labor and equipment resources required to meet the current master schedule as well as long-term future production needs of the firm.

- Also serves to identify the limitations of the available production resources so that an unrealistic master schedule is not planned.
- Accomplished in two stages:
  1. Rough-cut capacity planning – to assess feasibility of master production schedule.
  2. Capacity requirements planning – detailed capacity calculation for individual departments and work cells.

Two Stages of Capacity Planning



Production Control

- Concerned with determining whether the necessary resources to implement the production plan have been provided.
  - If not, it attempts to take **corrective action** to address the deficiencies (shortages).

- Major topics in production control:
  - Shop floor control
  - Inventory control

Shop Floor Control

Concerned with releasing production orders to the factory, monitoring and controlling the progress of the orders through the plant, and acquiring current information on the status of the orders.

- Manufacturing execution system (MES) - the computer software that supports shop floor control.
  - Typically includes capability to respond to on-line inquiries about the status of orders in the shop.
  - Other MES functions may include generation of process instructions, real-time inventory control, and labor tracking.

Three Phases of Shop Floor Control

1. Order release
2. Order scheduling
3. Order progress

Inventory Control

- Concerned with achieving an appropriate compromise between two opposing objectives:
  1. Minimizing the cost of holding inventory
     - Implies keeping inventory to a minimum.
  2. Maximizing customer service
     - Implies keeping large stocks on hand so the customer can immediately take possession.

Costs of Holding Inventory

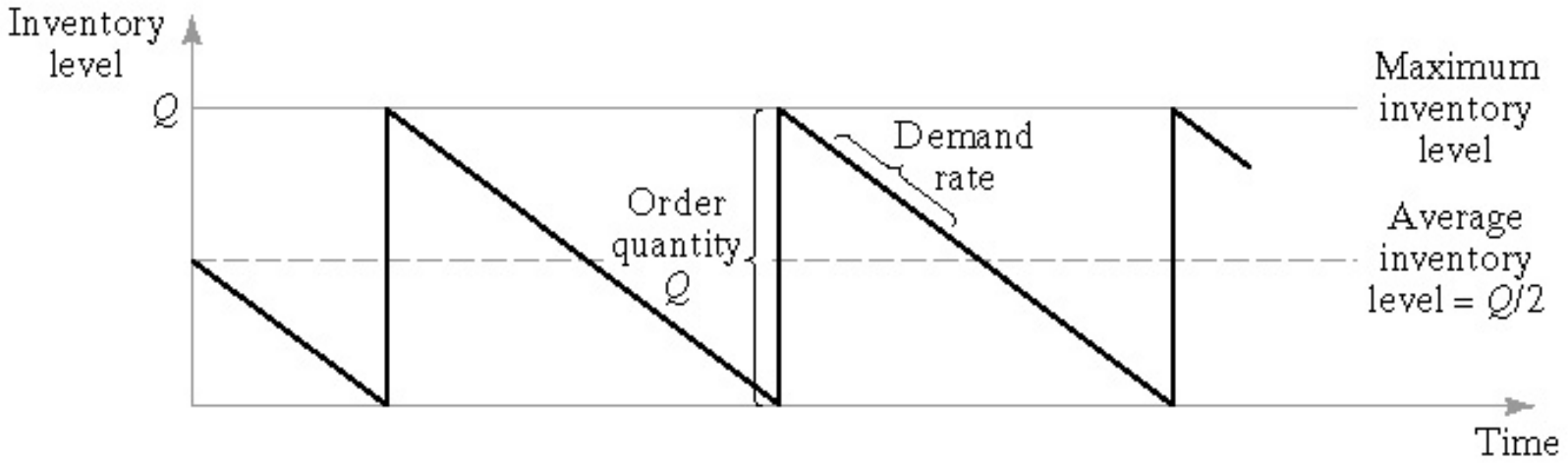
1. Investment costs
   - Cost of money tied up in inventory until the customer pays for the finished product.
2. Storage costs
   - Cost of space to store the inventory.
3. Cost of possible obsolescence or spoilage
   - Reduction in value of inventory when it cannot be used.

- Collectively, these costs are referred to as carrying costs or holding costs.

Order Point Inventory Systems

- Concerned with two related problems that must be solved when managing inventories of independent demand items:
  1. How many units should be ordered?
     - Often solved by using economic order quantity formulas.
  2. When should the order be placed?
     - Can be solved using reorder point methods.

Inventory Model in Make-To-Stock



Inventory level over time in a typical make-to-stock situation.

Economic Order Quantity Formula

- Situations when EOQ formula is appropriate:
  1. Demand rate for the item is fairly constant.
  2. Rate of production is significantly greater than the demand rate.

EOQ: Total Cost Equation

$$TC_{EOQ} = \left(\frac{D}{Q}S\right) + \left(\frac{Q}{2}H\right)$$

Where

TC = total annual cost

D = annual demand

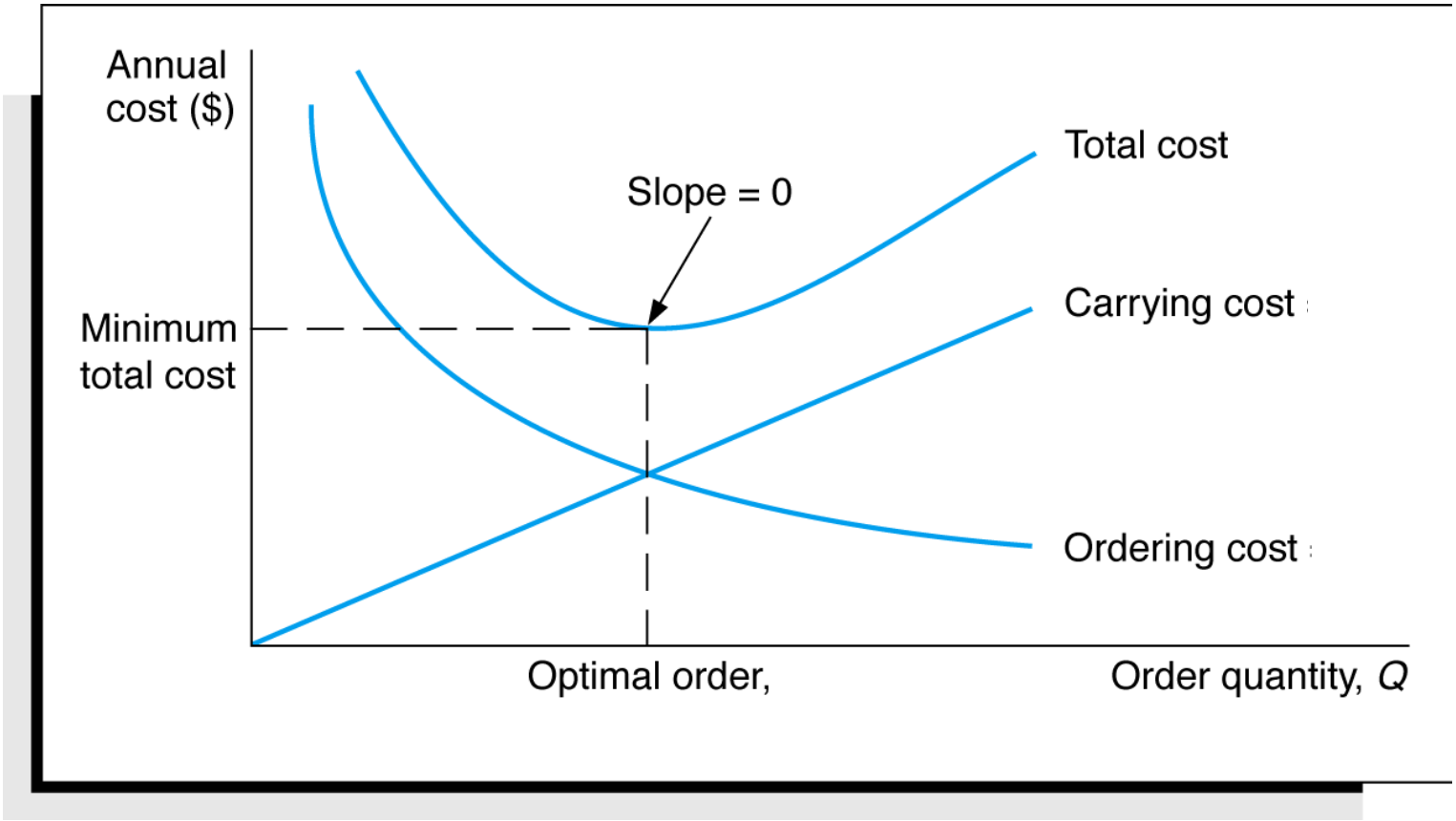
Q = quantity to be ordered

H = annual holding cost

S = ordering or setup cost

EOQ Total Costs

Total annual costs = annual ordering costs + annual holding costs



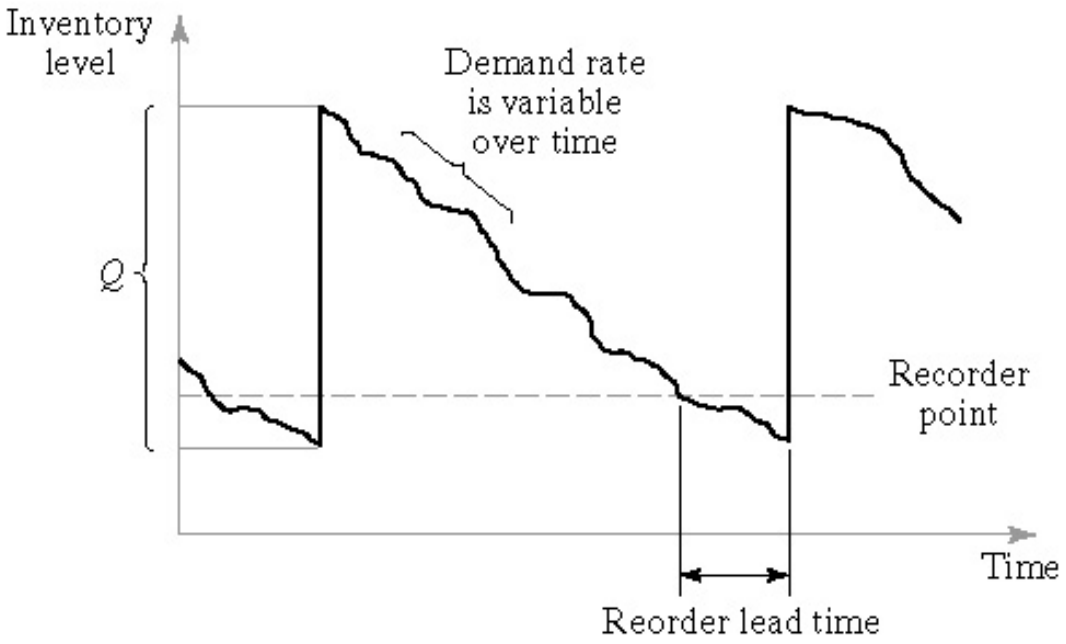
The EOQ Formula

Minimize the TC by ordering the EOQ:

$$Q = EOQ = \sqrt{\frac{2D \times S}{H}}$$

Reorder Point Systems

- The actual demand rate for the item is not constant throughout the order cycle
- The time to reorder occurs when the actual inventory level falls below a point known as the reorder point



When inventory level reaches the reorder point, the next order for quantity *Q* is placed

When to Order: The Reorder Point

- Without safety stock:

$$\boxed{R = d \times L}$$

where R = reorder point in units

d = daily/weekly demand in units

L = lead time in days/weeks

- With safety stock:

$$\boxed{R = d \times L + SS}$$

where SS = safety stock in units

EOQ Example

- Weekly demand = 240 units
- No. of weeks per year = 52
- Ordering cost = $50
- Unit cost = $15
- Annual carrying charge = 20%
- Lead time = 2 weeks

EOQ Example Solution

$$D = 52 \times 240 = 12{,}480\, units / year$$

$$H = 0.2 \times 15 = \$3\ per\ unit\ per\ year$$

$$Q = \sqrt{\frac{2DS}{H}} = \sqrt{\frac{2 \times 12{,}480 \times 50}{3}} = 644.98 \cong 645\, units$$

$$TC = \left(\frac{D}{Q}S\right) + \left(\frac{Q}{2}H\right) = \left(\frac{12{,}480}{645} \times 50\right) + \left(\frac{645}{2} \times 3\right)$$

$$= 967.44 + 967.5 = \$1{,}934.94$$

$$R = dL = 240 \times 2 = 480\, units$$