

EE 590  
Scientific Research Methods  
and Ethics for Engineers

Week 5 Course Notes

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# Topics

- Ethics and ethical standards in Engineering
- Ethical codes
- Whistleblowing
- Ethics discussion methodology
- Case studies

# Ethics

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**“When you say ‘ethical’ do you mean marginally ethical, semi-ethical, or appearing to be ethical?”**

Source: <http://www.glasbergen.com/>

# Ethics

- Ethics addresses the identification of the proper course of action beyond the written rules and laws
  - The *right thing to do* versus the *wrong thing to do*
  - The *right thing to not do* versus the *wrong thing to not do*
- Then decision is facilitated based on a set of guidelines
  - Key principles with which members of the intended society is expected to comply
- These guidelines reach outside and beyond the legal or moral issues

**What do you do when no-one is looking?**

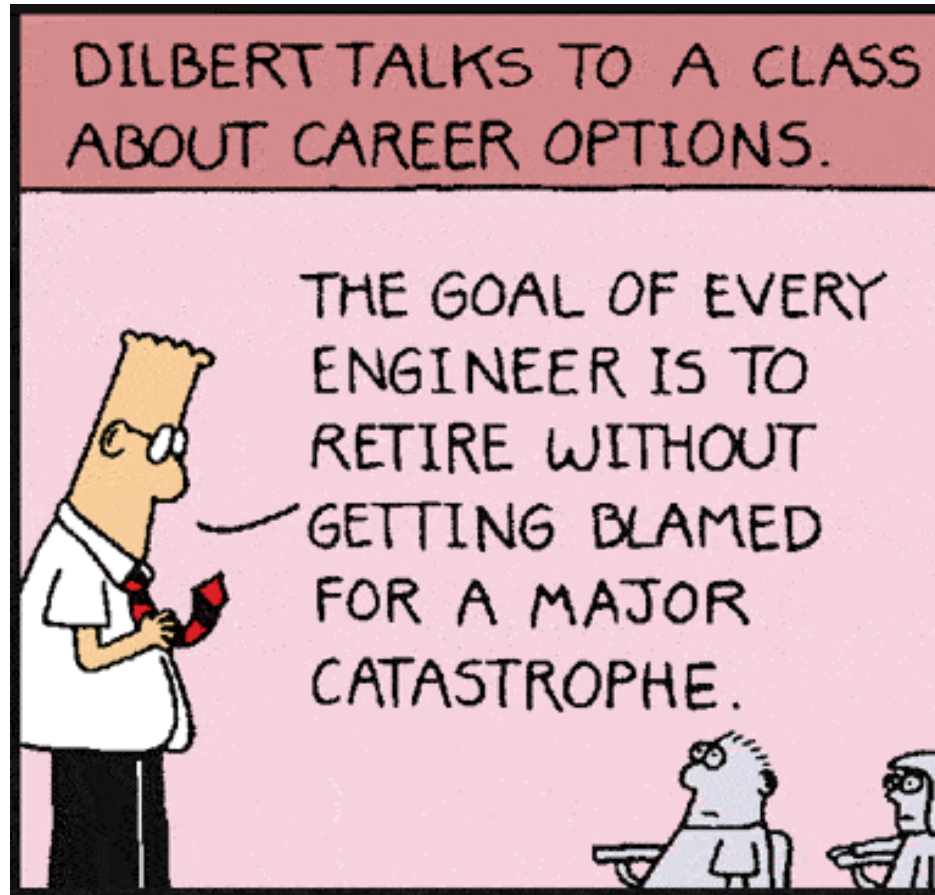
or

**Have you considered the consequences?**

# Engineering Ethics

- Engineering ethics formalizes a set of guidelines that engineers are expected to uphold
- Q: Why?
- Q: What does it mean, “to uphold”?

# Engineering Ethics



Source: <http://dilbert.com/stip/1993-04-23>

# Engineering Ethics

- Quebec bridge collapse (1907)
  - A bridge was designed over the Saint Lawrence River as part of a rail network
  - The construction began in 1904
  - At the final stage where the middle section was being raised, the load bearers buckled and collapsed under the weight
  - The collapse was attributed to incorrect load calculations
    - The issue had been raised several times by other engineers on the project



Source: [io9.com/these-are-some-of-the-worst-architectural-disasters-in-512561209](http://io9.com/these-are-some-of-the-worst-architectural-disasters-in-512561209)

# Engineering Ethics

- Boston molasses disaster (1919)
  - A large tank containing 8.7M liters of molasses burst due to high pressure with a force of around 2 tons per square foot
  - The explosion swept the streets
    - Killed 21 people along with horses and other animals
    - Injured about 150 people
    - Lifted a train off its tracks
    - Demolished nearby buildings
    - Threw a truck into the Charles river
  - The cause was linked to
    - Poor construction
    - Insufficient testing prior to use



Source: <http://www.mnn.com/family/protection-safety/stories/the-1919-boston-molasses-flood-the-forgotten-tragedy-too-bizarre>



# Engineering Ethics

- The Three Mile Island accident (1979)
  - The cooling mechanism failed due to a pressure valve stuck open, leading to coolant loss
  - The loss of coolant was not detected in time
  - The reactor heated excessively
  - Associated events compounded into the release of radioactive gases into the atmosphere
  - Causes were linked to
    - Mechanical failures
    - Inadequate training of the personnel
    - Ambiguous control room indicators



Source: [http://www.cjr.org/the\\_kicker/and\\_thats\\_the\\_way\\_it\\_was\\_march\\_19.php](http://www.cjr.org/the_kicker/and_thats_the_way_it_was_march_19.php)

# Engineering Ethics

- Engineers provide solutions to outstanding problems
  - As the professionals of the corresponding engineering discipline
  - Non-professionals are – by definition – not knowledgeable on the subject and must rely on the judgments of the engineers
  - This requires a **basis of trust** in which
    - engineers can expect to be identified as the experts of the field
    - non-engineers can expect to be provided with the expert service that they seek
  - This system is operable only if a solid basis of trust is maintained

# Engineering Ethics

- Compliance with the ethical standards ensures that the necessary basis of trust is maintained by all practicing members of any profession
  - General standards of ethics for scientific conduct
    - Ethical principles for scientific research and reporting
    - Ethical principles for research on humans and animals
  - Additional ethical standards for members of a specific profession
    - Engineering ethics for engineering
    - Medical ethics for doctors/physicians
    - ...

# Ethical Codes

- Fundamental principles:
  - Hold paramount the safety, health, and welfare of the public
  - Perform services only in areas of professional competence
  - Issue public statements only in an objective and truthful manner
  - Act for each employer or client as faithful agents or trustees
  - Avoid deceptive acts
  - Conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession

(from NSPE code of ethics at  
<http://www.nspe.org/Ethics/CodeofEthics/index.html>)

# IEEE Code of Ethics

We, the members of the IEEE, in recognition of the importance of our technologies in affecting the quality of life throughout the world, and in accepting a personal obligation to our profession, its members and the communities we serve, do hereby commit ourselves to the highest ethical and professional conduct and agree:

- to accept **responsibility** in making decisions consistent with the safety, health, and welfare of the public, and to disclose promptly factors that might endanger the public or the environment;

- to avoid real or perceived **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** in all its forms;

- to improve the understanding of technology; its appropriate application, and potential consequences;

- to maintain and improve our **technical competence** and to undertake technological tasks for others only if qualified by training or experience, or after full disclosure of pertinent 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 and to not engage in acts of discrimination based on race, religion, gender, disability, age, national origin, sexual orientation, gender identity, or gender expression;

- to **avoid injuring others**, their property, reputation, or employment by false or malicious action;

- to assist colleagues and co-workers in their professional development and to support them in following this code of ethics.



Source: <http://www.ieee.org/about/corporate/governance/p7-8.html>

# Whistleblowing



- The responsibility vested upon the engineers by the engineering ethical standards is two-fold:
  - Compliance with the ethical standards
  - Dissent in the face of non-compliance
- Ignoring others' unethical behavior is not acceptable
  - Ethical standards exist to uphold the profession
  - Violation of these standards will damage the profession and all professionals

# Whistleblowing



- IEEE Guidelines for Engineers Dissenting on Ethical Grounds\*
  1. Establish a clear technical foundation
  2. Keep your arguments on a high professional plane, as impersonal and objective as possible, avoiding extraneous issues and emotional outbursts
  3. Try to catch problems early, and keep the argument at the lowest managerial level possible
  4. Before going out on a limb, make sure that the issue is sufficiently important
  5. Use organizational dispute resolution mechanisms
  6. Keep records and collect paper
  7. Resigning

\*From <http://www.onlineethics.org/Resources/ethcodes/EnglishCodes/IEEEguidelines.aspx>

# Methodology

- Any discussion on what to do in an ethics-related issue requires the following steps:
  - Identify the different parties to the matter at hand
    - Whom will the decision impact?
  - Determine the interests of each party
    - What do they expect?
    - What do they stand to lose?
  - Evaluate the *costs* and *benefits* of all alternative courses of action
  - Elaborate on preventive steps to not have the same discussion again in the future



# Case Studies

- A client believes an engineer's designs are too costly, but the engineer fears that anything less may endanger the public

(from <http://www.onlineethics.org/>)

# Case Studies

- Three competing firms submit price proposals with significant price differences. The lowest price proposal is challenged on the grounds that competent engineering services could not be provided within this budget.

(from <http://www.onlineethics.org/>)

# Case Studies

- Two Engineers co-own both an engineering firm and a consulting firm called Electricity Services. Their engineering firm is awarded an assignment by the board of directors of the water plant on the basis of reports and recommendations provided by their other company, Electricity Services.

(from <http://www.onlineethics.org/>)