ENGINEERING ECONOMICS

ENGINEERING – Transformation of the resources of nature for the benefit of mankind.

Such, resources of nature that require engineering enrichment include everything from ores and crops to information and energy.

The resources of the earth are limited (i.e., finite) and this places a pressing dimension on engineering evaluations.

The focus on scarce (or limited) resources links engineering to economics

“ECONOMICS - is the study of how people and society choose to employ scarce resources that could have alternative uses in order to produce various commodities and to distribute them for consumption, now or in the future, among various persons and groups in society.”

From: Paul A. Samuelson and William D. Nordhaus

Economics, 12th ed., McGraw-Hill,

New York, 1985

ENGINEERS are:

|  |  |  |
| --- | --- | --- |
| * Planners | * Builders | * Problem Solvers |
| * Managers | * Decision Makers |  |

Engineering Economics features prominently in all these activities since plans and production must be financed, problems are defined in terms of their dollar dimensions and decisions are evaluated by their monetary consequences.

Engineering Economics is devoted to problem solving, and decision making at the operations level. It involves the identification of the alternative uses of limited resources and obtaining the appropriate data, and the selection of the preferred course of action through analysis of the data.

Engineering economic evaluations rely mainly on mathematical models and cost data but judgement and experience are pivotal inputs.

Consider the following questions:

* Which one of several competing engineering designs should be selected?
* Should the machine now in use be replaced with a new one?
* How many units of production have to be sold before a profit can be made? (This area is commonly called break-even analysis)
* Among several proposals for funding that yield substantially equivalent worthwhile results but have different cash flows patterns, which one is preferable?
* Are the benefits expected from a public service project large enough to make its implementation costs acceptable?

Each of the questions in the foregoing involves:

* Choice among alternatives
* Economic considerations

In all cases, adequate data are required, the problem must be defined, taking technological constraints into consideration, and, finally legitimate solutions (i.e., decisions or recommendations) must be unidentified.

# **ENGINEERING ECONOMICS**

## **SUMMARY OF BASIC CONCEPTS IN ENGINEERING ECONOMIC ANALYSIS**

1. Decisions are among alternatives: it is desirable that alternatives be clearly defined and that the merits of all appropriate alternatives be evaluated.
2. Decisions should be based on the expected consequences of the various alternatives. All such consequences will occur in the future.
3. Before establishing procedures for project formulation and project evaluation, it is essential to decide whose viewpoint is to be adopted.
4. In comparing alternatives, it is desirable to make consequences commensurable with one another insofar as practicable. That is, consequences should be expressed in numbers and the same units should apply to all the numbers. In economic decisions, money units are the only units that meet the foregoing specification.
5. Only the differences among alternatives are relevant in their comparison.
6. Insofar as practicable, separable decisions should be made separately.
7. It is desirable to have a criterion for decision making, or possibly several criteria.
8. The primary criterion to be applied in a choice among alternative proposed investments in physical assets should be selected with the objective of making the bet use of limited resources.
9. Even the most careful estimates of the monetary consequences of choosing different alternatives almost certainly will turn out to be incorrect. It often is helpful to a decision maker to make use of secondary criteria that reflect in some way the lack of certainty associated with all estimates of the future.
10. Decisions among investment alternatives should give weight to any expected differences in consequences that have not been reduced to money terms as well as to the consequences that have been expressed in terms of money.
11. Often there are side-effects that tend to be disregarded when individual decisions are made. To consider such side-effects adequately, it may be necessary to examine the interrelationships among a number of decisions before any of the individual decisions can be made.

\*Reference: Grant, Ireson and Leavenworth, Principles of Engineering Economy, 7th, ed., Ronald Press, 1982.

The decisions an engineer has to make are not of a purely technical nature; the environmental, social, political, financial and economics consequences of decisions must also be taken into consideration.

### Example

You want to buy a car and you have three choices:

|  |  |  |  |
| --- | --- | --- | --- |
|  | **57 Chevy** | **87 Honda** | **82 Mercedes** |
| **Purchase** | $12,000 | $7,000 | $20,000 |
| **Operation** | $200/Mo | $50/Mo | $150/Mo |
| **Resale** | $13,000 | $6,000 | $20,000 |

Which one should you buy?

##### On economic grounds alone, ignoring inflation and possible drastic changes in general interest rates, the Chevy. This answer will make sense in due course. However, one should also take into account other factors such as:

* The Chevy’s probable unreliability
* The availability of funds
* Which car is the most comfortable
* Which car is most suited to your lifestyle
* Etc.

There are a number of ways to incorporate these intangibles into an engineering decision.

Some other examples of problems that require engineering decision-making:

* Should a manufacturing plant produce a part in its own production facility, knowing that major investment will be needed in new equipment and that expensive training procedures will have to be implemented, or should the plant subcontract to an outside vendor?
* An electric utility in considering updating its computer networking capability. Should the utility upgrade its existing minicomputer file servers, or should it consider scrapping them for new IBM AS/400 minicomputer systems? If it takes the latter, should the utility buy or lease?
* A manufacturing engineer is planning a high-speed production line that will use automated transfer mechanisms to move and position products from one automated workstation to the next. More complex workstations will allow more operations to be completed at a workstation at the expense of lower production rates per hour. However, such a situation could have the advantage of allowing fewer expensive transfer mechanisms. Given forecasts of product demand for the next 5 years, should the engineer plan for a one-shift operation with a certain number of transfer mechanisms or for a two-shift operation with fewer transfer mechanism?

###### TIME VALUE OF MONEY

As a result of interest, which can be defined as the cost of using capital, money has different values at different times even if the purchasing power remains the same.

###### Example

|  |  |  |  |
| --- | --- | --- | --- |
| End of Year | Payment | | |
| 0  1  2 | $1,000  -  - | $500  $500  - | -  -  $1,000 |
| Value at end of Year 2@10% | $1,210 | $1,155 | $1,000 |

OBJECTIVE OF TIME-VALUE ANALYSIS: To translate various time series to a single equivalent payment (given interest rate) or can equivalent earned interest (rate or return)