GME 100
General and Professional Ethics
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Engineering Ethics

SOURCES

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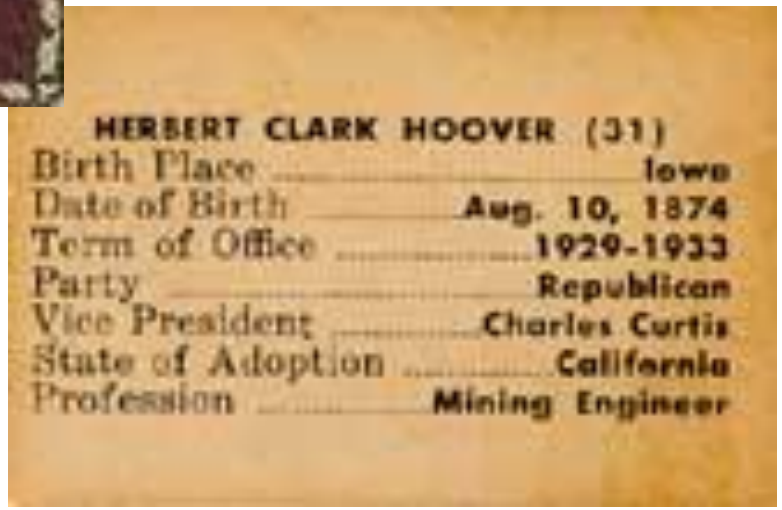
Herbert Hoover (on engineering)

"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."*



4-5 ETHICS

The study of the characteristics of morals.

Engineering Ethics –

- Rules and standards governing conduct of engineers.
- A body of philosophy indicating ways that engineers should conduct themselves in their professional capacity.

What is Engineering Ethics*

- The study of the moral issues and decisions confronting individuals and organizations engaged in engineering
- The study of related questions about the moral ideals, character, policies, and relationships of people and corporations involved in technological activity.

* from Martin. M. & Schinzinger, R. Ethics in Engineering (3rd Ed.) (New York: McGraw-Hill, 1996, pp. 2-3.

Ethics and Engineering

- Where the ethical issues can arise:
  - Conceptualization, Design, Testing, Manufacturing, Sales, Service
  - Supervision and Project Teams
    - Project timelines and budgets
    - Expectations, opinions, or judgments
  - Products: Unsafe or Less than Useful
    - Designed for obsolescence
    - Inferior materials or components
    - Unforeseen harmful effects to society

Ethics and Engineering

- Other fields where ethics are critical
  - Medical Ethics
  - Legal Ethics
  - Business Ethics (closest to Engineering Ethics)
  - Scientific Ethics
- An "applied ethics" domain (rather than a theoretical analysis of philosophy)
- Engineering occurs at the confluence of *technology*, *social science*, and *business*
  - Engineering is done by people and for people
  - Engineers' decisions have a impact on all three areas in the confluence
  - The public nature of an engineer's work ensures that ethics will always play a role

Ethics

- **Principles,**
  Morale,
  Believes,
  Standards,
  …etc

- **Engineering Ethics**: is about
  - how we have to act and live as an engineer,
  - what we have to consider when making decisions,
  - according to what standards are these actions right or wrong.

  Shortly Engineering ethics is how engineers morally act as an Engineer. This is professional ethics NOT personal ethics.

ENGINEERING ETHICS

Engineers have an ethical and social responsibility to themselves, their clients, and to society.

Practically (although there is much debate about this), engineering ethics is about balancing cost, schedule, and risk.

Ethics and Engineering

- **Impacts of an engineer's ethical decisions:**
  - The Products & Services (safety and utility)
  - The Company and its Stockholders
  - The Public and Society (benefits to the people)
  - Environment (Earth and beyond)
  - The Profession (how the public views it)
  - The Law (how legislation affects the profession and industry)
  - Personal Position (job, internal moral conflict)
- Typically, good ethical decisions…
  - …may be just that: "good," but rarely "great" or "ideal"
  - …will not always be in the best interest (irrespective of the timeline) of all stakeholders
  - …are not automatic but require thought, consideration, evaluation, and communication (much like the "design process")

WHY ENGINEERS NEED ETHICS

WHY STUDY?

Several notorious cases –

Achieved great attention and led engineers to gain an increased sense of professional responsibilities.

Led to an awareness of the importance of ethics, how engineers have far reaching impact on society.

Why engineers need ethics ?

- Because engineering is not just a way of making just a living . It is profession, a calling' in which individuals are personally committed to using their skills and abilities to achieve a high social goal .
- **Engineering is not just a way of making money . It is a moral commitment**
- In decision making, rules do not encompass every situation
- No set of rules or policies can anticipate every ethical problem
- Engineers should be sensitive to ethical questions
- Engineers make decisions crucial to society at large

WHY ENGINEERING ETHICS ?

Students of engineering receive inputs in

- basic engineering sciences
- Design
- Manufacture
- Technical Problems Solving Abilities
- Software skills.

A technically gifted engineer but ethically weak engineer may cause harm & damage to the society

Models of professional roles:

- Engineering profession or any profession should take care of public safety welfare and health.
- In order to perform and achieve the goals, an engineer will have to adapt himself to the following professional roles or models.
- An engineer has to play the role of,

❖ **A Savior:**

An engineer has to protect and safeguard the society from poverty, inefficiency, waste, excessive manual and from other harmful effects

❖ **A guardian:**

An engineer is expected to act as a guardian of the Technological advancements, knowing the best direction in which the technology should develop and improve .

- **A bureaucratic servant:**

  An engineer as an employee has to receive and translate the directive of his superiors.

- **A social servant :**

  As a servant of the society ,an engineer provides service with responsibility to the society and satisfies the desires of the society.

- **A social enabler and catalyst:**

  An engineer is needed to help the management and the society by understanding their own needs and to take decisions about technological developments.

- **A game player**:

  Engineer are neither servants nor masters of anyone . They play their part according to the economic game rules, and come out successful within organizations ,enjoying both the pleasure of technological achievements and satisfaction of winning.

Who Decides?

- Standards adopted by Professional Community
  NSPE(National society of professional engineers), ASME etc.
  May conflict with personal ethics

Ethics as Relating to Engineering

Engineering often is based on Preventative Ethics
which is based on two dimensions:

1. Engineers must be able to think ahead to anticipate possible consequences of their professional actions.

2. Engineers must be able to think effectively about those consequences and decide what is the 'ethically' correct manner to handle the situation.

Engineering ethics

- Study of human morality
- Determining values in human conduct
- Deciding the "right thing to do" - based upon a set of norms

In engineering

- dealing with colleagues
- dealing with clients
- dealing with employees
- dealing with "users'
- dealing with public

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.

Two Dimensions of Ethics in Engineering

- Ethics is part of engineering for two main reasons:

1. Engineers need to be socially responsible when building products and processes for society.

2. Social responsibility requires professional responsibility.

The Engineering Code of Ethics

- The Engineering Code of Ethics has three components:

1. The Fundamental Canons: which articulate the basic components of ethical engineering.
2. The Rules of Practice: which clarify and specify in detail the fundamental canons of ethics in engineering.
3. Professional Obligations: which elaborate the obligations that engineers have.

Some disaster examples

Boston Molasses Disaster

- The Boston Molasses Disaster, also known as the Great Molasses Flood and the Great Boston Molasses Tragedy, occurred on January 15, 1919, in the North End neighborhood of Boston, Massachusetts in the United States. A large molasses storage tank burst, and a wave of molasses rushed through the streets at an estimated 35 mph (56 km/h), killing 21 and injuring 150.

Space shuttle challenger

KEY DATES

- 1974 - Morton-Thiokol awarded contract to build solid rocket boosters.
- 1976 - NASA accepts Morton-Thiokol's booster design.
- 1977 - Morton-Thiokol discovers joint rotation problem. November 1981 - O-ring erosion
- discovered after second shuttle flight.
- January 24, 1985 - shuttle flight that exhibited the worst O-ring blow-by.
- July 1985 - Thiokol orders new steel billets for new field joint design.
- August 19, 1985 - NASA Levell management briefed on booster problem.
- January 27, 1986 - night teleconference to discuss effects of cold temperature on booster
- performance.
- January 28, 1986 - Challenger explodes 72 seconds after liftoff.

QUESTIONABLE ENGINEERING PRACTICES

Forging – " inventing some or all of the research data..."

Plagiarism – misappropriating intellectual property.

Conflicts of interest (such as accepting gifts.)

- actual
- potential
- apparent

CLEARLY WRONG ENGINEERING PRACTICES

Lying

Deliberate deception

Withholding information

Failure to seek out the truth

Revealing confidential or proprietary information.

GOAL

Sensitize you to the important ethical issues before you have to confront them.

Moral autonomy –

- To think critically and independently about moral issues.
- To apply this moral thinking to situations that arise in professional engineering practice.

ETHICAL ISSUES

Are there underlying ethical principles that can provide a foundation for good practice?

- According to the NSPE Code of Ethics for Engineers (n.d.) the public health, safety and welfare, professional competence, objectivity/truthfulness and conflict of interest all play a part in how engineers and corporations should assess risk and, what their professional engineering and corporate responsibilities are to the public.

- The quality of corporate associates and engineers, who in short, would define the code of ethics that they would employ.

- Santa Clara University's Markkula Center for Applied Ethics (n.d.) states that in making an ethical decision, one must first recognize the ethical issue, evaluate what should be done and what the alternative actions are, and then proceed to act and reflect on the outcome of the situation.

RECOMMENDATIONS

The seven – step checklist by Schermerhorn and Otten

1. Recognize and clarify the dilemma
2. Get all the possible facts
3. List your options
4. Test each option
5. Make your decision
6. Double check your decision
7. Take Action

(Nguyen and Wang, 2012)

RECOMMENDATIONS

- Be realistic in setting values and goals regarding employment relationships.
- Integrate ethical decision-making into the performance appraisal process.
- Be professional at all times
- "Engineers shall issue public statements only in an objective and truthful manner" (Code of Ethics of Engineers, n.d). The ethics department can have seminars where the company's code of conduct is discussed.

Conclusions

- Ethics determines role morality active and passive responsibility of an engineer
- Deals with the ethical dilemmas like value conflict and conflict of interest
- Guides an engineer in case of decision making
- Exchequer for an employee during gifts , bribes or kick bags

WHISTLE BLOWING

- Disobedience by protest
- The most controversial topic in engineering ethics

What is whistle blowing ?

- According to American heritage dictionary , a whistler blower is a person who reveals a wrong doing within a organization to the public or to those in positions of authority

Types of whistle blowing

- Internal whistle blowing
- External whistle blowing
- Open whistle blowing
- Anonymous whistle blowing

When the whistle blow is permissible

- The harm to the public by the product is serious
- The employee reported to his seniors earlier
- Getting no results from higher authorities

Case Studies

DETAILS OF CASE STUDY

- A hose company decided to redesign the reinforcements within its type of hoses with a new material called AAH#1.
- Studies were carried out at the Texas A&M University, the yarn used was,"… not materially affected by the low concentration of NH_4Oh vapor, but the strength of the yarn is reduced over time to 46% of its original strength by the vapor from anhydrous ammonia."
- AAH #1 could not be ruled out as a feasible reinforcing material. However using it as a reinforcing material for hoses and the company should over-design their hoses to compensate for gradually diminishing strength.
- These new hose designs were deemed cheaper and cost effective by Cooperate and to the public ,especially to farmer's who usually use these hoses for fertilizing .The anhydrous ammonia has been used by farmers as a nitrogen fertilizer.

DETAILS OF CASE STUDY

- Extreme caution needed to be used because the toxicity of the ammonia vapors expelled to the atmosphere when the material is "knifed" into the soil.
- The usage of the AAH #1 hose was met with widespread failure and harm to human life a short time after.
- Due to this and other numerous incidents of malfunctioning of the AAH #1 hose and subsequent injuries, XYZ Cooperatives selling the hose were sued by the affected farmers.
- XYZ did not properly design, test and monitor their product while in use, and therefore they put the end users of the hose at risk.
- XYZ Hose Company claimed that their product was misused or abused while in operation in the field which led to the many malfunctions of their product.
- The company restore its duty to the public and its image and damage control readiness and reputation.

According to what standards are these actions right or wrong?

- *Case 1:*

  Mary discovers that her plant (factory) is discharging a substance into the river that is not regulated by the government. She decides to do some reading about the substance and finds that some of the studies suggest that it is carcinogen. As an engineer, she believes she has an obligation to protect the public, but she also wants to be a loyal employee. The substance will probably be very expensive to remove, and her boss advises, “Forget about it until the government makes us do something. Then all the other plants will have to spend money too, and we will not be at a competitive disadvantage.” ***What should Mary do?***

According to what standards are these actions right or wrong?

- Case 2:

  Tom is designing a new chemical plant. One of his responsibilities is to identify the valves to be used in a certain portion of the plant. Before he makes his final decision, a salesperson for one of the firms that manufactures valves invites Tom to a golf game at the local country club. ***Should Tom accept the offer?***

According to what standards are these actions right or wrong?

- Consider the cases as a professional engineer.

- What you have to consider when making decisions in those cases.
- According to what standards are these actions right or wrong in those cases.

Things to consider and standards:

- NSPE Codes (National Society of Professional Engineers)
  - As a professional engineer it is your obligation / responsibility to obey NSPE codes.

Therefore;

- Engineering Ethics **(NSPE codes)**: shows you how you have to act and live as an engineer. What you have to consider when making decisions. According to NSPE codes these actions are right or wrong.

Case: The Forklifter

Engineering student Bryan Springer has a high paying summer job as a forklift operator. This job enables him to attend university without having to take out any student loans. He was now staring at a 50-gallon drum filled with used machine coolant, wondering what he should do.

Just moments ago, Bryan's supervisor, Max Morrison, told him to dump half of the used coolant down the drain. Bryan knew the coolant was toxic, and he mentioned this to Max. But Max was not swayed.

Case: The Forklifter (cont.)

Max: The toxins settle at the bottom of the drum. If you pour out half and dilute it with tap water while you're pouring it, there's no problem.

Byran: I don't think that's going to work. Besides, isn't it against the law?

Max: Look, kid, I don't have time for chat about a bunch of laws. If I spent my time worrying about every little regulation that comes along, I'd never get anything done -- and neither will you. Common sense is my rule. I just told you --Toxins settle at the bottom, and most of them will stay there. We've been doing this for years, and nothing's happened.

Byran: You mean no one's **said** anything about it? That doesn't mean the environment isn't being harmed.

Max: You aren't one of those "environmentalists," are you? You students spend too much of your time with "theory". It's time to "get real" -- and get on with the job.

Case:The Forklifter (cont.)

Byran: But....

Max: But nothing. Time to get real-and get on with the job. You know, you're very lucky to have a good paying job like this, kid. In three months you'll be back in your university. Meanwhile, how many other students do you think there are out there wondering if they'll be able to afford to go back -- students who'd give everything to be where you are right now.

Max then left, fully expecting Bryan to dump the used coolant. As Bryan stared at the drum, he pondered his options.

What options do you think he has? What do you think he should do?

Case study(citi corp center in manhattan)

- Sky scrapper has to be built
- Welding quality and weld material chosen was inappropriate
- An engineer came to know that the practice is not safe told his senior manger but was ignored
- After sometime removed from the job
- Wrote letter to the senator and got succeeded in the safe design