

Engineering Ethics

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What is (are) Ethics?

- General ethics: principles governing activities between people in personal and professional lives.
- Professional ethics: principles governing activities between professionals and their clients, customers, and the public.

Professional Ethics

Hagar The Horrible



Professional Ethics: Reasons for Study

- Provides guidance for:
 - How we should act (as engineering professionals and citizens).
 - Who should act (qualifications).
- Required by the profession (NSPE, ASCE, AiCHE, IEEE, ASME, IIE,).
- Required by law.

Moral Theory

- Moral theory defines terms in uniform ways and links ideas and problems together in consistent ways.
- Scientific theory organizes ideas, defines terms, facilitates problem solving.
- Both attempt to provide a logical framework for decision making.

Modes of Ethical Reasoning

- Theories of Ethical Thought:
 - Value
 - Duty
 - Utility

Value Ethics

- Ethics based on the moral concept of “virtue.”
 - Focused on the “character” of the individual.
 - Correct behavior (virtue) are actions that lead to or stem from “good” character traits.
 - Incorrect behavior (vice) are actions that lead to or stem from “bad” character traits.
 - Society defines “virtue” and “vice”

Value Ethics

- Concept of ***character*** is part of Texas Engineering Practices Act - consider:
“ § 133.51 ... (c) All reference providers shall be provided by individuals with personal knowledge of the applicant’s **character**, reputation, and general suitability for holding a license. ...”

Duty Ethics

- Ethics based on the concept of “duty.”
 - Correct behavior is a set of fundamental duties for which all citizens are responsible (Immanuel Kant 1724-1804.)
 - Individuals have certain rights that are to be respected; Life, liberty, property, etc. (John Locke, 1632-1704)

Duty Ethics

- Concept of **duty** is part of Texas Engineering Practices Act - consider:
 - § 137.55 ... (c) Engineers **shall** first **notify** involved parties of any engineering decisions or practices that might endanger the health, safety, property or welfare of the public. [Implicit **duty** to notify]

Duty Ethics

- Concept of **duty** is part of Texas Engineering Practices Act - consider:

§ 137.55 ... (c) (continued) ... When, in an engineer's judgment, any risk to the public remains unresolved, that engineer **shall report** any fraud, gross negligence, incompetence, misconduct, unethical or illegal conduct to the Board or to proper civil or criminal authorities. [Implicit **duty** to report]

Duty Ethics

- Concept of **duty** is part of Texas Engineering Practices Act - consider:

§ 137.55 ... (d) Engineers should strive to adequately examine the environmental impact of their actions and projects, including the prudent use and conservation of resources and energy, in order to make informed recommendations and decisions.

[Implicit **duty** to conserve resources and energy; adequate attention to the environment]

Utility Ethics

- Depends on knowing what will lead to the most good.
 - Determining benefit often involves guesswork.
 - Consequences matter
 - Sometimes cannot predict outcomes.
 - Involves quantification of risk.
- Despite these challenges it is a valuable tool for decision making.

Utility Ethics

- Ethics based on the concept of usefulness [to society].
 - Actions that maximize well being of society.
 - Utility, usefulness, benefit are all fundamental ideas in this mode of ethical reasoning.
 - Benefit or well being of the individual is subservient to well being of society.
 - Engineering benefit/cost analysis is a utility based concept.

Utility Ethics

- Benefit-cost analysis
 - Fundamentally it is an application of utilitarianism.
 - Costs usually straightforward to predict.
 - Benefits require guess work.
 - Some benefits are not economically quantifiable.
 - Often only policy (politics) can assign benefit in these situations.
 - Are those who benefit the same as those who bear the costs?
 - Taxation and public infrastructure.

Utility Ethics

- Concept of *utility* is part of Texas Engineering Practices Act - consider:

§ 137.51 General Practice (a) In order to safeguard, life, health and property, to promote the *public welfare*, and to establish and maintain a high standard of integrity and practice ... [implied *benefit* to public]

Utility Ethics

- Concept of *utility* is part NSPE Code of Ethics:
 - II. Rules of Practice: 1. Engineers shall hold paramount the safety, health, and **welfare of the public**. ...
 - III. Professional Obligations: ... 2. Engineers shall at all times strive to serve the public interest.
 - a. Engineers shall seek opportunities to ... work for the **advancement** of the safety, health, and well-being of **their community**.

Summary of Ethical Theories

- Value
 - Individual character.
- Duty
 - Duty to behave ethically
- Utilitarian
 - Collective “good”
- Value/Duty/Utility: Consistent with individual rights and good character

Utility Ethics :

Philosophical Inconsistencies

- Act utilitarianism (John Stuart Mill 1806-1873) focused on actions.
 - Individual actions should be judged based on whether the most good was produced, and rules should be broken if doing so will lead to the most good.
 - Begs definition of “good.”
 - “End justifies the means.” (Machiavelli)
 - “The needs of the many outweigh the needs of a few” (Star Trek)

Utility Ethics :

Philosophical Inconsistencies

- Common rules of morality (don't steal, don't harm others, be honest, etc.) are consistent with this concept and are guidelines developed from centuries of human experience.
 - Sometimes these common rules must be violated to achieve common benefit. (e.g. it might be justifiable to steal food to prevent starvation)

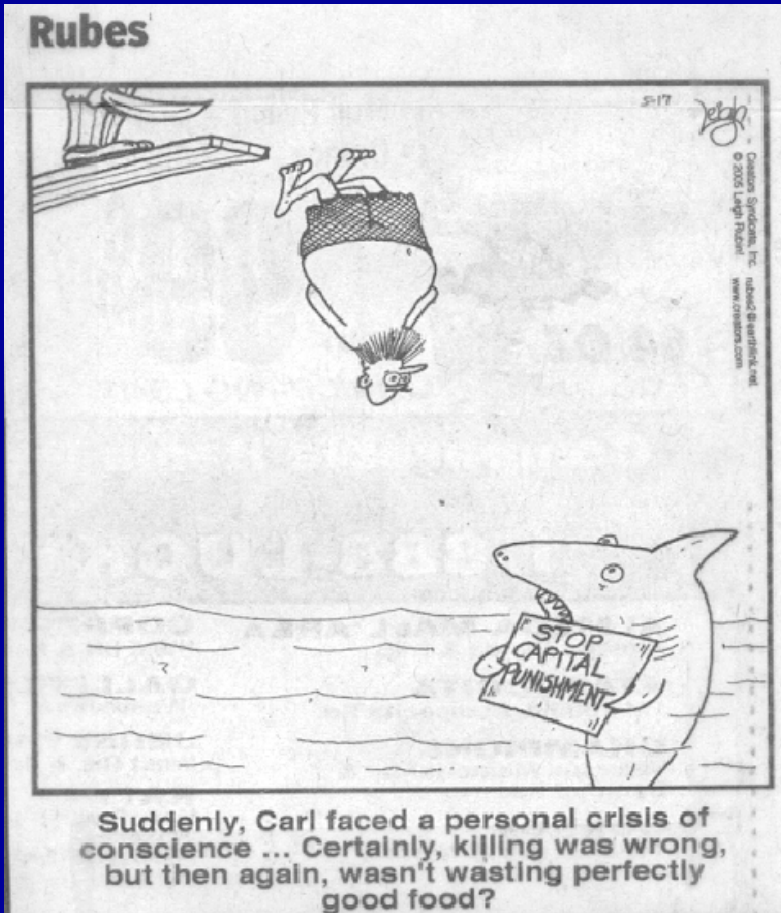
Utility Ethics :

Philosophical Inconsistencies

- Rule utilitarianism focused on compliance.
 - Common rules of morality (don't steal, don't harm others, be honest, etc.) are developed and tested from centuries of human experience.
 - Sacrifice in certain situations to uphold rules ultimately leads to the most good.
 - Creates dilemma:
 - “An unjust rule applied uniformly is fair”
 - “All pigs are equal, some pigs are more equal than others”

Ethical Dilemmas

- Dilemma – a choice between two options.



Ethical Dilemmas

- Dilemma – common usage:
 - State of uncertainty or perplexity especially as requiring a choice between equally unfavorable options
 - A situation in which a **character** must choose between two courses of action, both undesirable.
 - Sometimes people will call any challenging "moral problem" a dilemma, but this is a misleading use of the term.

Ethical Dilemmas

- Dilemma – Logic/Rhetoric:
 - In popular use a dilemma can be almost any sort of difficult choice, but in logic a dilemma is a choice in which there are only two options, attractive or not. (*Disjunctive Syllogism*)
 - Dilemma does not mean "an acute problem." It means "the necessary choice between evenly balanced alternatives."
 - One can refute a dilemma, that is, show that is not a real dilemma, by finding a third possibility.

Ethical Dilemmas

- Requires a choice exists:
 - Monopolies
 - Governments
- Principal dilemma engineers face is the choice between economic gain and protection of public health, safety, and welfare.

Ethical Dilemmas

- Engineering the business:
 - Needs to make profit; economic gain is driving influence.
- Engineering the profession:
 - Needs to protect the public; safety, health, welfare OF THE PUBLIC is the driving influence.
- In many situations the two goals work in tandem - the public can be served and the firm can make a profit.
- Whenever there is a forced choice (a true dilemma, no third option) - the professional obligation must overrule the economic choice!

Ethical Dilemmas

- The Texas Engineering Practices Act recognizes the inherent conflict between business and public welfare. Consider:
 - “ **§ 1001.004. ... (a)** The legislature recognizes the vital **impact** that the rapid advance of knowledge of the mathematical, physical, and engineering sciences as applied in the practice of engineering has on the **lives, property, economy, and security** of state residents and the national defense. ... ”

Ethical Dilemmas

- The Texas Engineering Practices Act recognizes the inherent conflict between business and public welfare. Consider:
 - “ § 1001.004. ... (b) The purpose of this chapter is to:
 - (1) **protect the public health, safety, and welfare;**
 - (2) enable the state and the public to identify persons authorized to practice engineering in this state; and
 - (3) fix **responsibility** for **work** done or **services** or acts performed in the practice of **engineering**. ... “

Ethical Dilemmas

- The Texas Engineering Practices Act recognizes the inherent conflict between business and public welfare. Consider:
§ 1001.004. ... (c) The legislature intends that:
(1) the privilege of practicing engineering be entrusted only to a person licensed and practicing under this chapter; ... “

Bribery, Corruption, and Corporations



- Bribery and Corruption.
- Economic consequences.
- Ethical reasoning.

Bribery and Corruption

- From NSPE Code of Ethics: 5-b.
“Engineers shall not offer, give, solicit, or receive, either directly or indirectly, **any contribution** to *influence* the award of a contract by public authority, or which may be reasonably construed by the public as having the effect or intent of influencing the awarding of a contract. ...” **(Shall not pay to play!)**

Bribery and Corruption

- From NSPE Code of Ethics: 5-b. (continued)
“ They [Engineers] shall not offer any gift or other valuable consideration in order to secure work. ...” (**Bribery**)

Bribery and Corruption

- From NSPE Code of Ethics: 5-b.
“They [Engineers] shall not pay a commission, percentage, or brokerage fee in order to secure work, except to a bona fide employee or bona fide established commercial or marketing agencies retained by them.”
(Advertising OK; Marketing OK; Submittal Fees OK; Personal check to someone with hiring authority = Corruption/Bribery)

Bribery and Corruption

- From Texas Engineering Practices Act: § 137.63

“(c) The engineer shall not:

(4) give, offer or promise to pay or deliver, directly or indirectly, any commission, gift, favor, gratuity, benefit, or reward as an inducement to secure any specific engineering work or assignment; [**Bribery**]

(5) accept compensation or benefits from more than one party for services pertaining to the same project or assignment;”
[**Corruption**]

Economic Consequences

- Economic consequences of corruption are staggering:
 - an estimated figure is that about 5.0 Trillion dollars a year (globally) are consumed in bribery and corruption in engineering projects.
 - The FY07 U.S. Budget expenditures submitted to Congress are only 2.8 Trillion dollars.

Bribery, Corruption, and Corporations

- Most firms and public agencies do their best to define and implement anti-corruption policies.



- It is recognized that a need for meaningful rewards for integrity are required.

Bribery, Corruption, and Corporations

- A corporation is not a person, hence it cannot be a moral agent.
 - A corporation is neither ethical or unethical.
- Corporations are comprised of people and deal with people.
- Because of the interactions with people, **corporations are expected to behave** morally, even though it [moral behavior] is unenforceable (in the legal sense).

Ethics and Law



- Legal
- Ethical
- Comparison
- Example

Ethics and Law: Legal

- What is meant by “Legal”?
 - Behavior and conduct and actions that are in agreement with **codified** (written) standards in some legal **documents** by some appointed legal **body**.
 - The documents and the legal experts determine what is law and whom should obey it.

Ethics and Law: Legal

- Key concepts are:
 - Codified
 - Legal Body (Courts)
 - Documents and the Legal Body determines what is legal.
 - May not apply to all.
(“whom should obey”)

Ethics and Law: Ethical

- What is meant by “Ethical”?
 - Behavior, conduct, and actions that lead to outcomes that are socially acceptable (beneficial) that do not unduly impact individual rights.
 - Society determines what is ethical.

Ethics and Law: Ethical

- Key concepts are:
 - Defined by society.
 - Exists independently of any “experts.”
 - Applies to all members of society.

Ethics and Law: Comparison

- What's the difference?
 - Law.
 - Codified
 - Documents and the Legal Body determines what is legal. (Dependent on legal “experts”).
 - Varies across the world.
 - May not apply to all.
 - Ethics
 - Not necessarily codified
 - Exists independently of any “experts.”
 - Is uniform in all societies.
 - Applies to all members of society.

Ethics and Law: An example

- Legal requirement that a load-bearing beam must resist 5X the average predicted dead load.
 - A calculation will determine if beam is “legal.”
- Ethical standard that a beam have a safety factor sufficient to ensure ensure public safety.
 - A calculation alone is insufficient.
 - Probability and consequences of failure.

Ethics and Law: Confusion?



- Software is copyrighted (law).
- Advancing the public welfare (ethics).

Privileged Information: Confidentiality and Disclosure

- Obligation to keep certain information confidential.
 - Well established principle in law and medicine.
- Why?
 - Competitive advantage (of how to engineer).
- What?
 - Test results, designs, formulas, etc.
 - Suppliers identities, production costs, employee assignments, etc.

Privileged Information: Confidentiality and Disclosure

- The Texas Engineering Practices Act and NSPE recognize the concepts.
 - Consider the NSPE Code of Ethics,
“ ... 4. Engineers shall not disclose, with out consent, confidential information concerning the business affairs or technical processes of any present or former client or employer, or public body on which they serve. “

Privileged Information: Confidentiality and Disclosure

- The Texas Engineering Practices Act and NSPE recognize the concepts.
 - Consider the TEPA,
- “ **§ 137.61** (a) The engineer may reveal confidences and private information only with a fully informed client’s or employer’s consent, or when required by law or court order; or when those confidences, if left undisclosed, would constitute a threat to the health, safety or welfare of the public. ... “

Privileged Information: Confidentiality and Disclosure

- The Texas Engineering Practices Act and NSPE recognize the concepts.
 - Consider the TEPA,
- “ **§ 137.61** (b) The engineer shall not use a confidence or private information regarding a client or employer to the disadvantage of such client or employer or for the advantage of a third party. “

Privileged Information: Confidentiality and Disclosure

- The Texas Engineering Practices Act and NSPE recognize the concepts.
 - Consider the TEPA,
- “ **§ 137.61 (c)** The engineer shall exercise reasonable care to prevent unauthorized disclosure or use of private information or confidences concerning a client or employer by the engineer’s employees and associates.“

Privileged Information: Confidentiality and Disclosure

- How?
 - Non-disclosure agreements.
- Consequences?
 - Civil suit (intellectual property)
- In public infrastructure many items become public and secrecy becomes irrelevant.
 - Designs to public agencies become public.
 - Costs, production methods etc.
 - Selection (of the engineer)
 - Varies; Executive committee.
 - The “ratings” are public, but the actual discussions remain secret.

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Privileged Information: Disclosure by “Whistle blowing”

- **§ 137.55** ... (c) ... When, in an engineer’s judgment, any risk to the public remains unresolved, that engineer shall report any fraud, gross negligence, incompetence, misconduct, unethical or illegal conduct to the Board or to proper civil or criminal authorities.
- **§ 137.63 (2)** exercise reasonable care or diligence to prevent the engineer’s partners, associates, and employees from engaging in conduct which, if done by the engineer, would violate any provision of the Texas Engineering Practice Act, general Board rule, or any of the professional practice requirements of federal, state and local statutes, codes, regulations, rules or ordinances in the performance of engineering services; ...

Privileged Information: Disclosure by “Whistle blowing”

- What?
 - Act of an employee of informing the **public** or management of **unethical** or **illegal** behavior by and employer or supervisor.
 - In practice, many companies are concerned with the public disclosure and internal notification is tolerated as long as a “chain-of-command” is followed.

Whistle Blowing

- When?
 - Duty to report **illegal** behavior.
 - When internal checks fail and either safety or integrity is threatened.
- 4 “tests” that should be met:
 - Need; Proximity; Capability; Last resort

Whistle Blowing

- Need: Clear and important harm that can be avoided. Sense of proportion.
- Proximity: Must be in a clear position to report on the problem. Hearsay is not adequate. Firsthand knowledge and documentation are essential. Must be reasonably expert in the area to assess the situation.
- Capability: Must have a reasonable chance of success. Not expected to risk career or family if unable to see through to completion
- Last resort: Only if no-one else is more capable. Only if other means (internal communications) have/will fail.

Whistle Blowing

- Consequences:
 - Private corporation: termination is very likely; most employees are “at-will.”
 - Distrust: Even if the activity is truly wrong, you may not ever re-earn the trust of management.
 - Public employees: termination is still likely, but it might be considered retaliatory.

Engineering Services

- Engineering services covers:
 - Transactions between engineers and their clients.
 - Description of work to be performed (scope).
 - Agreement for compensation (how to get paid).

Engineering Services: Purchase Orders and Contracts

- Scope and payment are typically handled in two ways:
 - Purchase order
 - Contract

Engineering Services: Purchase Orders

- Purchase order:
 - Engineer is a **vendor** of service or thing.
 - The service or thing is a **commodity** type service or thing.
 - Things: generally available on market; end users are as knowledgeable as manufacturers about the things, their uses, and value. (Bolts, sand, food, wood, etc.)
 - Service: generally available on market; end user may not have specialized knowledge, but the service is a common and typical activity. (Hardware, software, licensing training; interior design, etc.)
 - Dollar value of service or thing is small (<\$10,000)

Engineering Services: Contracts

- Contract:
 - A mutual agreement between two or more parties to engage in a transaction that benefits both.
 - Scope of services is a component of the contract.
 - Mutual consent.
 - Offer and acceptance.
 - Consideration (how to get paid).
 - Generally for large dollar-value services (> \$10,000)

Engineering Services: Scope of Work

- Scope of work
 - Detailed explanation of what work is to be performed:
 - Tasks
 - Schedule
 - Itemized cost
 - Mechanical estimate on a car repair is a every-day example of a scope of work.
 - Scope is **part of the contract** - often as an attachment, but the two are not legally separable.

Engineering Services

- Consideration:
 - Without evidence of benefits to each party, it is impossible to decide if each party has fulfilled their side of the agreement.
- Breach of contract
 - Actual violation of terms of the contract.
 - Remedy is to recover value of violated item.
 - Frequently remedies are part of the contract
 - Different from penalties and incentives; these are economic tools to speed up a project.

Summary

- Moral Theories
- Dilemma
- Bribery and corruption
- Ethics and Law
- Confidential information
- Contracts and Scope of Work