Chapter 8

Inventory Management

Importance of Inventory Management

- 2001 - Cisco Systems declared $2.2 billion in inventory to be worthless.
- 2002 - Micron Technology wrote off $174 million of inventory because the market had shifted from SDRAM to DRAM.

Games People Play With Inventory

General Considerations

Functions of Inventories

- Transit Inventories
- Buffer Inventories (safety stocks)
- Anticipation Inventories
- Decoupling Inventories
- Cycle Inventories

Forms of Inventories

- Raw Materials
- Maintenance, repair, and operating supplies
- Work-In-Process (WIP)
- Finished Goods
Inventory-Related Costs

- Ordering or Setup Costs
- Inventory Carrying or Holding Costs
- Stockout Costs
- Opportunity Costs
- Cost of Goods

Decisions in Inventory Management

- What to order?
- When to order?
- How much to order?

Types of Inventory Management Systems

- Reorder point systems
  - time between orders varies
  - constant order quantity
- Periodic review systems
  - time between orders fixed
  - order quantity varies
- Material requirements planning (MRP)
  - dependent demand items

Fluctuations in Inventory

Reorder Point Systems

- Reorder point
- Lead time
- Two-bin system
- Perpetual inventory system
**Periodic Review System**

- maximum inventory level
- on-hand inventory
- on-order quantity
- demand over lead time
- reorder quantity

**Periodic Review System Without Considering On-Order Quantity**

**Periodic Review System (Assumes None On Order at Time of Reorder)**

**Priorities for Inventory Management: The ABC Concept**

- **A items**: 15-20% of items that account for 75-80% of annual inventory value
- **B items**: 30-40% of items that account for 15% of annual inventory value
- **C items**: 40-50% of items that account for 10-15% of annual inventory value

**ABC Inventory Categories**

**The Economic Order Quantity (EOQ)**
Assumptions

- Constant rate of demand
- Shortages not allowed
- Stock replenishment can be scheduled to arrive exactly when inventory drops to zero
- Purchase price, ordering cost, and per unit holding cost are independent of quantity ordered
- Items are ordered independently of each other

Notation

- \( Q \) = order quantity
- \( U \) = annual usage
- \( C_O \) = order cost per order
- \( C_H \) = annual holding cost per unit

Water Distributor’s Inventory Pattern

Water Distributor’s Inventory Graph

Annual Order Cost

Annual Holding Cost
Chapter 8 - Inventory Management

Graph of Annual Inventory Costs

Finding an Optimal Policy

\[
\frac{Q}{2}C_O + \frac{U}{2}C_o = \frac{U}{O}C_o
\]

\[
\frac{Q}{2}C_H = U C_o
\]

\[
Q^2 = \frac{2UC_O}{C_H}
\]

\[
EOQ = \sqrt{\frac{2UC_O}{C_H}}
\]

Alternative Way of Deriving EOQ

\[
TAC = \frac{Q}{2}C_a + \left(\frac{U}{Q}\right)C_o
\]

\[
\frac{dTAC}{dQ} = \frac{C_a}{2} - \left(\frac{U}{Q^2}\right)C_o
\]

\[
0 = \frac{C_a}{2} - \left(\frac{U}{Q^2}\right)C_o
\]

EOQ Example

- Given:
  - 25,000 annual demand
  - $3 per unit per year holding cost
  - $100 ordering costs

\[
EOQ = \sqrt{\frac{2(25,000)(100)}{3}} = 1291
\]

The Economic Production Quantity (EPQ)
Economic Production Quantity Model

\[ Q = \frac{\sqrt{2UC_S}}{C_H[1 - (u/p)]} \]

\[ Q^* = \frac{\sqrt{2UC_S}}{C_H[1 - (u/p)]} \]

**Setup Time (Cost) Reduction**

- Setup time has two components:
  - Internal setup: Executed while the machine is operating.
  - External setup: Executed while the machine is stopped.
- EX: Consider the setup for a lecture:
  - Erase the board, bring the screen down, turn on PC, project to screen.
  - Tying on the PC is the bottleneck.
- EX: Replast industries (a manufacturer of plastic bags) reduced setup times by 68%, down to 23 mins, and targeting 15 mins. This allowed Replast run smaller batches.

**Economic Production Quantity Example**

- \( U = 1,000 \) units
- \( C_S = 10 \) per item per year
- \( C_H = 0.50 \) per item per year
- \( p = 4 \) units per day
- \( u = 8 \) units per day

\[ Q_p^* = \frac{\sqrt{2UC_S}}{C_H[1 - (u/p)]} \]

\[ Q_p^* = \frac{2[1,000][10]}{0.50[1 - (4/8)]} = 80,000 \]

\[ Q_p^* = 282.8 \text{ or } 283 \text{ units} \]