Chapter 8
Lecture # 3-3

- **Evaluation of Equipment Alternatives**
- **Profit Margin**

Evaluation of Equipment Alternatives

Factors to Consider

- Capital Cost of the equipment.
- Operating cost of the equipment.
- Lifetime of the equipment.

Evaluation of Equipment Alternatives

Equipment with the Same Expected Operating Lives

- When operating cost and equipment lives are the same, obviously, choose the less expensive one (the lower capital cost one)

- When capital cost and operating cost are different but operating lives are the same, then do NPV and choose the one with the least negative NPV value

Evaluation of Equipment Alternatives

Example 8.6

In the final design stage of a project, the question has arisen as to whether to use a water-cooled exchanger or an air-cooled exchanger in the overhead condenser loop of a distillation tower. The information available on the two pieces of equipment is provided below:

	Initial Investment	Yearly Operating Cost
Air-cooled	$23,000	$1,200
Water-cooled	$12,000	$3,300

Both pieces of equipment have service lives of 12 years. For an internal rate of return of 8% p.a., which piece of equipment represents the better choice?

Evaluation of Equipment Alternatives

The *NPV* for each exchanger is evaluated below.

$$NPV = -\text{Initial Investment} - (\text{Operating Cost})(P/A, 0.08, 12)$$

	NPV
Air-cooled	–$32,040
Water-cooled	–$36,870

The air-cooled exchanger represents the better choice.

Evaluation of Equipment Alternatives

Equipment with Different Expected Operating Lives

- **Three Methods.**
  - **Capitalized Capital Cost Method**
  - **Equivalent Annual Operating Cost (EAOC) Method**
  - **Common Denominator Method**

- **Effect of inflation is not considered in the above methods.**

- **All of the methods consider both the capital and operating cost in minimizing expenses, thus maximizing our profits.**

Evaluation of Equipment Alternatives

Capitalized Cost Method

Capitalized Cost Method. In this method we establish a fund for each piece of equipment that we wish to compare. This fund provides the amount of cash that we would need

a. to purchase the equipment initially

b. to replace it at the end of its life

c. to continue replacing it forever

Evaluation of Equipment Alternatives

Capitalized Cost Method

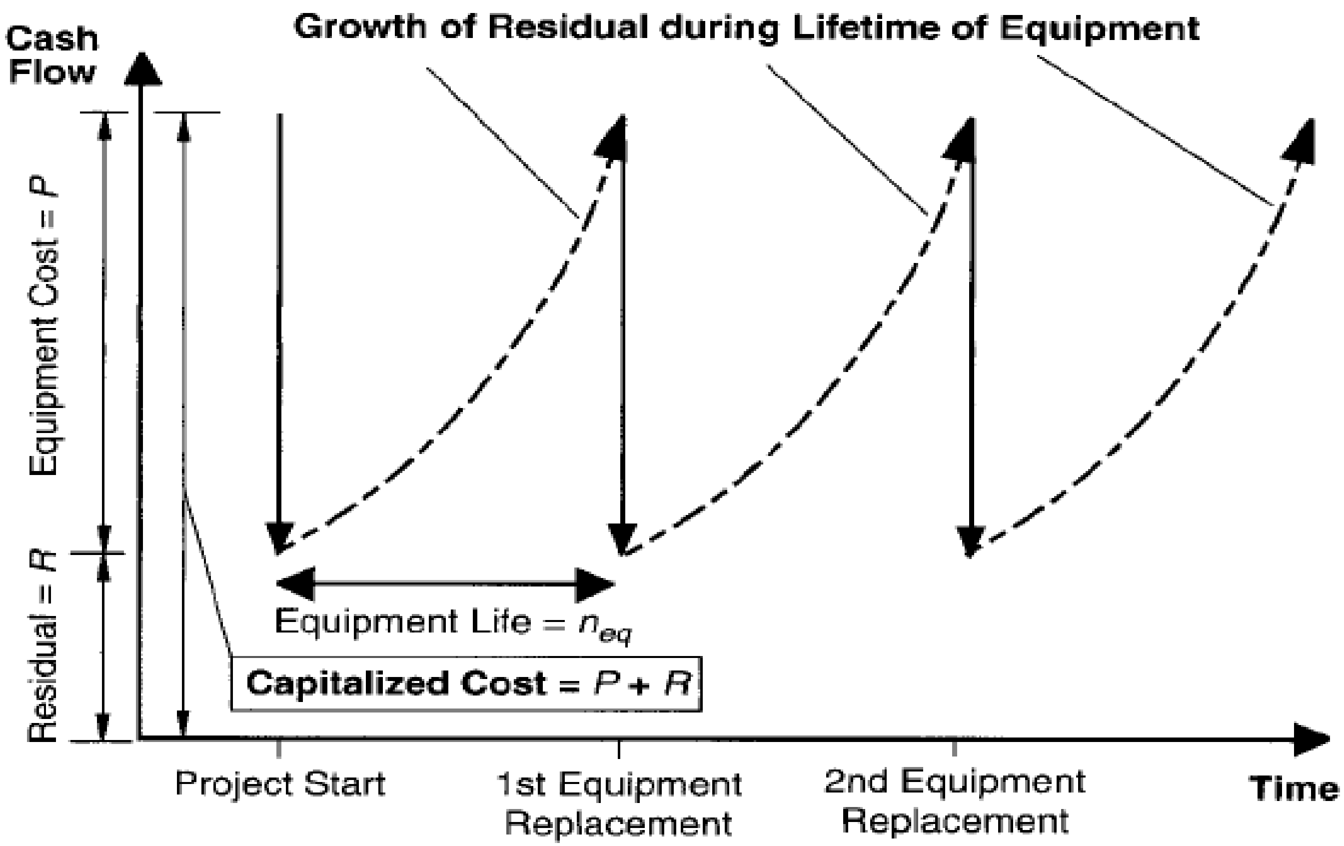

Figure 8.4 An Illustration of the Capitalized Cost Method for the Analysis of Equipment Alternatives

Evaluation of Equipment Alternatives

Capitalized Cost Method

$$\text{Capitalized Cost} = P + R = P + \frac{P}{(1+i)^{n_{eq}} - 1} = P\left[\frac{(1+i)^{n_{eq}}}{(1+i)^{n_{eq}} - 1}\right] \quad (8.1)$$

$$\text{Equivalent Capitalized Cost} = \text{Capitalized Cost} + \text{Capitalized Operating Cost}$$

$$\text{Equivalent Capitalized Cost} = \left[\frac{P(1+i)^{n_{eq}} + YOC(F/A,i,n_{eq})}{(1+i)^{n_{eq}} - 1}\right] \quad (8.2)$$

Evaluation of Equipment Alternatives

Example 8.7

During the design of a new project, we are faced with a decision regarding which type of pump we should use for a corrosive service. Our options are as follows:

	Capital Cost	Operating Cost (per year)	Equipment Life (years)
Carbon steel pump	$8000	$1800	4
Stainless steel pump	$16,000	$1600	7

Evaluation of Equipment Alternatives

Assume a discount rate of 8%, p.a.

Using Equation 8.2 for the carbon steel pump:

$$\text{Capitalized Cost} = \frac{(8000)(1.08)^4 + (1800)\dfrac{[1.08^4 - 1]}{0.08}}{1.08^4 - 1} = \$52,700$$

For the stainless steel pump:

$$\text{Capitalized Cost} = \frac{(16{,}000)(1.08)^7 + (1600)\dfrac{[1.08^7 - 1]}{0.08}}{1.08^7 - 1} = \$58,400$$

Because the carbon steel pump has the lower capitalized cost, it is recommended.

Evaluation of Equipment Alternatives

Equivalent Annual Operating Cost (EAOC) Method

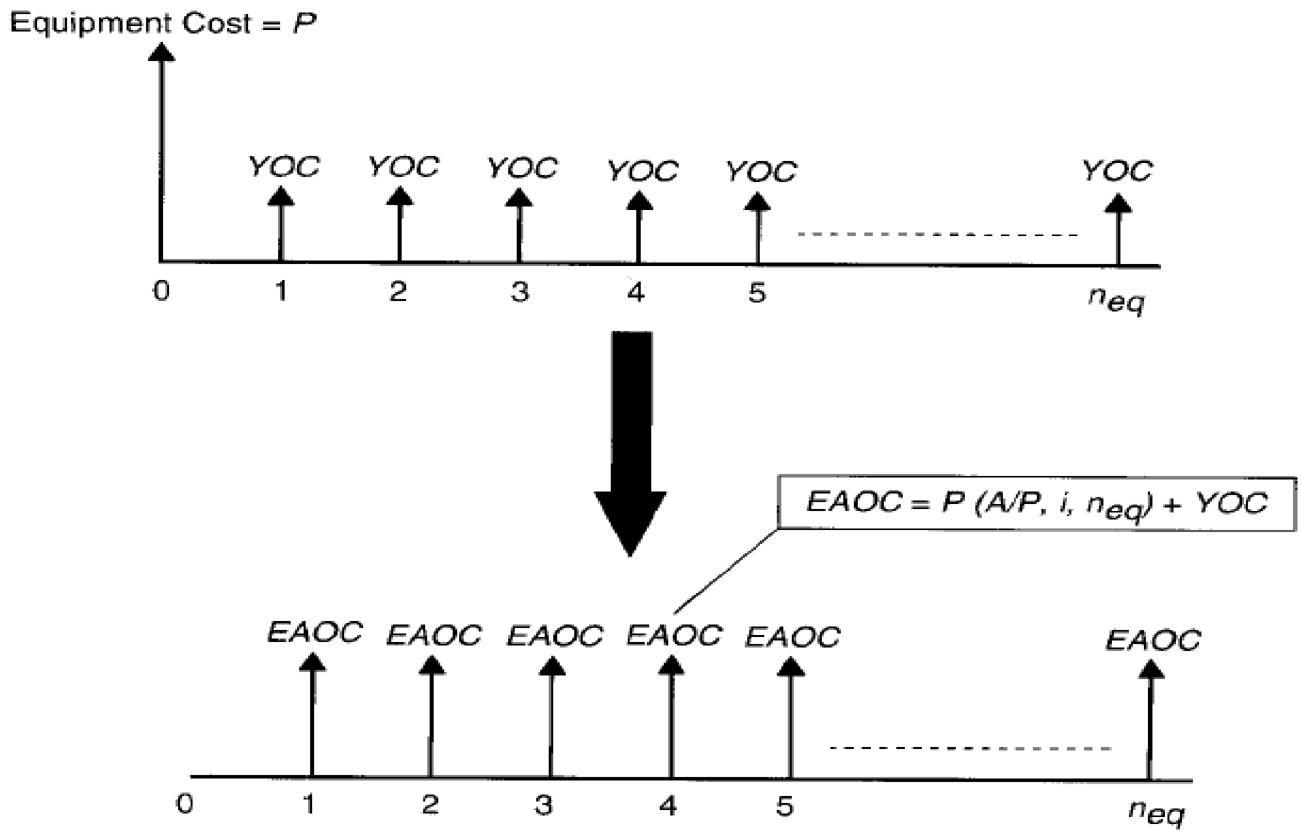

Figure 8.5 Cash Flow Diagrams Illustrating the Concept of Equivalent Annual Operating Cost

Evaluation of Equipment Alternatives

Equivalent Annual Operating Cost (EAOC) Method

Example 8.8

Compare the stainless steel and carbon steel pumps in Example 8.7 using the *EAOC* method.

For the carbon steel pump:

$$EAOC = \frac{(8000)(0.08)(1.08)^4}{1.08^4 - 1} + 1800 = \$4220 \text{ per year}$$

For the stainless steel pump:

$$EAOC = \frac{(16{,}000)(0.08)(1.08)^7}{1.08^7 - 1} + 1600 = \$4670 \text{ per year}$$

Profit Margin

$$\text{Profit Margin} = \Sigma(\text{Revenue Products}) - \Sigma(\text{Cost of Raw Materials}) \quad (8.11)$$

- If PM < 0, the process will not be profitable.
- A PM > 0 does not guarantee that the process will be profitable but does suggest that further investigation may be warranted.

Profit Margin

Example 8.17

Consider the DME process shown in Appendix B.1. Estimate the profit margin for this process using the costs of raw materials and products from Table 6.4.

From Tables 6.4 and B.2 the following flowrates and costs are found:

Cost of methanol = \$ 0.17/kg

Cost of dimethyl ether (DME) = \$ 1.23/kg

Feed rate of methanol to process (Stream 1, Figure B.1) = 8370 kg/h

Product rate of DME (Stream , Figure B.1) = 5970 kg/h

Profit Margin = (5970)(1.23) – (8370)(0.17) = \$5920/h or \$5920/5970 ≃ \$1/kg = DME