

# *CE 203 Civil Engineering Synthesis I*

## *Engineering Economic Analysis*

### **MAKING ECONOMIC DECISIONS**

### **Chapter 1**

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# Instructional Objectives

- Be able to define a problem as simple, intermediate or complex
- Be able to define the role of engineering economic analysis in decision making
- Be able to state the nine essential elements in the rational decision making process

# People are Surrounded by Problems

- Which career to pursue?
- What level of preparation is required for the career chosen?
- Where may the preparation be obtained?
- How to get up and get to class?

# Organizations Have Opportunities

- Do we make part A or B today?
- Should we use a drilling or boring machine?
- Should we purchase a boring machine?
- When must we replace the drilling machine?

*Decisions concerning these opportunities may be arrived at with the help of economic analysis.*

# Simple Problems:

- Simple
  - Intermediate
    - Complex
- Can generally be worked in one's head without extensive analysis.

# Intermediate Problems

- Must be organized and analyzed
- Are sufficiently important to justify serious thought and action
- Have significant economic aspects
- Are primarily economic
- Are the principal subject of this course
- Assume an economic situation in equilibrium
- Are generally adequately solved with single-criteria decision making

# Complex Problems

- Such problems represent a mixture of 3 elements: economic, political and humanistic.
- Complex problems are beyond the scope of this course from a decision-making criteria point of view, but the economic aspects of complex problems will be discussed.

# Role of Engineering Economic Analysis

- Assists in making decisions where:
  - The decision is sufficiently important that serious thought and effort is required.
  - Careful analysis requires that the decision variables be carefully organized and the consequences be understood.
  - ECONOMIC ISSUES are a significant component of the analysis leading to a decision.

# The Decision Making Process

1. Recognize problem;
2. Define the goal or objective;
3. Assemble relevant data;
4. Identify feasible alternatives;
5. Select criterion to determine the best alternative;
6. Construct a model;
7. Predict each alternative's outcomes or consequences;
8. Choose the best alternative; and
9. Audit the result.

# 1. Recognize the Problem

- A problem exists when:
  - A standard or expectation is not being met.
  - A new standard or expectation is established and needs to be achieved. (An opportunity.)

## 2. Define the Goal or Objective

- A goal or objective is the standard or expectation we wish to meet.
  - A goal is a general statement about what we expect.
    - Eliminate odors at the pump station
  - An objective is narrow and specific.
    - Install odor control equipment at the pump station to eliminate odor complaints from area residents

# 3. Assemble Relevant Data

- Information may be published or individual knowledge.
- Deciding which data is relevant may be a complex process.
- In engineering decision making two important sources of data are the organization's accounting and purchasing departments.
- In many engineering problems you may need to collect more information (data).

# 4. Identify Feasible Alternatives

- The best alternative should be implemented. Occasionally this is to maintain the existing situation.
- Alternatives considered should include both conventional and innovative approaches.
- Only feasible alternatives should be retained for further analysis.

# 5. Select the Criterion to Determine the Best Alternative

- A criterion, or a set of criteria, is used to evaluate the alternatives to determine which is best.
- The “best” alternative is relative.
- Selecting criteria to use is not easy because different groups often support different criteria.
- The criterion most often used in economic decision-making is to “use money in the most efficient manner.”

# Economic Decision-Making Problems Fall Into Three Categories

1. For fixed input situations, maximize the benefits or other outputs.
2. For fixed output situations, minimize the costs or other inputs.
3. Where inputs and outputs vary, maximize (benefits – costs).

# 6. Construct the Model

- Requires merging the various elements: objective, relevant data, feasible alternatives and selection criteria.
- In economic decision making the models are usually mathematical.
- A model is a representation of reality.
  - A model must represent the important parts of the system at hand.
  - Be adequate to solve the problem.

# 7. Predicting the Outcomes for Each Alternative

- To avoid complications, we assume that a decision is based on a single criterion. If necessary, multiple criteria are combined into a single criterion.
- Usually the consequences or alternatives are stated in the form of money, i.e., costs/benefits.
- Costs and benefits may occur over a short or long time period.

# 8. Choosing the Best Alternative

- When choosing the best alternative both economic and non-economic criteria must be considered.
- During the prior steps in the decision making process, only dominant alternatives may be included based on either economic or non-economic criteria.
- The elimination of feasible alternatives may predetermine the outcome of the decision making process.

# 9. Audit the Results

- Compare the results of changes to the predictions to assure that the chosen alternative was implemented as planned and the results are as expected.
  - Fix deviations from planned changes.
  - Make sure prediction errors are not repeated.
  - Identify added opportunities.
- Audits promote realistic economic analysis and implementation.

# Engineering Decision Making

- Examples: