ECONOMIC DESIGN CRITERIA

BASIC ECONOMIC TERMS

- **Total Capital Investment**, $TCI$ or $I$
  
  \[
  (\text{Total Capital Investment}) = (\text{Fixed Capital Investment}) + (\text{Working Capital})
  \]
  
  \[
  TCI = FCI + WC
  \]

- **Fixed Capital Investment**, $FCI$ or $I_F$
  
  \[
  FCI = (\text{Direct Costs}) + (\text{Indirect Costs})
  \]

- **Working Capital**, $WC$ or $I_W$
  
  Cash, raw materials, stock, etc. About 10-20% of $TCI$. 
**BASIC ECONOMIC TERMS**

- **Product Cost,** $C$
  
  \[ C = C_I + C_Q + C_O + C_G \]

- **Fixed Charges,** $C_I$
  
  Do not depend on production level (insurance, property taxes, depreciation, rent etc.)

- **Direct Production Cost,** $C_Q$
  
  Labor, utilities, raw materials, maintenance, supplies, royalties etc.

- **Plant Overhead,** $C_O$
  
  Recreation, employee facilities, packaging etc.

- **General Expenses,** $C_G$
  
  Administration, marketing, R&D, distribution.

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ChE 4253 - Design I
BASIC ECONOMIC TERMS

- **Income from Sales**, \( S \) in ($/yr)
- **Gross Earnings**, \( R \) in ($/yr)
  \[ R = S - C \]
- **Net Earnings**, \( P \) in ($/yr)
  \[ P = R - eI_F - (R - dI_F) t \]

(Net Profit) = (Gross) - (Amortization) - (Taxes)

- **Depreciation rate**
  - Recovery of Investment, \( e \)
  - Taxation purposes, \( d \)
  - Straight line depreciation, \( e = 1/n \)
  - Depreciation with capital reinvestment (sinking fund method, \( i \) is interest)

  \[ e = \frac{i}{(1+i)^n - 1} \]
BASIC ECONOMIC TERMS (break-even chart)

**FIGURE 6-3**
Break-even chart for a chemical plant.
BASIC ECONOMIC TERMS

Salvage Value
Net cash obtainable from the sale of used property (above charges for removal and sale)

Scrap value: Salvage value after dismantling a unit.

Present Value

Book Value: (Total Capital Investment) - (All Depreciation)

Market Value: Cash obtainable from selling the unit.

Replacement Value: Cost of obtaining the same property.
**BASIC ECONOMIC TERMS**

**Depreciation**

Reduction in value due to any causes.

*Example:* Pump

Cost: \( C_V = \$12,000 \)

Scrap value: \( V_S = \$2,000 \)

Depreciation: \( C_V - V_S = \$10,000 \)

For engineers, depreciation is considered as a cost for using the equipment.
DEPRECIATION

Types Of Depreciation

**Physical:** Wear and Tear, corrosion, accidents, age deterioration.

**Functional:** All other causes.

**Obsolescence:** Due to technological advances.

**Depletion:** Loss due to materials consumed. Applicable to Natural Resources (timber, mineral, oil deposits)

**IRS:** “A reasonable allowance for the exhaustion, wear and tear of property used in the trade or business including a reasonable allowance for obsolescence”
BASIC ECONOMIC TERMS

Service Life
The IRS has determined various values (See Peters et al., 2003, for complete list).

Group 1: General Business Assets. (Office furniture, Land, Buildings, etc)

Group 2: Non-manufacturing activities: (Agriculture, Fishing, Mining, etc.)

Group 3: Manufacturing, e.g. Petroleum Refining: 16 years. Chemicals 11 years.

Group 4: Transportation, Communication and Public Utilities: (Electrical, Gas, Motor transport, Radio and TV broadcasting, railroad, etc.)
BASIC ECONOMIC TERMS

- **Total Capital Investment, TCI**
- **Direct Costs, CD**
- **Indirect Costs, CI**
- **Working Capital, WC**
- **S, Income from sales**
- **R, Product Cost**
- **CF, Taxes**
- **D = e IF, Depreciation**

\[ (R - d I_F) t \]
BASIC ECONOMIC TERMS

Cumulative Cash Position (Figs 9.12, 10.1)

Cumulative cash position = Net profit + depreciation - TCI

Economic Life of Project

Net profit over n

Land, salvage, and WC

Construction Period

Time (yrs)

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