



College of Engineering

GE106: Introduction to Engineering Design

Engineering Ethics

By

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Outline



- **Opening Statements**
- **What is Ethics?**
- **Engineering Ethics**
- **Standards of Proper Conduct**
- **Concept of Engineering Ethics**
- **Engineering Code of Ethics**
- **Extracts from NSPE Code**
- **Extract from IEEE Code**
- **Personal Ethics (Everyday Examples)**
- **Peculiarities of Ethical Issues**
- **Whistle Blowing**
- **Case Studies (Three Cases)**
- **Personal Questions to Ask When Making a Decision**
- **Final Thoughts**

Before we Start

Ethics is knowing the difference between what you have a right to do and what is right to do.

Potter Stewart

Ethics are more important than laws.

Wynton Marsalis

“Educating the mind without educating the heart is no education at all.”

Aristotle

“Education without values, as useful as it is, seems rather to make man a more clever devil.”

C.S. Lewis

The Definition of Ethics

- A set of moral values and principles which form the standards of the code of conduct* of individuals, organizations and professions.
- It is the principles of good and bad behavior governing what is right and wrong conduct.



Code of conduct: قواعد السلوك
Ethics: أخلاقيات;
Morals: قيم

Engineering Ethics

Engineering ethics is based on “Preventative Ethics” which is based on two dimensions:

Think ahead and **anticipate** possible consequences of professional actions.

Think effectively about consequences and **decide** what is the ‘ethically’ correct manner to handle the situation.

Engineering Ethics - Issues

- Handling, storing and disposing of hazardous (unsafe) materials
- Accepting gifts and amenities (services)
- Conflict of interest
- Report falsification and ethical misconduct
- Social obligations
- Miscommunication between engineers and fabricators (Assemblers)
- Engineering responsibility versus management decisions
- Safety negligence of subordinates
- Accountability to clients and customers
- Plagiarism (The practice of taking someone else's work or ideas and passing them off as one's own)

Basic Concepts of Engineering Ethics

- Ethical considerations are an integral part of making engineering decisions.
- The professional obligations of engineers go beyond fulfilling a contract with a client or customer.
- Codes of ethics can provide guidance in the decision-making process.
- Ethical obligations do not stop at any country's borders; **they are global.**



Engineering Codes of Ethics

- Accreditation Board for Engineering and Technology (ABET)
- National Society of Professional Engineers (NSPE)
- Saudi Council of Engineers (SCE)
- Institute of Electrical and Electronic Engineers (IEEE)
- American Society of Mechanical Engineers (ASME)
- American Society of Civil Engineers (ASCE)
- Society of Petroleum Engineers (SPE)



Fundamental Canons (General rules)

Engineers, in the fulfillment of their professional duties, shall:

- Hold paramount (vital) the safety, health and welfare of the public in the performance of their professional duties.
- Perform services only in areas of their competence.
- Issue public statements only in an objective and truthful manner.
- Act in professional matters for each employer or client as faithful agents or trustees.
- Avoid deceptive acts* in the solicitation of professional employment.

Extracts from IEEE Code

- To accept responsibility in making engineering decisions consistent with the **safety, health and welfare of the public**, and to disclose (reveal) promptly factors that might endanger the public or the environment;
- To avoid real or perceived (supposed) **conflicts of interest** whenever possible, and to disclose them to affected parties when they do exist;
- To **be honest and realistic** in stating claims or estimates based on available data;
- To reject **bribery** (corruption) in all its forms;
- To improve the **understanding of technology, its appropriate application, and potential consequences**;

Conflicts of interest: تضارب المصالح (can you give an example)? How do you disclose conflict of interest?

Extracts from IEEE Code (Cont'd)

- To maintain and improve your **technical competence** and to undertake technological tasks for others only if qualified by training or experience, or after full disclosure of pertinent (relevant) limitations;
- To seek, accept, and offer **honest criticism of technical work**, to acknowledge and correct errors, and to credit properly the contributions of others;
- To **treat fairly all persons** regardless of such factors as race, religion, gender (sex), disability, age, or national origin;
- To **avoid injuring others**, their property, reputation, or employment by **false or malicious (cruel) action**;
- To **assist** colleagues and co-workers in their professional development and to **support** them in following this code of ethics

Personal Ethics

(everyday examples)

- Software piracy.
- Copying of homework or tests.
- **“Borrowing”** office supplies from employer.
- Copying of Videos or CD's.
- Plagiarism
- Expense account padding (adding unnecessary material or expenses for the purpose of increasing the cost claim)*.
- Personal use of the copy machine at work.



* e.g. “miscellaneous” expenses

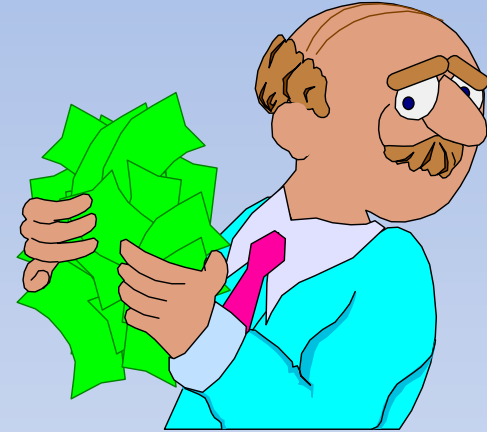
Ethical Issues are Seldom Black and White*



Moral Dilemmas

Kickbacks (offering of services with the intent to influence)

A County Engineer in Virginia demanded a 25% kickback in secret payments for highway work contracts he issued. In 1967 he made such an offer to Allan Kammerer, a 32 year old civil engineer who was vice president of a young and struggling consulting firm greatly in need of the work. Kammerer discussed the offer with others in the firm, who told him it was his decision to make. Finally Kammerer agreed to the deal, citing as a main reason his concern for getting sufficient work to retain his current employees. (Martin and Schinzinger, pg 14)



More Moral Dilemmas

Waste dumping

“On a midnight shift, a botched (spoilt) solution of sodium cyanide, a reactant in an organic synthesis, is temporarily stored in drums for reprocessing. Two weeks later, the day shift foreman cannot find the drums. Roy, the plant manager, finds out that the batch had been illegally dumped into the sanitary sewer. He severely disciplines the night shift foreman. Upon making discrete inquiries, he finds out that no apparent harm has resulted from the dumping.” (Martin and Schinzinger, pg 32)

Should Roy inform government authorities, as is required by law in this kind of situation?

Whistle-Blowing

Always the LAST RESORT, it indicates serious corporate culture problems.

Can be internal as well as external

Definition depends on one's point of view: (Martin and Schinzinger, pg 214)

“Whistle-blowing” - the act of a man or woman who, believing that the public interest overrides the interest of the organization he/she serves, publicly “blows the whistle” if the organization is involved in corrupt, illegal, fraudulent (fake; false), or harmful activity (Nader, Petkas, and Blackwell, 1972)

Examples of problems that might warrant whistle-blowing:

- Incompetence
- Criminal Behavior
- Unethical Policies
- Threat to Public Safety
- Injustices to Workers

Moral Guidelines to Whistle-Blowing

(ref. Richard T. DeGeorge)

It is morally permissible for engineers to engage in external whistle-blowing concerning safety:

1. If the harm that will be done by the product to the public is serious and considerable.
2. If they make their concerns known to their superiors
3. If getting no satisfaction from their immediate superiors, they exhaust the channels available within the corporation, including going to the board of directors.

In order for whistle-blowing to be morally obligatory however, DeGeorge gives two further conditions:

4. He [or she] must have documented evidence that would convince a reasonable, impartial observer that his [or her] view of the situation is correct and the company policy wrong.
5. There must be strong evidence that making the information public will in fact prevent the threatened serious harm.

Whistle-Blowing

The term whistle-blower comes from the whistle a referee uses to indicate an illegal or foul play*.



- Whistleblower is a person who exposes misconduct or illegal activity occurring in an organization such as fraud, health and safety violations, and corruption.

- Whistleblowers may make their allegations internally (within the accused organization) or externally (to regulators, law enforcement agencies, to the media or to groups concerned with the issues).



Whistle-Blowing (cont'd)

- It is morally permissible for engineers to engage in external whistle-blowing if:
 - ✓ The harm that will be done to the public is serious and considerable.
 - ✓ Getting no satisfaction from their immediate superiors, even after going to the board of directors.
- Need a documented evidence that would convince a reasonable, impartial observer.
- There must be strong evidence that making the information public will in fact prevent the threatened harm*.



* i.e. not to just look like a hero, or to gain money/fame, which –ironically- would be in itself unethical

Case 1: The “challenger” disaster (1986)

Designed a system that required a gasketed connection and did not have sufficient data to predict performance across a spectrum of conditions; pressure from management to complete the job led to:

- Poor Engineering Judgment
- Entire crew lost
- Space program set back years
- Loss of public confidence



Case 2: The “Ford Pinto” Gas Tank (1972)

- Under management pressure, engineers designed an automobile component* that later proved to fail under certain conditions and could be replaced for only \$11 under a recall.
- At \$11 per vehicle to recall, the total cost would be \$137 million.
- Corporate decision based on a “Benefit/Cost analysis”.
- Fearing the loss, Ford did not recall for repair.



Case 2 (cont'd)

- Over 500 documented deaths related to rear-end collisions in the Pintos.
- Hundreds of serious injuries and thousands of burned vehicles.

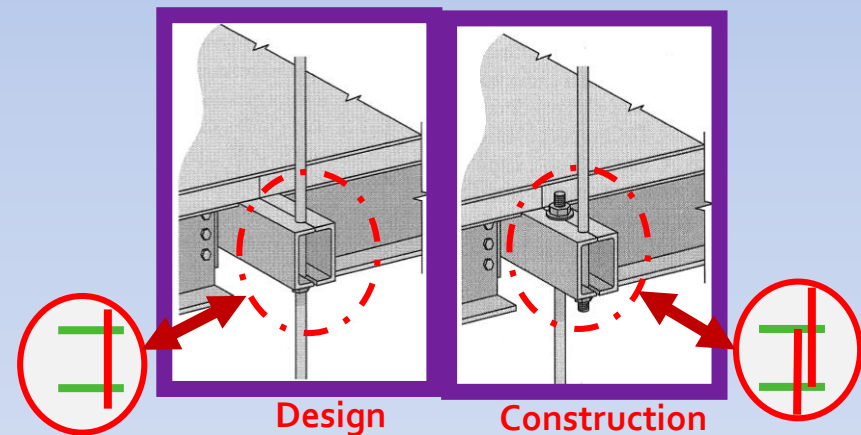
- Lawsuits and personal injury cases totaled over \$450 million.
- Company nearly folded after the lawsuits and low sales due to lack of trust in Ford products.



Case 3: The “Hyatt Regency ” (Kansas City 1981)

Engineers were asked to sign on a set of shop drawings that had come from a reliable vendor with whom they had a very good working relationship.

- Support system was changed in the shop drawings by the steel fabricator.
- Engineer failed to review the shop drawings and therefore did not discover the change.
- The change doubled the load on the supports.
- 32 ton walkways collapsed
- 114 deaths, 200 injuries
- Engineers prosecuted.



Boeing Max 737 Max 8 Plane Crashes

Homework for Class Discussions

A recent event, still being investigated by the US Congress, involving Boeing and Aerospace company on of the diapoly in airplanes manufacturing.

The Boeing Company is an American multinational corporation that designs, manufactures, and sells airplanes, rotorcraft, rockets, satellites, telecommunications equipment, and missiles worldwide. The company also provides leasing and product support services. [Wikipedia](#)

See excerpts of case and related issues here:

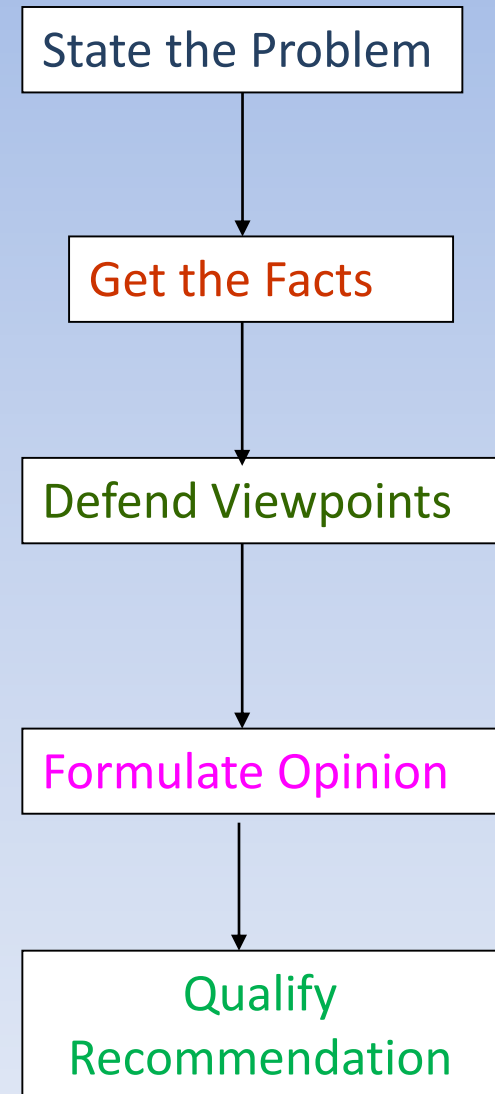
https://en.wikipedia.org/wiki/Boeing_737_MAX

Problem Solving in Engineering Ethics

(What Every Engineer Should Know About Ethics, by Kenneth K. Humphreys)

Various types of professionals, including engineers, often express significant differences of opinion when faced with cases requiring an ethical solution. The objective of these next few slides is to provide a framework for reconciling differences of opinion as we address the question, “what is the right thing to do?” in circumstances involving ethical issues in the engineering profession.

The problem solving model developed here involves five steps. It is a systematic approach to moral deliberation that is designed for groups of individuals, but can be used by individuals with some minor adjustments.



The Five cornerstones of Ethical Behavior

- 1. Do what you say you will do**
- 2. Never divulge information given to you in confidence**
- 3. Accept responsibilities of your mistakes**
- 4. Never become involved in a lie**
- 5. Never accept gifts that compromise your ability to perform in the best interests of your organization**

Top ten question you should ask yourself when making an ethical Decision

1. Could the decision become habit forming? If so, don't do it.
2. Is it legal? If it isn't, don't do it.
3. Is it safe? If it isn't don't do it.
4. Is it the right thing to do? If it isn't, don't do it
5. Will this stand the test of public inspection? If it won't, don't do it.
6. If something terrible happened, could I defend my actions? If you can't, don't do it.
7. Is it just, balanced, and fair? If it isn't, don't do it.
8. How will it make me feel about myself? If it feels lousy, don't do it.
9. Does this choice lead to the greatest good for the greatest number? If it doesn't, don't do it.
10. Would I do this in front of my mother? If you wouldn't, don't do it.

Ask yourself (when Making Decisions)

Is it safe?

Is it legal?

Is it the right thing to do?

Is it just, balanced, and fair?

How will it make me feel about myself?

If something terrible happened, could I defend my actions?

Does this choice lead to the greatest good for the greatest number?

Final Thoughts

- Read carefully the code of ethics of your profession*, better yet, memorize it!
- Never disclose information given to you in confidence, unless it violates ethical codes
- Assume responsibilities** of your mistakes
- Never accept gifts that compromise your ability to perform with freedom
- Start applying (no plagiarism, no software pirating, no abuse of office resources,...)

"Indeed the most honorable of you in the sight of God is the most righteous."

Chapter 49, Verse 13





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Questions

- What is the difference between laws, morals, and ethics?
- Would you accept gifts and hospitality from a prospective vendor? Justify your answer.

a- You work as a design engineer on an airplane. The project is late and the software does not work to specifications. It may be safety critical, but your boss says it is of no concern. And, after all, the project is late and over budget.

Identify the ethical issues and what you should do.

b- You are a consultant, asked to evaluate designs and recommend a solution for a company. You conclude that one particular company has the best solution. However, you do not mention that you have a significant financial interest in the company.

Is this ethical? Justify your answer.

a- A team of four students enrolls in the design course. A client has ideas for a software product. The students implement the ideas with a few new ideas of their own. After graduating, the students form a company, produce, and sell the same software. Identify the ethical issues and what you should do if you are a member of that team.

b- You are a consultant to develop a database for a company. An inexpensive implementation does not provide security for sensitive personal data of the client's customers. The more expensive implementation provides security, but the company says they want a cheap albeit non-secure solution. Is this ethical? Justify your answer.

Answer in a table formatted as the one shown below by **true or false** the following ethical statements and **provide** the NSPE **section number** attesting your choice.

1. Engineers, in the fulfillment of their professional duties, must carefully consider the safety, health, and welfare of the public.
2. Engineers shall act for each employer or client as faithful agents or trustees.
3. Engineers shall not be required to engage in truthful acts when required to protect the public health, safety, and welfare.
4. Engineers shall not permit the use of their names or associates in business ventures with any person or firm that they believe is engaged in fraudulent or dishonest enterprise, unless such enterprise or activity is deemed consistent with applicable state or federal law.
5. Engineers shall strive to be objective and truthful in professional reports, statements or testimony, with primary consideration for the best interests of the engineers' clients or employers. The engineers' reports shall include all relevant and pertinent information in such reports, statements, or testimony, which shall bear the date on which the engineers were retained by the clients to prepare the reports.
6. Engineers shall not accept compensation, financial or otherwise, from more than one party for services on the same project, or for services pertaining to the same project, unless the circumstances are fully disclosed and agreed to by all interested parties.
7. Engineers shall not solicit but may accept financial or other valuable consideration, directly or indirectly, from outside agents in connection with the work for which they are responsible, if such compensation is fully disclosed.
8. Engineers shall acknowledge their errors after consulting with their employers or clients.



Question Number	True/False	NSPE Reference Paragraph number
1		
2		
3		
4		
5		
6		
7		
8		