

IPE-209

Engineering Economy

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PEARSON

Engineering Economy, Fourteenth Edition
By William G. Sullivan, Elin M. Wicks, and C. Patrick Koelling

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Introduction to Engineering Economy

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The purpose of this course is to develop and illustrate the principles and methodology required to answer the basic economic question of any design: Do its benefits exceed its cost?

Engineering economy...

Involves the systematic evaluation of the economic merits of proposed solutions to engineering problems.

To be economically acceptable (i.e., affordable), solutions to engineering problems must demonstrate a positive balance of long-term benefits over long-term costs, and they must also.....

Solutions to engineering problems must

- Promote the well-being and survival of an organization,
- Embody creative and innovative technology and ideas,
- Permit identification and scrutiny of their estimated outcomes, and
- Translate profitability to the “bottom line” through a valid and acceptable measure of merit.

Engineering economic analysis can play a role in many types of situations.

- Choosing the best design for a high-efficiency gas furnace.
- Selecting the most suitable robot for a welding operation on an automotive assembly line.
- Making a recommendation about whether jet airplanes for an overnight delivery service should be purchased or leased.
- Determining the optimal staffing plan for a computer help desk.



Green Engineering in Action

Energy conservation comprises an important element in environmentally-conscious (green) engineering. In a Southeastern city, there are 310 traffic intersections that have been converted from incandescent lights to light-emitting diode (LED) lights. The study that led to this decision was conducted by the sustainability manager of the city. The wattage used at the intersections has been reduced from 150 watts to 15 watts at each traffic light. The resultant lighting bill has been lowered from \$440,000 annually to \$44,000 annually. When engineers went to check the traffic light meters for the first time, they were shocked by the low wattage numbers and the associated cost. One of them said, "We thought the meters were broken because the readings were so low." The annual savings of \$396,000 per year from the traffic light conversion more than paid for the \$150,000 cost of installing the LED lights. Chapter 1 introduces students to the decision-making process that accompanies "go/no go" evaluations of investments in engineering projects such as the one described above.

Fundamental principles of engineering economy.

- Develop the alternatives: Carefully define the problem! Then the choice (decision) is among alternatives. The alternatives need to be identified and then defined for subsequent analysis.
- Focus on the differences: Only the differences in expected future outcomes among the alternatives are relevant to their comparison and should be considered in the decision.
- Use a consistent viewpoint: The prospective outcomes of the alternatives, economic and other, should be consistently developed from a defined viewpoint (perspective).

Fundamental principles of engineering economy.

- Use a common unit of measure: Using a common unit of measurement to enumerate as many of the prospective outcomes as possible will simplify the analysis of the alternatives.
- Consider all relevant criteria: Selection of a preferred alternative (decision making) requires the use of a criterion (or several criteria). The decision process should consider both the outcomes enumerated in the monetary unit and those expressed in some other unit of measurement or made explicit in a descriptive manner.

Fundamental principles of engineering economy.

- Make uncertainty explicit: Risk and uncertainty are inherent in estimating the future outcomes of the alternatives and should be recognized in their analysis and comparison.
- Revisit your decisions: Improved decision making results from an adaptive process; to the extent practicable, the initial projected outcomes of the selected alternative should be subsequently compared with actual results achieved.

Engineering economic analysis procedure

- Problem definition
- Development of alternatives
- Development of prospective outcomes
- Selection of a decision criterion
- Analysis and comparison of alternatives.
- Selection of the preferred alternative.
- Performance monitoring and post-evaluation of results.



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Engineering economic analysis procedure

TABLE 1-1 The General Relationship between the Engineering Economic Analysis Procedure and the Engineering Design Process

Engineering Economic Analysis Procedure	Engineering Design Process (see Figure P1-15 on p. 18)
<i>Step</i>	<i>Activity</i>
1. Problem recognition, definition, and evaluation.	1. Problem/need definition.
2. Development of the feasible alternatives.	2. Problem/need formulation and evaluation.
3. Development of the outcomes and cash flows for each alternative.	3. Synthesis of possible solutions (alternatives).
4. Selection of a criterion (or criteria).	4. Analysis, optimization, and evaluation.
5. Analysis and comparison of the alternatives.	
6. Selection of the preferred alternative.	
7. Performance monitoring and post-evaluation of results.	5. Specification of preferred alternative.
	6. Communication.



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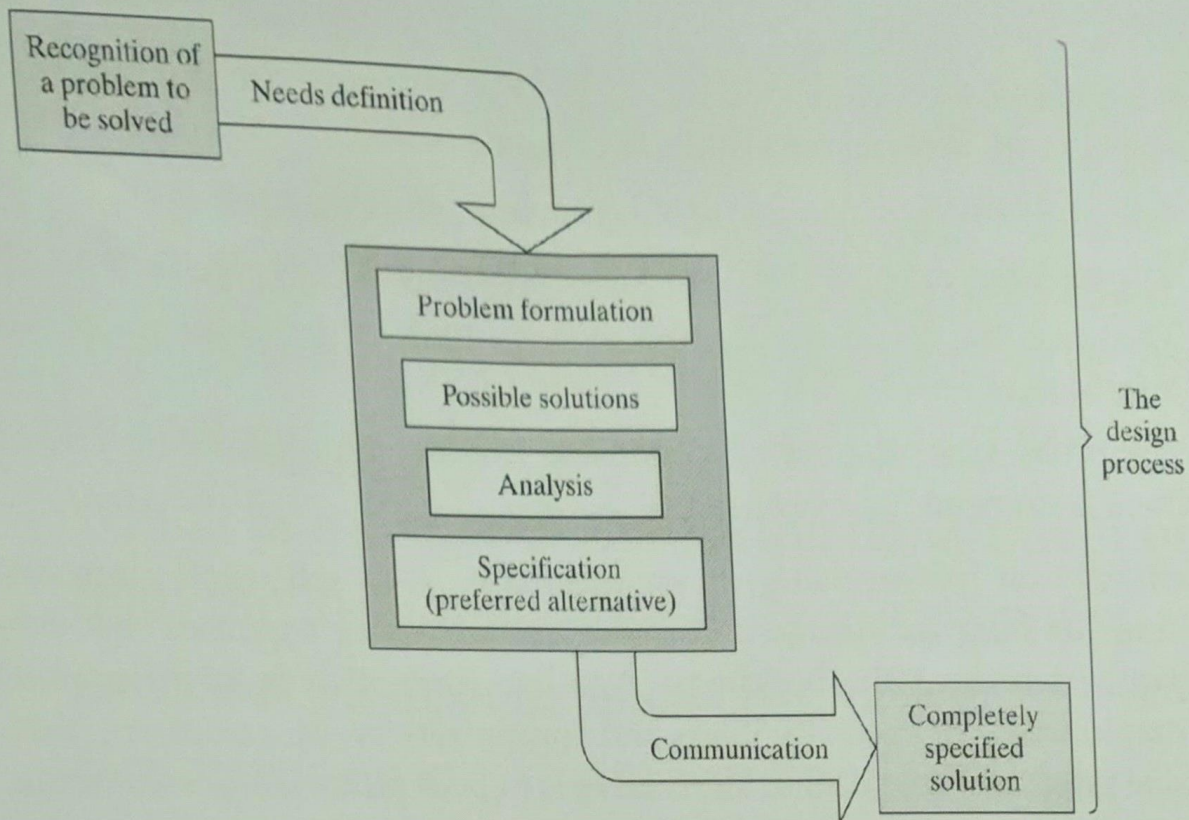


Figure P1-15

Engineering economic analysis procedure

Defining the Problem and Developing Alternatives

The management team of a small furniture-manufacturing company is under pressure to increase profitability to get a much-needed loan from the bank to purchase a more modern pattern-cutting machine. One proposed solution is to sell waste wood chips and shavings to a local charcoal manufacturer instead of using them to fuel space heaters for the company's office and factory areas.

- (a) Define the company's problem. Next, reformulate the problem in a variety of creative ways.
- (b) Develop at least one potential alternative for your reformulated problems in Part (a). (Don't concern yourself with feasibility at this point.)

Solution

- (a) The company's problem appears to be that revenues are not sufficiently covering costs. Several reformulations can be posed:
1. The problem is to increase revenues while reducing costs.
 2. The problem is to maintain revenues while reducing costs.
 3. The problem is an accounting system that provides distorted cost information.
 4. The problem is that the new machine is really not needed (and hence there is no need for a bank loan).
- (b) Based only on reformulation 1, an alternative is to sell wood chips and shavings as long as increased revenue exceeds extra expenses that may be required to heat the buildings. Another alternative is to discontinue the manufacture of specialty items and concentrate on standardized, high-volume products. Yet another alternative is to pool purchasing, accounting, engineering, and other white-collar support services with other small firms in the area by contracting with a local company involved in providing these services.



Application of the Engineering Economic Analysis Procedure

A friend of yours bought a small apartment building for \$100,000 in a college town. She spent \$10,000 of her own money for the building and obtained a mortgage from a local bank for the remaining \$90,000. The *annual* mortgage payment to the bank is \$10,500. Your friend also expects that annual maintenance on the building and grounds will be \$15,000. There are four apartments (two bedrooms each) in the building that can each be rented for \$360 per month.

Refer to the seven-step procedure in Table 1-1 (left-hand side) to answer these questions:

- (a) Does your friend have a problem? If so, what is it?
- (b) What are her alternatives? (Identify at least three.)
- (c) Estimate the economic consequences and other required data for the alternatives in Part (b).
- (d) Select a criterion for discriminating among alternatives, and use it to advise your friend on which course of action to pursue.
- (e) Attempt to analyze and compare the alternatives in view of at least one criterion in addition to cost.
- (f) What should your friend do based on the information you and she have generated?



Assignment

- We need a photocopier that will copy at least 30 pages/min. Average daily photocopy is 200 impressions. It has a budget of Tk100,000/-. Which brand/model should the department buy from the local market? Justify your answer (initial cost, maintenance cost, power consumption etc.) . Assume/(collect from photocopy shop owner) reasonable values for any missing information.