



ENGINEERING

What is Engineering?

- The application of mathematics and scientific principles to better or improve life
- To equip creative minds with the mathematical and analytical skills necessary to conceive of new designs
- To intelligently question present ways of accomplishing tasks
- To find better alternative methods in light of evolving technology

What Functions Do Engineers Perform?

RESEARCH:

- To employ basic scientific principles in the discovery and application of new knowledge that will have commercial or economic value
- To develop existing or invent new products
- The scientist job is to “discover truths” about a subject
- Research engineers find a use for the discoveries of scientists
- Can be disheartening - much of the work is trial and error
- Last few decades, almost all research was done solo
- With knowledge of chemistry, physics, and biology, groups or “research teams” of scientists and engineers would accelerate discoveries

What Functions Do Engineers Perform?

DEVELOPMENT :

- The actual construction, fabrication, assembly, layout, and testing of scale models, pilot models, and experimental models for pilot processes or procedures that will work
- Does not deal exclusively with new discoveries but involves using well-known principles and employing existing processes or machines to perform a new or unusual function
- Searches in library, manufacturing literature and patents for existing ideas

What Functions Do Engineers Perform?

DEVELOPMENT :

- Involved in the acquisition of patents to protect ideas, processes or products
- Creativity and innovation, a knowledge of basic principles of science and an inherent cleverness in making things work
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DESIGN:

- Must anticipate all manner of problems that the user may create in the application of a machine, or use of a structure
- Must prevent user errors, accidents, and dissatisfaction
- Requires a mastery of basic engineering principles and mathematics, and an understanding of the capabilities of machines
- Not only must the device or process work, it must also be made in a style and at a price that will attract customers.
- To arrive at a design solution that will provide for adequate safety without excessive redundancy

What Functions Do Engineers Perform?

PRODUCTION AND CONSTRUCTION:

- Must take the design engineer's drawings and supervise the assembly of the object as it was conceived
- Works closely with the technicians, mechanics, and laborer
- Associated with the process of estimating and bidding for competitive jobs
- Employ knowledge of structural materials, fabricating processes and general physical principles to estimate both time and cost to accomplish a task

What Functions Do Engineers Perform?

PRODUCTION AND CONSTRUCTION:

- “Project Engineer” controls other engineers on job
- Preparation of schedules for production or construction
- Must have knowledge of engineering principles and visualization skills

What Functions Do Engineers Perform?

OPERATIONS OR PLANT:

- Responsible for the maintenance of the building, equipment, grounds, and utilities
- Varies from routine tasks to setting up and regulating the most complex automated machinery
- Wide knowledge of several branches of engineering
- Compare costs of operating under various conditions and set schedules for machines so that the best use will be made of them
- Evaluate new equipment and retire old equipment
- Must be able to work with people and machines and know what results to expect from them

What Functions Do Engineers Perform?

SALES:

- Presenting the use of new products to prospective customers
- Intimate knowledge of the principles involved, to educate possible users so that a demand can be created
- Ability to “talk their language” and answer technical questions
- Must be familiar with the operations of a customer’s plant
- Be able to show how their product will fit into the plant
- Ability to show the economics involved to convince the customer to buy
- Knowing applications in which no apparatus is available and reporting back to the company that a need exists for R& D

What Functions Do Engineers Perform?

MANAGEMENT:

Recent surveys show that the trend today is for corporate leaders in the United States to have a background in engineering and science

- Using the capabilities of the company to the best advantage to produce a desirable product in a competitive economy
- Make decisions involving:
 - equipment in the plant
 - the labor force
 - financial assets



What Functions Do Engineers Perform?

MANAGEMENT:

- Business side of the operation that the engineer usually must work harder to develop
- Concerned with long-range effects of policy decisions mainly financial, legal, and labor aspects



What Fields Of Engineering Are Available ?

WHAT IS INVOLVED IN THAT
FIELD OF STUDY?



Aeronautical Engineering

- Deals with flight and the movement of fluids in the earth's atmosphere.
- Specializing in work areas centered on:
 - aerodynamics
 - propulsion
 - controls
 - structure



Aerospace and Astronautical Engineering

- Deals with environments not found on earth
- Specialization in work areas centered on:
 - propulsion cryogenics
 - materials navigation
 - thermodynamics cosmic radiation



Agricultural Engineering

- Blends engineering knowledge with soil systems, land management, and environmental control to create methods and technologies that will allow the continuation of high crop yield
- Five specialty Fields:
 1. Soil & Water Engineering:
 - water drainage
 - erosion control
 - irrigation systems
 - land use



Agricultural Engineering

2. Food Engineering:

- minimize waste -minimize energy consumption
- minimize damage -Drying (vacuum)
- irradiation(long-term storage)

3. Power Machinery Engineering:

- feed systems
- storage systems(silo)
- waste handling systems
- processing(tractors, rakes, combines, mowing)



Agricultural Engineering

4. Structures Engineering:

- livestock
- silo (food)
- milking parlors
- waste handling

5. Electric Power Generation Engineering:

- remote locations
- self sufficiency
- power outages



Architectural Engineering

- Works with architects focusing on structural integrity and safety of design
- Structural engineering and this field are very similar, the main difference is the concern for aesthetics



Automotive Engineering

- Design and build all types of vehicles:
 - automobiles -trucks -tractors
 - bulldozers -motorcycles

Deals with:

- **Engine Design:**
 - thermal and mechanical
 - fuels and lubrication



Automotive Engineering

- **Structural Design:**
 - thermoplastics vs. metal
- **Tire Design:**
 - Manufacturing processes
 - Tread and Tire life



Biomedical Engineering

- Bridges engineering, physical, and life sciences in identifying and solving medical and health-related problems

Three general divisions:

1. **Bioengineering**, a research activity, applies engineering techniques to biological systems (kidney dialysis)
2. **Medical Engineering** develops medical instrumentation, artificial organs, prosthetic devices, and materials
3. **Clinical Engineering** concerns itself with the hospital systems; decontaminating airlines, removing anesthetics gases from operating rooms



Ceramic Engineering

- The use of nonmetallic, inorganic material that fuse at high temperatures to form a variety of materials
- Materials from beautiful but commonplace table settings, to the protective coatings of electrical transducers or the refractories of space exploratory nozzles, to the spark plugs of your car
- Ceramic engineers are employed by a variety of industries



Chemical Engineering

- Must be able to apply scientifically the principles of chemistry, physics, and engineering to design an operation of plants for the production of materials that undergo chemical changes during their processing
- Responsible for new and improved products and processes:
 - new fuels for rockets, reactors, and booster propulsion
 - medicines, vaccines, serum, and plasma
 - plastics, synthetics and textiles

Civil and Construction Engineering

- Plan, design, and supervise the construction of facilities in both the public and private sectors
- Projects vary widely in nature, size and scope:
 - space satellites launch facilities
 - offshore structures bridges
 - buildings tunnels
 - highways transit systems
 - dams airports
 - irrigation projects
 - treatment and distribution facilities for water
 - collection and treatment for wastewater



Computer Engineering

- The design and organization of computers:
 - hardware
 - software

Who is the largest consumer of computers today?
Automotive Industry



Electrical and Electronics Engineering

- Deals with the motion of electrons in metals
- Work focused on:
 - large electrical systems
 - motors and generators
 - electrical circuits in buildings
 - power transmission systems
 - electrical generation plants
- Electronics Engineering deals with the passage of charged particles in a gas, vacuum, or semiconductor:
 - microprocessor-bases control systems



Environmental Engineering

- Deals with creating processes and product that minimally disrupts the natural environment
- Affiliated with civil engineering programs in universities
- Concerns:
 - chemically; focusing on the containment of hazardous materials
 - mechanically; focusing on air pollution caused by the combustion process
 - civil; dealing with waste disposal or water quality issues



Industrial Engineering

- The design, improvement, and installation of integrated systems of people, materials and energy to produce a product at the lower possible cost
- Deals with:
 - design of systems for the manufacture of products
 - raw materials to machines
 - workforce to operate machinery
 - removal of finished products
 - maintenance of machinery
 - analysis of manufacturing processes for cost



Manufacturing Engineering

- Design of a manufacturing facility for a product or products
- Deals with:
 - physical plant layout
 - use of existing machines or new
 - buy or rent facilities
 - purchase of nonproducing facilities and equipment
 - packaging of product
 - shipping to market



Marine Engineering

- Responsible for the design of the ships propulsion and auxiliary systems such as:
 - heat and ventilation
 - water and waste systems
 - navigational system
- **Naval Architect** - designs the ships structure; its hull form and the interaction between the hull and the water
- **Ocean Engineering** - designs of vehicles and devises that cannot be called a ship or boat
 - drill rigs
 - offshore harbor facilities
 - underwater machinery

Materials and Metallurgical Engineering

- **Materials Engineering** seek to understand the properties of materials by their behavior
- Develop new material to improve characteristics such as :
 - strength
 - corrosion resistance
 - fatigue strength
- **Metallurgical Engineering** deals with the extraction of metals from naturally occurring ores;
 - steel from iron ore
 - aluminum from bauxite



Mechanical Engineering

- Apply the principles of mechanics and energy to the design of machines and devices
- Most often associated with devices that move but includes thermal designs as well HVAC
- Vibration analysis
- Lubrication
- Gears and Bearing



Geological Engineering

- The exploration and mapping of oil, minerals or ore bodies
- Knowledge of
 - geology
 - drilling
 - soils and rock
 - blasting techniques
 - environment restoration



Nuclear Engineering

- Deals with the design and development of electrical power plants
- Design of propulsion systems
- Design of equipment for the medical profession
- Irradiation of food for long-term storage
- Radiation techniques to detect hidden flaws in material



Assignment 1

- List the major functions an engineer performs and an example of each function
- List each field of engineering and the description of what each type of engineer does.

For detailed employment information visit:

<http://www.bls.gov/oco>



Project 2

- Choose 1 Field of Engineering to study in detail
- Use the internet to gather information about your chosen field
 - Locate and write down the address for a minimum of (3) websites that contain information about your chosen field
- Create an informational poster for your field of engineering that includes the following information:
 - A description of the type of work involved
 - Images related to that specific field
 - Education requirements
 - Typical salary range
 - Employment statistics
 - Job outlook for the field
 - “For More Information” section that lists the 3 addresses from above