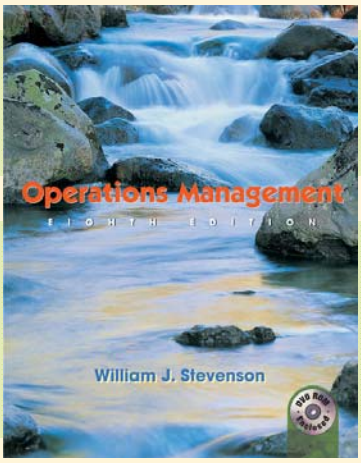


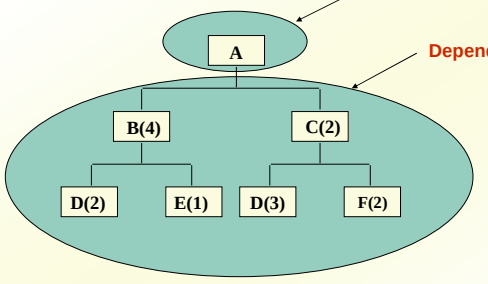
CHAPTER 11

Inventory Management

***Inventory*: a stock or store of goods**

Independent Demand

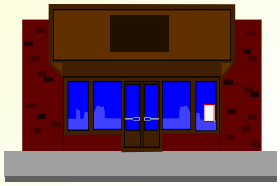
Dependent Demand



Independent demand is uncertain.
Dependent demand is certain.

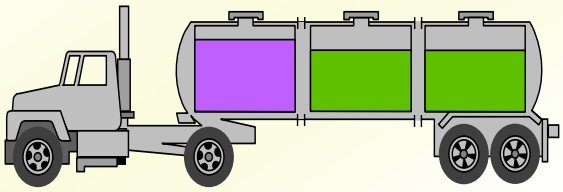
Types of Inventories

- Raw materials & purchased parts
- Partially completed goods called *work in progress*
- Finished-goods inventories
  - (*manufacturing firms*) or merchandise (*retail stores*)



Types of Inventories (Cont'd)

- Replacement parts, tools, & supplies
- Goods-in-transit to warehouses or customers



Functions of Inventory

- To meet anticipated demand
- To smooth production requirements
- To decouple operations
- To protect against stock-outs

Functions of Inventory (Cont'd)

- To take advantage of order cycles
- To help hedge against price increases
- To permit operations
- To take advantage of quantity discounts

Objective of Inventory Control

- To achieve satisfactory levels of customer service while keeping inventory costs within reasonable bounds
  - Level of customer service
  - Costs of ordering and carrying inventory

Effective Inventory Management

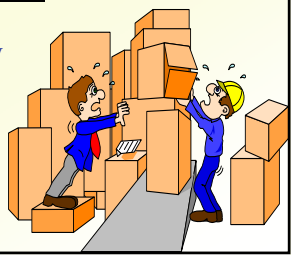
- A system to keep track of inventory
- A reliable forecast of demand
- Knowledge of lead times
- Reasonable estimates of
  - Holding costs
  - Ordering costs
  - Shortage costs
- A classification system

Inventory Counting Systems

- *Periodic System*

  Physical count of items made at periodic intervals
- *Perpetual Inventory System*

  System that keeps track of removals from inventory continuously, thus monitoring current levels of each item



Inventory Counting Systems (Cont'd)

- *Two-Bin System* - Two containers of inventory; reorder when the first is empty
- *Universal Bar Code* - Bar code printed on a label that has information about the item to which it is attached

Key Inventory Terms

- *Lead time*: time interval between ordering and receiving the order
- *Holding (carrying) costs*: cost to carry an item in inventory for a length of time, usually a year
- *Ordering costs*: costs of ordering and receiving inventory
- *Shortage costs*: costs when demand exceeds supply

ABC Classification System

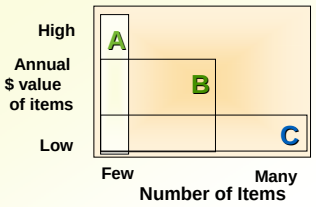
Figure 11.1

Classifying inventory according to some measure of importance and allocating control efforts accordingly.

A - very important

B - mod. important

C - least important



Cycle Counting

- A physical count of items in inventory
- Cycle counting management
  - How much accuracy is needed?
  - When should cycle counting be performed?
  - Who should do it?

Economic Order Quantity Models

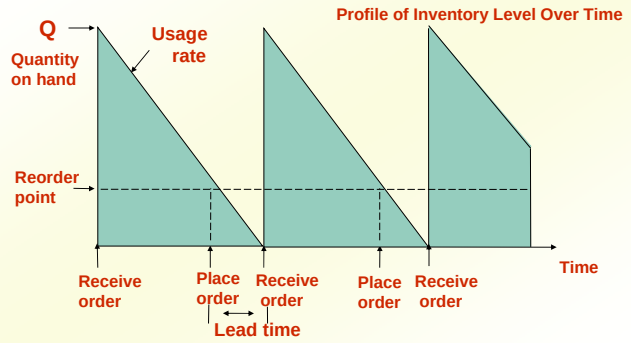
- Economic order quantity model
- Economic production model
- Quantity discount model

Assumptions of EOQ Model

- Only one product is involved
- Annual demand requirements known
- Demand is even throughout the year
- Lead time does not vary
- Each order is received in a single delivery
- There are no quantity discounts

The Inventory Cycle

Figure 11.2



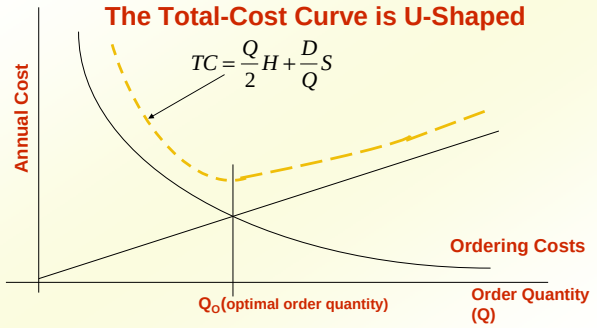
Total Cost

$$\text{Total cost} = \text{Annual carrying cost} + \text{Annual ordering cost}$$

$$TC = \frac{Q}{2}H + \frac{D}{Q}S$$

Cost Minimization Goal

Figure 11.4C



Deriving the EOQ

Using calculus, we take the derivative of the total cost function and set the derivative (slope) equal to zero and solve for Q.

$$Q_{OPT} = \sqrt{\frac{2DS}{H}} = \sqrt{\frac{2(\text{Annual Demand})(\text{Order or Setup Cost})}{\text{Annual Holding Cost}}}$$

Minimum Total Cost

The total cost curve reaches its minimum where the carrying and ordering costs are equal.

$$Q_{OPT} = \sqrt{\frac{2DS}{H}} = \sqrt{\frac{2(\text{Annual Demand})(\text{Order or Setup Cost})}{\text{Annual Holding Cost}}}$$

Economic Production Quantity (EPQ)

- Production done in batches or lots
- Capacity to produce a part exceeds the part's usage or demand rate
- Assumptions of EPQ are similar to EOQ except orders are received incrementally during production

Economic Production Quantity Assumptions

- Only one item is involved
- Annual demand is known
- Usage rate is constant
- Usage occurs continually
- Production rate is constant
- Lead time does not vary
- No quantity discounts

Economic Run Size

$$Q_0 = \sqrt{\frac{2DS}{H}}\sqrt{\frac{p}{p-u}}$$

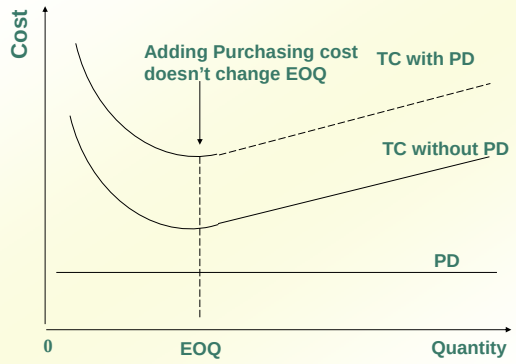
Total Costs with Purchasing Cost

$$TC = \text{Annual carrying cost} + \text{Annual ordering cost} + \text{Purchasing cost}$$

$$TC = \frac{Q}{2}H + \frac{D}{Q}S + PD$$

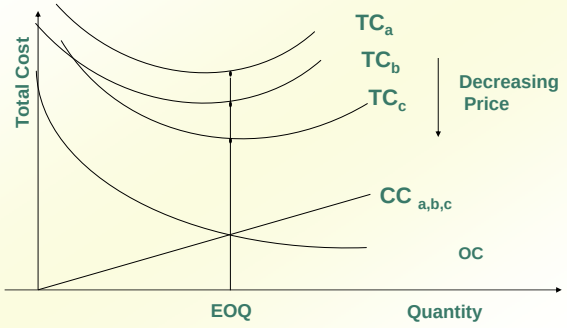
Total Costs with PD

Figure 11.7



Total Cost with Constant Carrying Costs

Figure 11.9



When to Reorder with EOQ Ordering

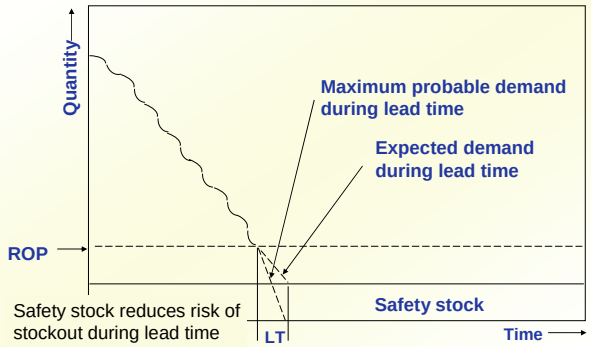
- *Reorder Point* - When the quantity on hand of an item drops to this amount, the item is reordered
- *Safety Stock* - Stock that is held in excess of expected demand due to variable demand rate and/or lead time.
- *Service Level* - Probability that demand will not exceed supply during lead time.

Determinants of the Reorder Point

- The rate of demand
- The lead time
- Demand and/or lead time variability
- Stockout risk (safety stock)

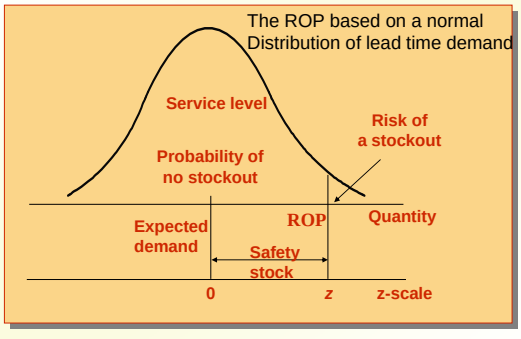
Safety Stock

Figure 11.12



Reorder Point

Figure 11.13



Fixed-Order-Interval Model

- Orders are placed at fixed time intervals
- Order quantity for next interval?
- Suppliers might encourage fixed intervals
- May require only periodic checks of inventory levels
- Risk of stockout

Fixed-Interval Benefits

- Tight control of inventory items
- Items from same supplier may yield savings in:
  - Ordering
  - Packing
  - Shipping costs
- May be practical when inventories cannot be closely monitored

Fixed-Interval Disadvantages

- Requires a larger safety stock
- Increases carrying cost
- Costs of periodic reviews

Single Period Model

- *Single period model*: model for ordering of perishables and other items with limited useful lives
- *Shortage cost*: generally the unrealized profits per unit
- *Excess cost*: difference between purchase cost and salvage value of items left over at the end of a period

Single Period Model

- Continuous stocking levels
  - Identifies optimal stocking levels
  - Optimal stocking level balances unit shortage and excess cost
- Discrete stocking levels
  - Service levels are discrete rather than continuous
  - Desired service level is equaled or *exceeded*

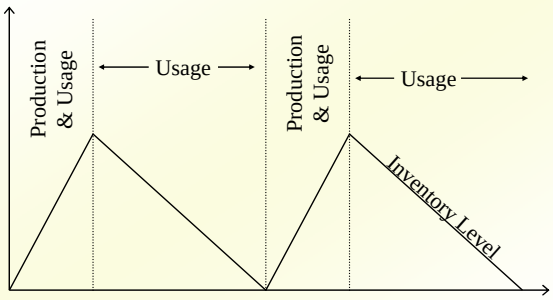
Operations Strategy

- Too much inventory
  - Tends to hide problems
  - Easier to live with problems than to eliminate them
  - Costly to maintain
- Wise strategy
  - Reduce lot sizes
  - Reduce safety stock

CHAPTER 11

Additional PowerPoint slides contributed by Geoff Willis, University of Central Oklahoma.

Economic Production Quantity



Gortrac Manufacturing

GTS3

Inventory/Assessment/Reduction

Materials

PS7

Washburn Guitars