Introduction to Inventory Management

MIT Center for
Transportation & Logistics

Why Hold Inventory?

- Cover process time
- Allow for uncoupling of processes
- Anticipation / Speculation
- Minimize control costs
- Buffer against uncertainties
    - Demand
   - Supply
    - Delivery
    - Manufacturing/Processing

Three Levels of Inventory Decisions

- ## Supply Chain Decisions
  Strategic
  - What are the potential alternatives to inventory?
  - How should the product be designed?

- ## Deployment Decisions
  Tactical
  - What items should be carried as inventory?
  - In what form should they be maintained?
  - How much of each should be held and where?

- ## Replenishment Decisions
  Operational
  - How often should inventory status be determined?
  - When should a replenishment decision be made?
  - How large should the replenishment be?

Classification of Inventory

- Financial / Accounting Categories
  - Raw Materials
  - Work in Process (WIP)
  - Components, Semi-Finished Goods
  - Finished Goods

- Functional Roles
  - Cycle Stock
  - Safety Stock
  - Pipeline Inventory

Inventory On Hand (y-axis)

Cycle Stock, Cycle Stock, Cycle Stock

Safety Stock

Time
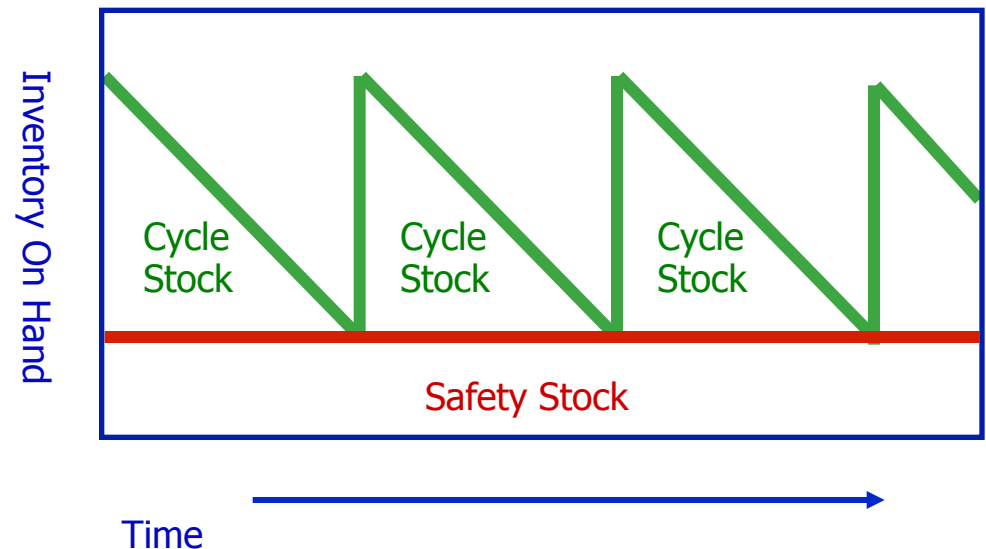
Total Relevant Costs

Total Relevant Costs (TRC)

TC = Purchase + Order + Holding + Shortage

- Four Standard Cost Components

    - Purchase (Unit Value) Cost

    - Ordering (Set Up) Cost

    - Holding (Carrying) Cost

    - Shortage Cost

- What makes a cost relevant?

    A note about nomenclature . . . all texts differ!

Relevant Costs

- Purchase (Unit Value) Costs   C
  - Units?
    - $ / Unit
  - What does it contain?
    - Total landed cost for acquiring product
  - How do we determine this number?
    - purchase price vs. manufacturing cost
  - When is it relevant?
    - When purchase price differs with respect to quantity or timing of order

Relevant Costs

- Ordering (Set Up) Costs c_t
  - Units?
    - $/ Order
  - What does it contain?
    - Cost to place, receive, & process a batch of goods
    - Includes processing, invoicing, auditing, labor, etc
    - In manufacturing, set up cost for a run
  - How do we determine this number?
    - Workflow analysis
    - Sum all admin & other costs and divide by total orders
  - When is it relevant?
    - Whenever it exists and is non-trivial

Relevant Costs

- ## Holding (Carrying) Costs $\qquad$ $ch = c_e$
  - ### Units?
    - $/unit-time where h=$/$inventory/time
  - ### What does it contain?
    - Costs required to hold inventory
      - Storage - $/sf – warehouse space
      - Service costs - $/$inv – insurance and taxes
      - Risk costs - $/item – lost, stolen (shrinkage), damaged, obsolete
      - Capital costs - $/$inv – cost of capital, hurdle rate
  - ### How do we determine this number?
    - Usually set by management
    - Worth seeing if any of the secondary aspects dominate
  - ### When is it relevant?
    - Whenever inventory is being held for any period of time

Relevant Costs

- ## Shortage (Stock-Out) Costs c_s
  - ### Units?
    - $/unit or $/unit/time or $/order or . . . .
  - ### What does it contain?
    - Cost of not having an item in stock
      - Backorder – customer will wait for item
      - Lost Sales – customer goes elsewhere (fill or kill)
      - Lost Customer Sales – customer goes away for ever
      - Disruption Costs – holds up production line
  - ### How do we determine this number?
    - Engineer the cost – determine specific values
    - Implicitly assume the cost by establishing a set service level
  - ### When is it relevant?
    - Whenever there is uncertainty in demand, replenishment time, etc.

Inventory Replenishment Model Assumptions

Replenishment Models

- Objective:
  - Find an optimal policy for managing inventory

- Policy consists of:
  - How much to order (Q)
  - When to order:
    - Time based – every T time units
    - Quantity based – when inventory is a certain level
    - Combination

Replenishment Model Assumptions

- Demand
  - Constant vs Variable
  - Known vs Random
  - Continuous vs Discrete
- Lead Time
  - Instantaneous
  - Constant vs Variable
  - Deterministic vs Stochastic
  - Internally Replenished
- Dependence of Items
  - Independent
  - Correlated
  - Indentured
- Review Time
  - Continuous vs Periodic
- Number of Locations
  - One vs Multi vs Multi-Echelon
- Capacity / Resources
  - Unlimited
  - Limited / Constrained

- Discounts
  - None
  - All Units vs Incremental vs One Time
- Excess Demand
  - None
  - All orders are backordered
  - Lost orders
  - Substitution
- Perishability
  - None
  - Uniform with time
  - Non-linear with time
- Planning Horizon
  - Single Period
  - Finite Period
  - Infinite
- Number of Items
  - One vs Many
- Form of Product
  - Single Stage
  - Multi-Stage

Questions, Comments, Suggestions?
Use the Discussion!

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