

ENGINEERING

What is It?

What Do Engineers Do?

Where Do Engineers Do It?



Prof. Howard Kimmel,
Associate Vice President,
Executive Director
Center for Pre-College
Programs
Professor of Chemical
Engineering
New Jersey Institute of
Technology
Newark, NJ



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New Jersey Institute of Technology Background



- **Located in Newark, NJ**
- **5800 undergraduates and 3000 graduate students**
- **Five Academic Colleges and the Albert Dorman Honors College**
- **Students can be “career-ready” with Bachelor’s degree**
- **1/3 under-represented populations (women, Hispanic and black)**



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Why Engineering?

- 21st Century economy demands educated workforce
 - Science, technology, engineering and mathematics (STEM)
- Science and technology have been and will continue to be engines of US economic growth and national security
 - Need an ample and well-educated workforce
- BLS Projections from 2002 to 2012 (jobs >20%)
 - Environmental engineers, software engineers, biomedical engineers



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What is Engineering?

Engineers design and develop objects which are perceived as needed but do not occur naturally or where needed, Scientists concern themselves primarily with understanding the world and nature as it is.

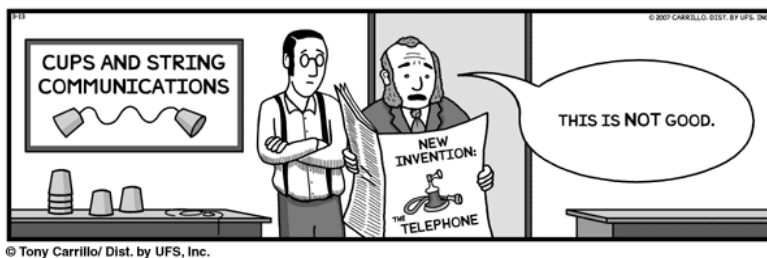
*“A scientist can discover a new star but he cannot make one. He would have to ask an engineer to do it for him.”-
- Gordon L. Glegg*

“Scientists study the world as it is, engineers create the world that never has been.” -- Theodore Von Karman



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Engineering is around us



What impacts a school/typical day



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Engineers are everywhere!

- What do they do?



A button on the bottom activates this self-heating can, which is being test-marketed by Nescafé.



- Where do they work?
 - Everywhere and anywhere!



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WHO WERE THE FIRST ENGINEERS?

Loose Parts by Gilpin & Blazek

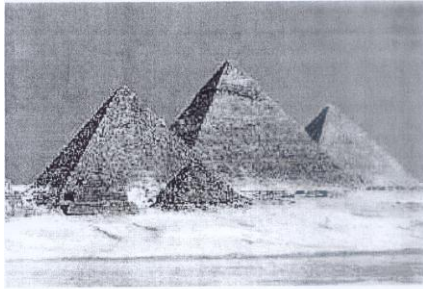


"I gotta believe this whole thing would go a lot better if one of us would just invent fire."



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WHO WERE THE FIRST ENGINEERS?



The pyramids at Giza.



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Engineering in Practice

Engineers work in environments that:

- Are people-oriented **AND** machine oriented
- Require teamwork **AND** individual work
- Work to improve lives **AND** to gain personal satisfaction
- Are family-oriented **AND** career-intensive
- Make a difference **AND** make money
- Engineers can be involved in:
 - Research
 - Design
 - Manufacturing
 - Sales
 - Service



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Types of Engineering Specialties

- Aerospace
- Agricultural
- Biomedical (NJIT)
- Chemical (NJIT)
- Civil (NJIT)
- Computer (NJIT)
- Control Systems
- Electrical (NJIT)
- Environmental (NJIT)
- Fire Protection
- Geotechnical
- Industrial (NJIT)
- Manufacturing (NJIT)
- Materials
- Mechanical (NJIT)
- Mining
- Nuclear
- Petroleum
- Sanitary
- Traffic



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Biomedical Engineering

- Biomedical engineering combines biology and engineering
 - Apply engineering principals to medicine
 - Help people live longer and have a better quality of life
- Work closely with biologists and medical doctors to
 - Develop medical instruments
 - Remote surgery
 - Artificial Organs
 - Artificial heart
- Work in pharmaceutical and medical device industry
 - Pacemakers, Heart pumps, Patient monitoring, Artificial limbs/joints Biotechnology



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Tracks in BME

- Bioinstrumentation
- Biomechanics
- Biomaterials and Tissue Engineering
- Modeling and Simulation



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BME – Where do they work?

- Hospitals, universities
- Pharmaceutical and medical device industry
 - Pacemakers
 - Heart pumps
 - Patient monitoring
 - Artificial limbs/joints
 - Biotechnology
- Research laboratories



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Chemical Engineering

- Work with the design, construction, and operation of plants for manufacturing products
 - Pharmaceuticals, food and beverages, synthetic fibers and plastics, oil and gas, pulp and paper, fertilizers, and cosmetics
- Key roles in the growing fields of biotechnology, environmental protection, and electronic materials processing



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Chem Eng – where do they work?

- Virtually all industries
- Government
- Healthcare
- Research laboratories
- Patent law
- Engineering consulting businesses



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Civil Engineering

- Planners and builders of the fabric of modern civilization
- Design, construct and maintain facilities
 - Buildings, highways, bridges, water supply systems, and entire communities
- Work meets human needs by addressing population growth, environmental protection and public safety



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Civil Eng – where do they work?

- Engineering consulting firms
- Construction companies
- Public agencies
- Start their own engineering and construction businesses
- Work in the corporate sector for companies such as Exxon and Johnson & Johnson



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Electrical and Computer Engineering

- Electrical Engineers design and maintain
 - Electrical, electronic, electro-optical, and electromechanical devices, integrated circuits, and communications systems
- Computer engineers focus on the hardware and software aspects of design and development
 - Involved in system aspect of computing, computer architecture, networking and communication—whether it's designing new products or solving problems in these areas



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Where do they work?

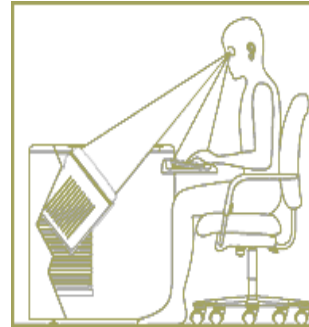
- Elect. Engineers work in companies specializing in
 - Integrated circuitry, computing, biomedical instrumentation
 - Energy conversion, power generation and distribution
 - Control systems, microprocessors, telecommunications
 - Wireless communications, and multimedia
- Comp. Engineers work in companies specializing in
 - Major computer manufacturers
 - Computer networking and communication industries
 - Banks
 - Manufacturing firms
 - Universities



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Industrial Engineering

- Industrial engineers improve processes
 - Assembly line that produces computers
 - Surgery operation, the sorting of packages, a space walk
 - The screening of passengers at an airport
 - Improvements may include doing it cheaper, faster, in a way that pollutes the environment less, safer, or in a less complicated way
- The IE slogan is: Engineers make things, IEs make them better



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IE – where do they work?

- Companies that make automobiles, household products, computers, pharmaceuticals, cosmetics, etc.
- Hospital systems, insurance companies, airlines and package delivery providers, retailers, public transit agencies, universities and other non-profit organizations
- Responsible for
 - Efficient operation of the factory floor, the distribution system, customer service, regulatory compliance, research and development, finance, quality control or any other operational or business function
- Specialization tracks in
 - Operations engineering, manufacturing engineering, or process engineering



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Mechanical Engineering

- Design, development, manufacture and operation of a wide variety of energy conversion and machine systems
 - Air-conditioning, robotics, refrigeration, automotive, and manufacturing
 - Also to develop conventional and alternative energy sources



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ME – where do they work?

- Areas such as
 - Energy conversion
 - CAD/CAM systems
 - Robotics
 - Manufacturing systems
 - Biomedical applications
 - Design of vehicles and aircraft



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Pathways to Engineering and Engineering Technology

High School



Engineering
(NJIT)



(Four years)



Engineering
Technology
-NJIT

(second two years)

Engineering Technology
Community College
(First two years)



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What kind of engineer is featured here?



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Engineering Impact - Multidiscipline

Biomedical engineering

(Instrument body to measure stresses)

Mechanical engineering

(Determine optimum string setting and racquet design)

Electrical and Computer engineering

(Automatic system for service faults)



Industrial engineering

(Methods to mass produce racquets)

Chemical engineering

(Develop new materials for strings and racquet in quantity)

Civil engineering

(Create highway system to travel to tournament)



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Engineering Impact - Multidiscipline

Chemical engineering

(Develop methods to keep food stable and fresh)

Mechanical engineering

(Design systems that take fragile food items, like candy bars, place them in packaging, and move them around a processing plant at high rates of speed without damage)



Electrical and computer engineering

(Develop smart control systems to monitor and manage the production of candy bars)

Industrial engineering

(Produce large scale rather than small batches in a test kitchen)

Civil engineering

(Design and construct the buildings that house candy--making equipment)



Information from www.engineergirl.org

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Neil Armstrong



Scott Adams

Herbie Hancock



William Hewlett
David Packard



They Are All Engineers



Herbert Hoover
Jimmy Carter
Boris Yeltsin
Leonid Brezhnev

Alexander Graham
Bell



Alfred Hitchcock
Frank Capra



Tom Landry



David Robinson



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How does it compare?

Engineering	
Chemical Engineering	\$51,301 (down 1.7%)
Civil Engineering	\$41,541 (up 2.9%)
Computer Engineering	\$52,722 (up 0.4%)
Electrical Engineering	\$50,615 (down less than 1%)
Electrical Engineering	\$50,391 (down 3.3%)
Source: Winter 2003 Salary Survey	

Business	
Accounting	\$42,005 (up 4.6%)
Business Administration	\$36,634 (up 11%)
Economics/Finance	\$40,413 (up 4.4%)
Marketing	\$35,698 (up 5.2%)
Management Information Systems	\$40,566 (down 5.6%)
Source: Winter 2003 Salary Survey	

Liberal Arts	
English	\$35,538
Criminal Justice	\$27,596
Liberal Arts/General Studies	\$29,586
Political Science	\$34,594
Psychology	\$27,194
Psychology	\$26,459
Source: Winter 2003 Salary Survey	



Source: Jobweb.com

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What do Engineers Do?

Engineers are basically problem solvers. It is the purpose and function of the engineer not only to design

products, but to keep improving upon their design.

The

products of today contain many improvements over those first created by early engineers. Engineers:

- Design things that meet the needs of people, the community, and society.
- Analyze existing objects for improvements.
- Re-think and re-engineer existing objects.



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Loose Parts by Gilpin & Blazek



"I don't know what they're talkin' about. Gettin' me a steer ain't made plowin' no easier."



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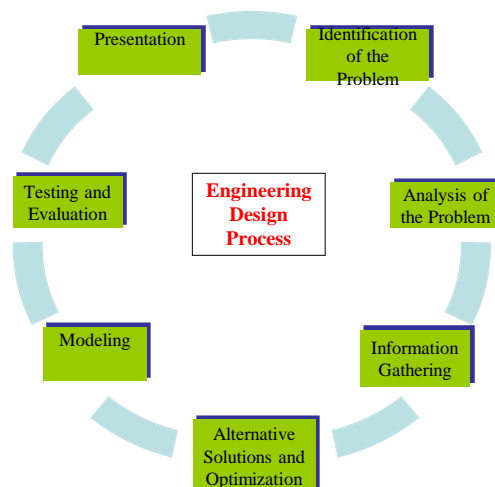
ENGINEERING DESIGN PROCESS

Engineering design is ...a collaborative process to investigate, create, plan, make, test, improve, and evaluate solutions to a problem.

- Identification of the Problem
- Analysis of the Problem – Design Constraints
- Research the Problem – Information Gathering
- Brainstorm Alternative Design Solutions
- Modeling “Best” Solution
- Testing and Evaluating Model/Prototype
- Refine and Retest Model/Prototype
- Communicate Final Design (e.g. Presentation)



Engineering Design Problem



MR. BOFFO Joe Martin

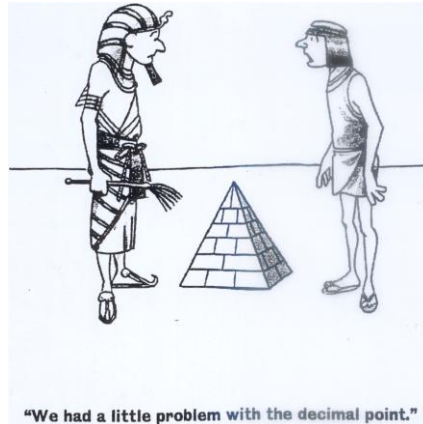


Factors to be Considered in Designing a Product

- Personal interests of the engineer
- Company interests
- Needs of the community
- Economics and the marketplace
- Politics
- Social and environmental issues
- Aesthetics
- Ethics
- Raw materials - Availability and quality

Design Criteria

- How can failure occur?
- What design features can prevent that failure mode with introducing another one?



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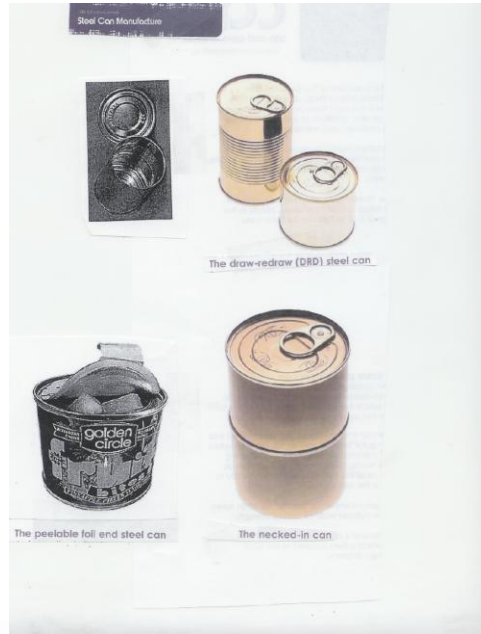
A button on the bottom activates this self-heating can, which is being test-marketed by Nescafé.

THIS, BUD, 'S FOR YOU

Some years ago, in a popular commercial on television, a fellow smashed a beer can against his forehead. Did it hurt? Was the can closed or open, and would that make a difference? (This question requires only a theoretical answer. Do not attempt to investigate through experimental means.)

Although aluminum beverage cans must be designed primarily to withstand the internal pressure of their contents, most are designed to be strong enough (before being opened) to support a good-sized person standing on them. Is this behavior something that happens frequently in fraternity houses and such places, or are there other reasons for this design criterion?

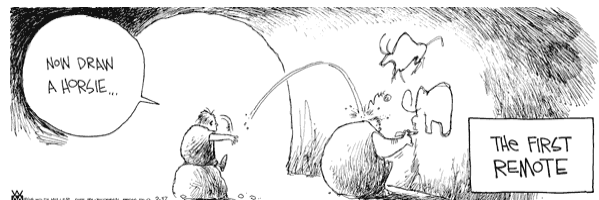




A Challenge

Observe and explain how parts are related to other parts in systems, such as cars, household devices, or creatures.

Estimate the effect of making a change in one part of a system on the system as a whole.





Questions



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