



PROFESSIONAL & SOCIAL ETHICS

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20 Engineering Achievements

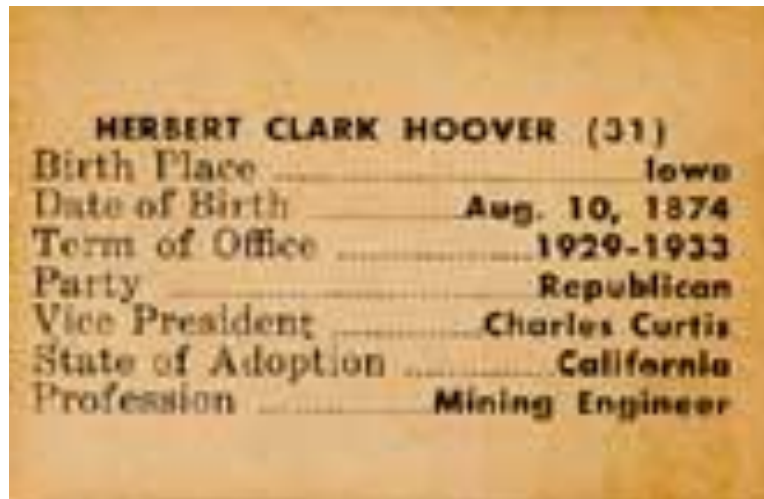
1. Electrification,
2. automobiles,
3. airplanes,
4. water supply and distribution,
5. electronics,
6. radio and television,
7. agricultural mechanization,
8. computers,
9. telephones,
10. air-conditioning and refrigeration,
11. highways,
12. spacecrafts,
13. Internet,
14. imaging technologies in medicine and elsewhere,
15. household appliances,
16. health technologies,
17. petrochemical technologies,
18. laser and fiber optics,
19. nuclear technologies,
20. high-performance materials.



Herbert Hoover (on engineering)



- *“The great liability of the engineer compared to men of other professions is that his works are out in the open where all can see them. His acts, step by step, are in hard substance. He cannot bury his mistakes in the grave like the doctors. He cannot argue them into thin air or blame the judge like the lawyers....He cannot, like the politician, screen his shortcomings by blaming his opponents and hope that the people will forget. **The engineer simply cannot deny that he did it.** If his works do not work, he is damned forever.”*





A person's behavior is always ethical when one:

- A. Does what is best for oneself
- B. Has good intentions, no matter how things turn out
- C. Does what is best for everyone
- D. Does what is legal

What is meant by Ethics?

- Morals
 - Principles of right and wrong
- Ethics
 - A set of moral principles guiding behavior and action
- Laws
 - Binding codes of conduct; formally recognized and enforced
 - Company Policies

Engineering Ethics

engineering ethics is the study of the decisions, policies, and values that are morally desirable in engineering practice and research.

Law vs. Morality: Don't Confuse the Two

Legal & Moral	Legal & Immoral
Illegal & Moral	Illegal & Immoral

Examples of the Categories

Legal & Moral	Designing a system to be safe.
Legal & Immoral	Owning a slave pre-civil war in the US.
Illegal & Moral	Parking in a no parking zone, to come to the aid of an injured person
Illegal & Immoral	Killing an innocent person.

Ethics in an Engineering Course????

We have been studying engineering, such as design, analysis, and performance measurement.



Where does ethics fit in?

How Ethics Fits into Engineering


○ Engineers . . .

- **Build products** such as cell phones, home appliances, heart valves, bridges, & cars. In general they advance society by building new technology.
- **Develop processes**, such as the process to convert salt water into fresh water or the process to recycle bottles. These processes change how we live and what we can accomplish.

Products and processes have consequences for society:

- If the bridge has an inadequate support, it will fail.
- If the gas tank is positioned too close to the bumper, it might explode from a small accident.
- If a medical instrument isn't accurate, improper doses of medication can be given.
- If the process for refining gas produces too much toxins, it harms the local community.

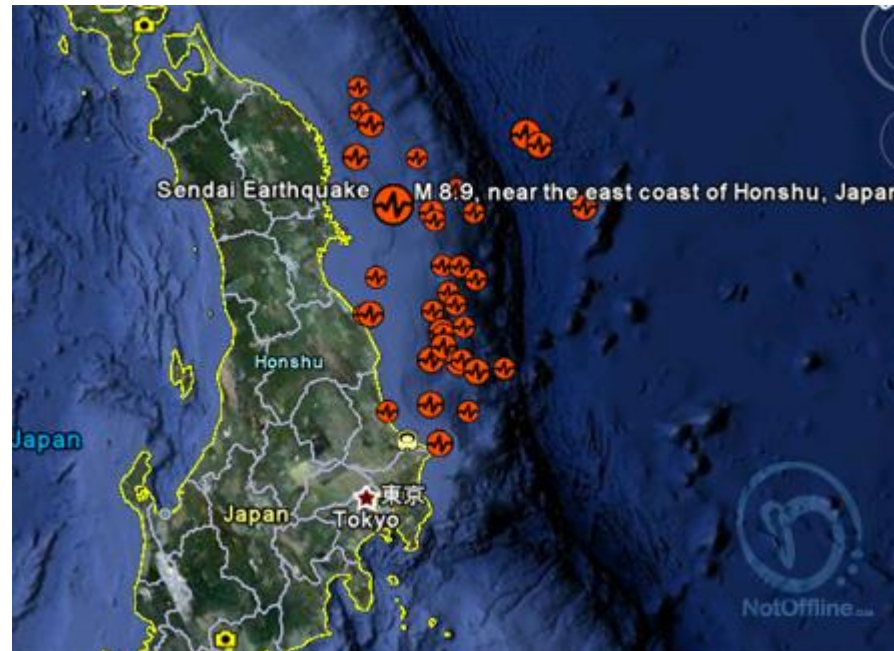




**Decisions made by engineers
usually have serious
consequences to people --
often to multitudes of people.**

**Ethics and ethical reasoning
guide decision-making.**

**Consider the March 11, 2011
8.9 magnitude earthquake
near Sendai, Japan.**





The damage to the Fukushima I Nuclear Power Plant (*Fukushima Dai-ichi*) has led people worldwide to rethink the ethics of nuclear power.

Notice the issues that come up in these discussions:

ISSUE #1: HEALTH AND SAFETY

RISKS: Danger to current and future generations from leakage of radio-isotopes used in nuclear power.

Plutonium-239 (half-life = 24,110 yrs) is a particularly toxic radio-isotope. Normally, 10 half lives are required before a Pu-239 contaminated area is considered safe again, in the case of plutonium, roughly **250,000 years.**

So if Pu leaked, -- say, due to an earthquake -- it would cause a health risk for roughly 8000 generations!!



Issues (cont.):

ISSUE #1: HEALTH AND SAFETY RISKS, FURTHER CONSIDERATIONS:

a) The possibility of medical science discovering a cure for cancer sometime in the current or next centuries adds uncertainty to the long-term health risks of leakages of radio-active isotopes.



Issues (cont.):

ISSUE #1: HEALTH AND SAFETY RISKS, FURTHER CONSIDERATIONS:

b) The use of nuclear power may increase our knowledge of radioisotopes used for medical purposes (possible benefit?).



Ethical Reasoning

The kind of reasoning that goes on in such discussions involves certain *goals* such as, in this case, health, safety.



The Essence of Your Engineering Career

- Engineering is one of the most important professions in society.
- As engineers we *don't just build things and develop processes.*
- We build things and make processes *in order to better society.*
- In order to make society better we have to reflect constantly on the products and processes that we make.

Social Responsibility

- One main connection between ethics and engineering comes from the impact that engineered products and processes have on society.
- Engineers have to think about designing, building, and marketing products that benefit society.
- **Social Responsibility** requires taking into consideration the needs of society.

Typical Ethical Issues that Engineers Encounter

- Safety
- Acceptable risk
- Compliance
- Confidentiality
- Environmental health
- Data integrity
- Conflict of interest
- Honesty/Dishonesty
- Societal impact
- **Fairness**
- Accounting for uncertainty, etc.

Take A4 Page, sketch issue



Professional Responsibility

- Ethics has a second connection with engineering.
- It comes from the way in which being socially responsible puts duties and obligations on us individually.
- Ethics fits into engineering is through **professional responsibility**.

Two Dimensions of Ethics in Engineering

- Ethics is part of engineering for two main reasons.
 - a) Engineers need to be **socially responsible** when building products and processes for society.
 - b) Social responsibility requires **professional responsibility**.

SCOPE OF ENGINEERING ETHICS

- Engineering as social experimentation
- Ethics and Excellence
- Personal meaning and commitments
- Promoting responsible conduct than punishing
- Numerous moral reasons generate ethical dilemmas
- Micro and Macro issues
- Optimism about technology with caution

DIMENSIONS OF ENGINEERING

Initiation of Task
(Idea, specific request, or market demand)

Design

Concept, goals, preliminary design.
Performance specifications.
Preliminary analysis.

Detailed analysis; simulation / prototyping.

Specifications for materials and components.
Detailed shop drawings.

Manufacture

Scheduling of tasks.
Purchasing components and materials.

Fabrication of parts.
Assembly / construction.

Quality control / testing.

Implementation

Advertising, sales and financing.
Operating and parts manuals.

Shipping and installation. Operator training.
Provisions for safety measures and devices.

Use of the product.

Field service: Maintenance, repairs, spare parts.

Monitoring social and environmental effects.

Reporting findings to parties at possible risk.

Final Tasks

Geriatric service: rebuilding, recycling.

Disposal of materials and wastes.

Figure 1-2 progression of engineering tasks

Table 1-1 Engineering tasks and possible problems

Tasks	A selection of possible problems
Conceptual design	Blind to new concepts. Violation of patents or trade secrets. Product to be used illegally.
Goals; performance specifications	Unrealistic assumptions. Design depends on unavailable or untested materials.
Preliminary analysis	Uneven: Overly detailed in designer's area of expertise, marginal elsewhere.
Detailed analysis	Uncritical use of handbook data and computer programs based on unidentified methodologies.
Simulation, prototyping	Testing of prototype done only under most favorable conditions or not completed.
Design specifications	Too tight for adjustments during manufacture and use. Design changes not carefully checked.
Scheduling of tasks	Promise of unrealistic completion date based on insufficient allowance for unexpected events.
Purchasing	Specifications written to favor one vendor. Bribes, kickbacks. Inadequate testing of purchased parts.

ENGINEERING TASKS AND POSSIBLE PROBLEMS

Fabrication of parts	Variable quality of materials and workmanship. Bogus materials and components not detected.
Assembly/ construction	Workplace safety. Disregard of repetitive-motion stress on workers. Poor control of toxic wastes.
Quality control/testing	Not independent, but controlled by production manager. Hence, tests rushed or results falsified.
Advertising and sales	False advertising (availability, quality). Product over-sold beyond client's needs or means.
Shipping, installation, training	Product too large to ship by land. Installation and training subcontracted out, inadequately supervised.
Safety measures and devices	Reliance on overly complex, failure-prone safety devices. Lack of a simple "safety exit."
Use	Used inappropriately or for illegal applications. Over-loaded. Operations manuals not ready.
Maintenance, parts, repairs	Inadequate supply of spare parts. Hesitation to recall the product when found to be faulty.
Monitoring effects of product	No formal procedure for following life cycle of product, its effects on society and environment.
Recycling/disposal	Lack of attention to ultimate dismantling, disposal of product, public notification of hazards.

Table 1-1 Engineering tasks and possible problems