

# Introduction to Engineering Economy

SEA – General Engineering Department

# Engineering Economy

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Engineering is the profession in which a knowledge of the mathematical and natural sciences gained by study, experience, and practice is applied with judgment to develop ways to utilize, economically, the materials and forces of nature for the benefit of mankind. (Accreditation Board for Engineering and Technology)



# Engineering Economy

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Economics deals with the allocation of resources, creation and utilization of goods and services for the satisfaction of human wants.

# Engineering Economy

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Engineering economy involves the systematic evaluation of the economic merits of proposed solutions to engineering problems.



# Engineering Economy

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Engineering economy is the analysis and evaluation of the factors that will affect the economic success of engineering projects to the end that a recommendation can be made which will insure the best use of capital.

# Engineering Economy

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Engineering economy involves technical analysis, with emphasis on the economic aspects, and has the objective of assisting decisions.

The mission of engineering economy is to balance trade-offs in the most economical manner.

Any engineering project must not only be physically realizable but also economically affordable.



# Solutions to Engineering Problems must

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- promote the well-being and survival of an organization
- embody creative and innovative technology and ideas
- permit identification and scrutiny of their estimated outcomes
- 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.**

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- 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.



# Principles of Engineering Economy

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- Develop the alternatives
- Focus on the differences
- Use a consistent viewpoint
- Use a common unit of measure
- Consider all relevant criteria
- Make risk and uncertainty explicit
- Revisit your decisions

# Principles of Engineering Economy

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- Develop the alternatives

The final 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.



# Principles of Engineering Economy

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- Use a consistent viewpoint

The prospective outcomes of the alternatives, economic and other, should be consistently developed from a defined viewpoint (perspective).

- Use a common unit of measure

Using a common unit of measurement to enumerate as many of the prospective outcomes as possible will make easier the analysis and comparison of alternatives.

# Principles of Engineering Economy

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- Consider all relevant criteria

Selection of a preferred alternative (decision making) requires the use of a criterion (or several criteria).

- Make risk and uncertainty explicit

Uncertainty is inherent in projecting (or estimating) the future outcomes of the alternatives and should be recognized in their analysis and comparison.



# Principles of Engineering Economy

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- 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 Economy and the Design Process

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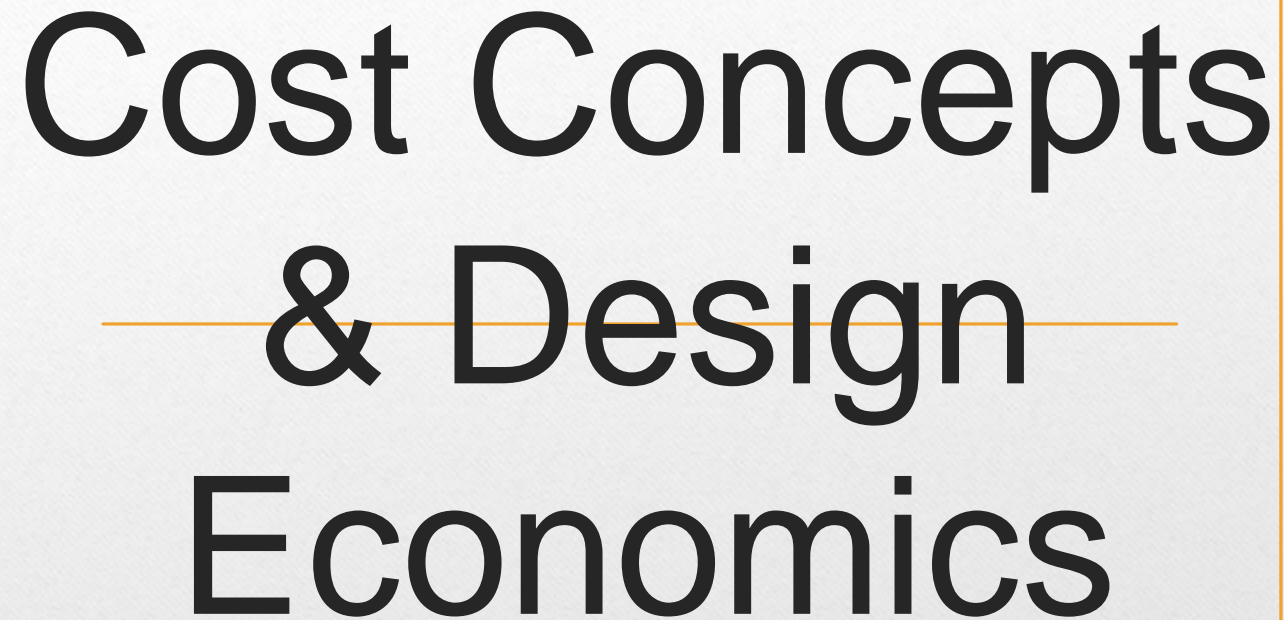
An engineering economy study is accomplished using a structured procedure and mathematical modeling techniques. The economic results are then used in a decision situation that involves two or more alternatives and normally includes other engineering knowledge and input.



# Engineering Economic Analysis Procedure

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1. Problem definition
2. Development of alternatives
3. Development of prospective outcomes
4. Selection of a decision criterion
5. Analysis and comparison of alternatives
6. Selection of the preferred alternative
7. Performance monitoring and post-evaluation of results



# Cost Concepts & Design Economics



# Cost Terminology

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- Fixed costs are those unaffected by changes in activity level over a feasible range of operations for the capacity or capability available.

Examples: insurance and taxes on facilities, general management and administrative salaries, license fees, interest costs on borrowed capital

- Variable costs are those associated with an operation that varies in total with the quantity of output or other measures of activity level.

Examples: costs of material and labor used in a product or service

# Cost Terminology

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- Incremental cost (or incremental revenue) is the additional cost (or revenue) that results from increasing the output of a system by one (or more) units.

Example: mileage

- Direct costs are costs that can be reasonably measured and allocated to a specific output or work activity.

Example: labor and material costs directly associated with a product, service or construction activity



# Cost Terminology

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- Indirect costs are costs that are difficult to attribute or allocate to a specific output or work activity.

Examples: proportion, costs of common tools, general supplies and equipment maintenance in a plant

- Standard costs are planned costs per unit of output that are established in advance of actual production or service delivery.

Examples: anticipated labor hours, materials and overhead categories

# Cost Terminology

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- Cash cost is a cost that involves payment of cash.  
Example: estimated, future expenses for alternatives
- Book cost is a noncash cost that is reflected in the accounting system.  
Example: depreciation



# Cost Terminology

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- Sunk cost is one that has occurred in the past and has no relevance to estimates of future costs and revenues related to an alternative course of action.

Example: money spent on passport and deposit

- Opportunity cost is incurred because of the use of limited resources, such that the opportunity to use those resources to monetary advantage in an alternative use is foregone.

Example: a student who could earn P50,000 a year but chooses to study and spend P20,000

# Cost Terminology

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- Life-cycle cost refers to a summation of all the costs related to a product, structure, system, or service during its life span.
- Life cycle begins with identification of the economic need or want and ends with retirement or disposal activities.



# Life Cycle Cost

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- Acquisition phase (investment cost and working capital)
  - Needs assessment, definition of requirements
  - Conceptual design, advanced development, prototype testing
  - Detailed design, production or construction planning, facility and resource acquisition

# Life Cycle Cost

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- Operation phase (operation and maintenance cost and disposal cost)
  - Production or construction
  - Operation or consumer use
  - Maintenance and support
  - Retirement and disposal



# Life Cycle Cost Categories

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- Investment cost – is the capital required for most of the activities in the acquisition phase
- Working capital – refers to the funds required for current assets that are needed for the start-up and support of operational activities

# Life Cycle Cost Categories

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- Operation and maintenance cost – includes many of the recurring annual expense items associated with the operation phase of the life cycle (people, machines, materials, energy and information)
- Disposal cost – includes those nonrecurring costs of shutting down the operation and the retirement and disposal of assets at the end of the life cycle





# General Economic Environment

# General Economic Environment

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- Consumer goods and services are those products or services that are directly used by people to satisfy their wants.
- Examples: food, clothing, homes, cars, television sets and medical services



# General Economic Environment

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- Producer goods and services are used to produce consumer goods and services or other producer goods.
- Examples: machine tools, factory buildings, buses, farm machinery

# General Economic Environment

- Necessities are those products or services that are required to support human life and activities.
- Luxuries are those products or services that are desired by humans and will be purchased if money is available after the required necessities have been obtained.



# General Economic Environment

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- Demand is the quantity of a certain commodity that is bought at a certain price at a given place and time.
- Supply is the quantity of a certain commodity that is offered for sale at a certain price at a given place and time.

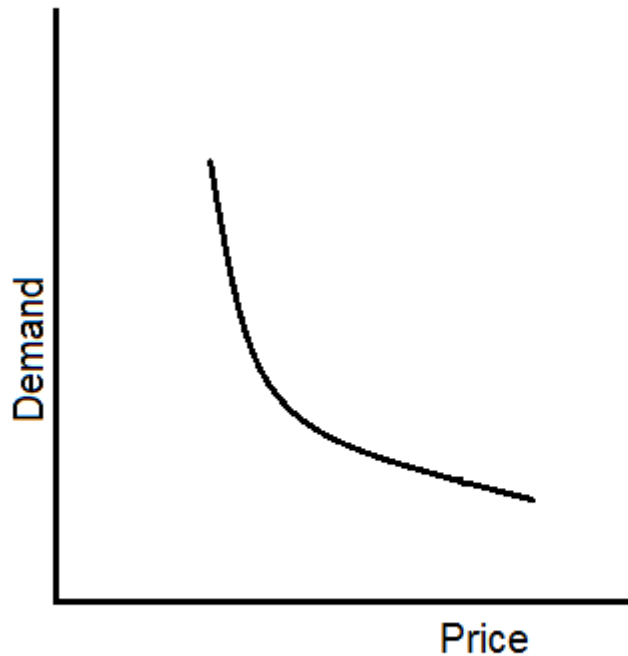
# General Economic Environment

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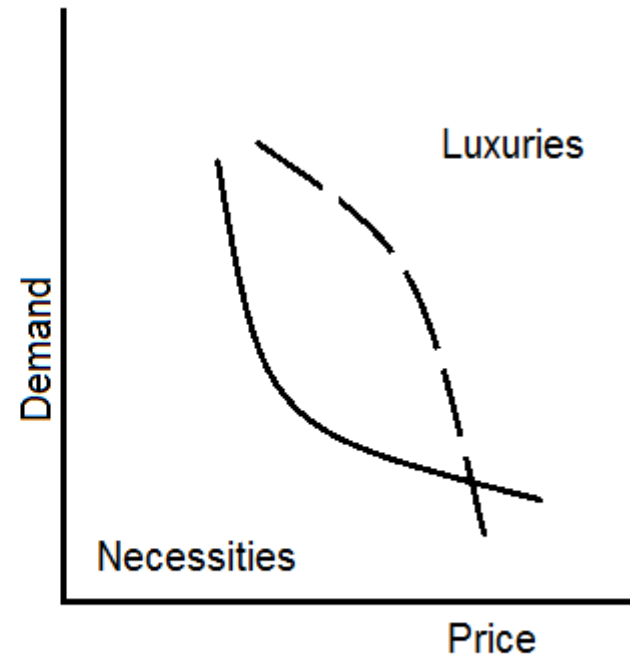
- Elastic demand occurs when a decrease in selling price result in a greater than proportionate increase in sales.
- Inelastic demand occurs when a decrease in the selling price produces a less than proportionate increase in sales.
- Unitary elasticity of demand occurs when the mathematical product of volume and price is constant.



# General Economic Environment



General price-demand relationship



Price-demand relationship for luxuries and necessities

# General Economic Environment

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- Perfect competition occurs in a situation in which any given product is supplied by a large number of vendors and there is no restriction on additional suppliers entering the market.



# General Economic Environment

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- Perfect monopoly exists when a unique product or service is only available from a single supplier and that vendor can prevent the entry of all others into the market.

# General Economic Environment

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- Oligopoly exists when there are so few suppliers of a product or service that action by one will almost inevitable result in similar action by the others.



# Law of Supply and Demand

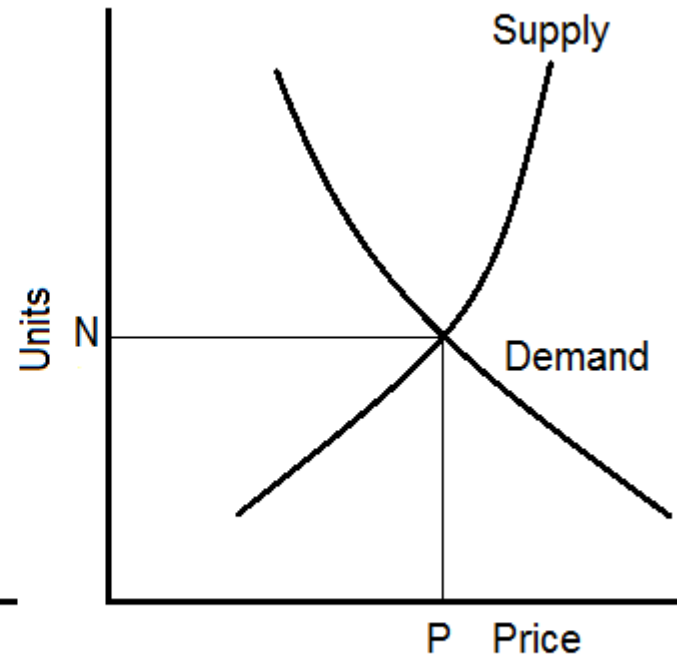
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Under conditions of perfect competition the price at which a given product will be supplied and purchased is the price that will result in the supply and the demand being equal.

# General Economic Environment



General price-supply relationship



Price-supply-demand relationship



# Law of Diminishing Returns

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When the use of one of the factors of production is limited, either in increasing cost or by absolute quantity, a point will be reached beyond which an increase in the variable factors will result in a less than proportionate increase in output.

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