Engineering Economy

[5-1]
Present Worth Analysis

- Let’s do some Engineering Economy.
- Do you still remember what is it???

Alternatives

- In general, the decision making process involves the identification of the best alternative among different alternatives

- There may initially be many alternatives, nevertheless only a few will be feasible and actually evaluated

- Therefore, each alternative is a stand-alone option that involves description and best estimates of parameters such as first cost (purchase prices, development, installation), estimated annual incomes and expenses, salvage value, interest rate, etc.

Alternative Selection

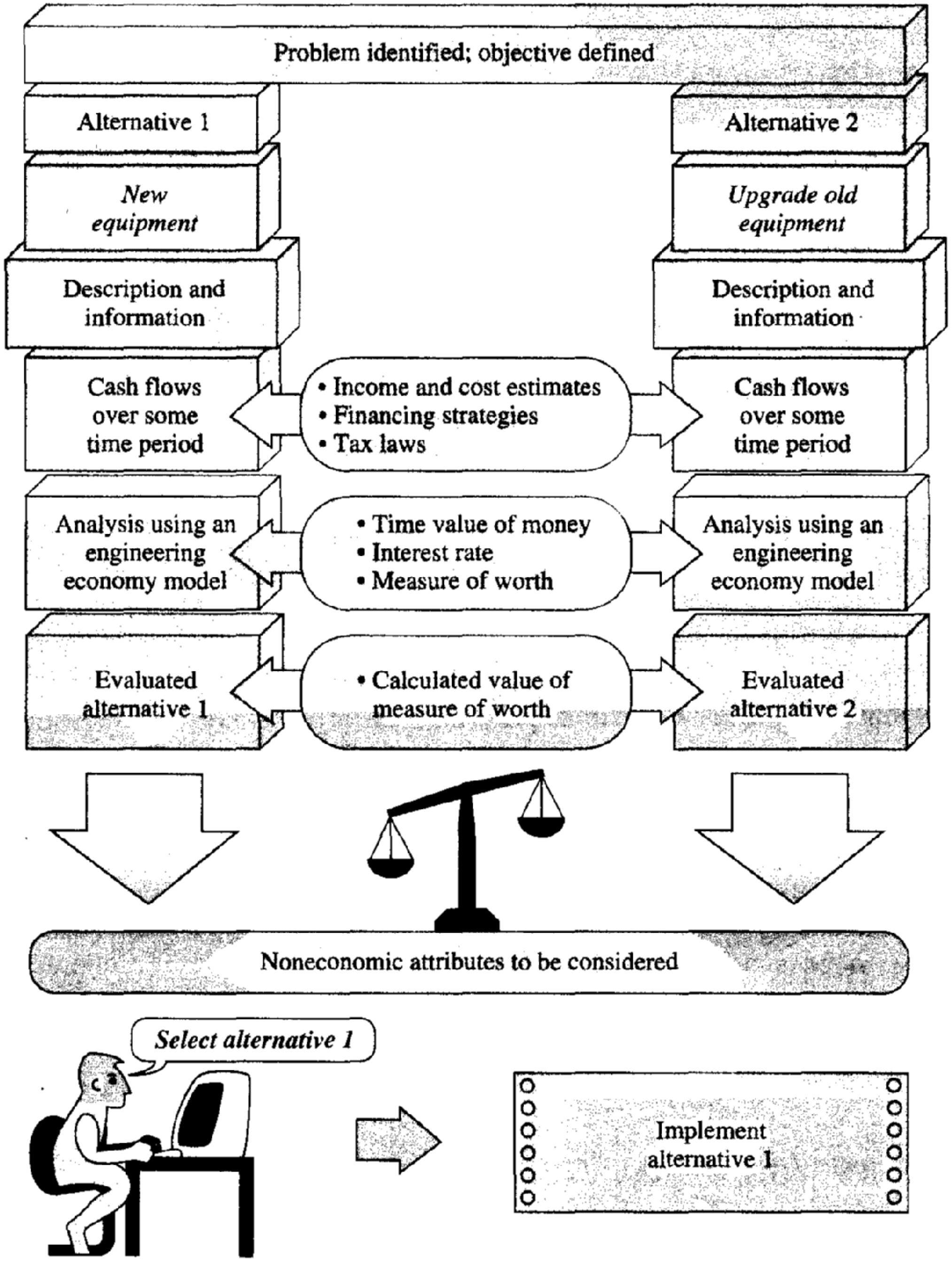
- To select an alternative among different ones, the measure-of-worth values are compared

- This is simply the result of engineering economy analysis

- Once the alternatives are evaluated and compared, the best alternative is selected and implemented

- Keep in mind that the alternatives represent projects that are economically and technologically viable

Alternative Selection Process



Project Categories

To help formulate alternatives, projects are categorized as one of the following:

- Mutually exclusive. Only one of the viable projects can be selected by the economic analysis. Each viable project is an alternative and *compete among each other*

- Independent. More than one viable project may be selected by the economic analysis. The *projects do not compete among each other*

Examples of Mutual Exclusive Projects

- Selection of the best power generation engines from several engines

- Constructing a road between two cities with an option of a road that crosses an intermediate city or another option of a road that circumvent that city

- Transporting goods between two river banks either by boats or through building a bridge

The Do-Nothing Alternative

- The do-nothing (DN) option is usually understood to be an alternative when the evaluation is performed
- If it is absolutely required that one of the defined alternatives to be selected, do nothing is not considered an option. This may occur when a mandated function must be installed for safety, legal, or other purposes
- Selection of the DN alternative means that the current situation is maintained; nothing new is initiated. No new costs, revenues, or savings are generated by the DN alternative

Analysis-period

- Three different analysis-period situations are encountered in economic analysis problems:
  1. The useful life of each alternative equals the analysis period.
  2. The alternatives have useful lives different from the analysis period.
  3. There is an infinite analysis period, n = 00.

Present Worth Analysis of Equal-Life Alternatives

- In present worth analysis, the P value, now called PW, is calculated at the MARR for each alternative

- MARR is the minimum attractive rate of return and is higher than the rate expected from a bank or some safe investment

- The expected rate of return must meet or exceed the MARR for an alternative to be financially viable

Present Worth Analysis of Equal-Life Alternatives

- The present worth method is popular because future cost and revenue estimates are transformed into equivalent dollars now

- This makes it easy to determine the economic advantage of one alternative over another

- The PW comparison of alternatives with equal lives is straightforward

- If alternatives are used for the same time period, they are termed equal-service alternatives

Present Worth Analysis of Equal-Life Alternatives

In mutually exclusive alternatives, the following guidelines are applied to select one alternative:

- One alternative. Calculate PW at the MARR. If PW ≥ 0, the requested MARR is met or exceeded and the alternative is financially viable

- Two or more alternatives. Calculate the PW of each alternative at the MARR. Select the alternative with the PW value that is numerically largest (less negative or more positive), indicating a lower PW of cost cash flows or larger PW of net cash flows of receipts minus disbursements

Present Worth Analysis of Equal-Life Alternatives

- Note that the guideline to select one alternative with the lowest cost or the highest income uses the criterion of numerically largest

- This is NOT the absolute value of the PW amount, because the sign matters

PW1 $	PW2 $	Selected Alternative
-1,500	-500	2
-500	1,000	2
+2,500	-500	1
+2,500	1,500	1

Present Worth Analysis of Equal-Life Alternatives

If the projects are independent, the selection guideline is as follows:

For one or more independent projects, select all projects with $PW \geq 0$ at the MARR

Present Worth Analysis of Equal-Life Alternatives - Example

Perform a present worth analysis of equal-service machines with the costs shown below, if the MARR is 10% per year. Revenues for all the three alternatives are expected to be the same

Cost Type	Electric-Powered	Gas-Powered	Solar-Powered
First cost, $	-2,500	-3,500	-6,000
Annual operating cost, $	-900	-700	-50
Salvage value, $	200	350	100
Life, years	5	5	5

Present Worth Analysis of Equal-Life Alternatives - Example

- The salvage values are considered a "negative" cost, so a "+" sign precedes them
- The PW of each machine is calculated at $i = 10\%$ for $n = 5$ years
- $PW_E = -2{,}500 - 900(P/A,10\%,5) + 200(P/F,10\%,5) =$ $\$ -5{,}788$
- $PW_G = -3{,}500 - 700(P/A,10\%,5) + 350(P/F,10\%,5) =$ $\$ -5{,}936$
- $PW_S = -6{,}000 - 50(P/A,10\%,5) + 100(P/F,10\%,5) =$ $\$ -6{,}127$
- The electric-powered machine is selected since the PW of its costs is the lowest (it has the numerically largest PW value)