



ENGINEERING ETHICS

Ethics vs. Morals

- **Morals** are the principles on which individual's own judgments of right and wrong are based
- **Ethics** are principles of right conduct

	Ethics	Morals
What are they?	Rules of conduct recognized in respect to particular class of human actions or particular group or culture	Principles or habits with respect to right or wrong conduct – Morality is ultimately personal compass of right and wrong
Where do they come from?	Social system - External	Individual - Internal
Why we do it?	Because society says it is the right thing to do	Because we believe in something being right or wrong
Flexibility	<ul style="list-style-type: none">- Dependent on others for definition- Tend to be consistent within a certain context, but can vary between contexts	Usually consistent, although can change if an individual's beliefs change
Acceptability	Governed by professional and legal guidelines within particular time and place	Transcends cultural and religious norms

Why Study Ethics ?

- Engineering ethics topic is not about preaching virtue rather, its objective is to increase your ability as engineers to responsibly confront moral issues raised by technological activity
- Professional ethics are a kind of contract with society
 - ▣ You get certain privileges as a member of a particular profession and in return you are required to follow the rules of that profession
 - ▣ Because you agree to follow the rules in return for privileges you do not have the right to ignore those rules that you don't agree with
 - ▣ Professional ethics may expect you to do something contrary to your personal moral views (for example lawyer defending a murderer)

Code of Ethics: NSPE (USA)

- **Fundamental Canons:** Engineers, in the fulfillment of their professional duties, shall:
 - ▣ Hold paramount the safety, health, and welfare of the public
 - ▣ Perform services only in areas of their 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

Rules of Practice

- Engineers shall hold paramount the safety, health, and welfare of the public
 - ▣ If engineers' judgment is overruled under circumstances that endanger life or property, they shall notify their employer or client and such other authority as may be appropriate.
 - ▣ Engineers shall approve only those engineering documents that are in conformity with applicable standards
 - ▣ Engineers shall not reveal facts, data, or information without the prior consent of the client or employer except as authorized or required by law or this Code
 - ▣ Engineers shall not permit the use of their name or associate in business ventures with any person or firm that they believe is engaged in fraudulent or dishonest enterprise
 - ▣ Engineers shall not aid or abet the unlawful practice of engineering by a person or firm
 - ▣ Engineers having knowledge of any alleged violation of this Code shall report thereon to appropriate professional bodies and, when relevant, also to public authorities, and cooperate with the proper authorities in furnishing such information or assistance as may be required

Rules of Practice

- Engineers shall perform services only in the areas of their competence
 - ▣ Engineers shall undertake assignments only when qualified by education or experience in the specific technical fields involved
 - ▣ Engineers shall not affix their signatures to any plans or documents dealing with subject matter in which they lack competence, nor to any plan or document not prepared under their direction and control
 - ▣ Engineers may accept assignments and assume responsibility for coordination of an entire project and sign and seal the engineering documents for the entire project, provided that each technical segment is signed and sealed only by the qualified engineers who prepared the segment

Rules of Practice

- Engineers shall issue public statements only in an objective and truthful manner
 - ▣ Engineers shall be objective and truthful in professional reports, statements, or testimony. They shall include all relevant and pertinent information in such reports, statements, or testimony, which should bear the date indicating when it was current
 - ▣ Engineers may express publicly technical opinions that are founded upon knowledge of the facts and competence in the subject matter
 - ▣ Engineers shall issue no statements, criticisms, or arguments on technical matters that are inspired or paid for by interested parties, unless they have prefaced their comments by explicitly identifying the interested parties on whose behalf they are speaking, and by revealing the existence of any interest the engineers may have in the matters

Rules of Practice

- Engineers shall act for each employer or client as faithful agents or trustees
 - ▣ Engineers shall disclose all known or potential conflicts of interest that could influence or appear to influence their judgment or the quality of their services
 - ▣ 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
 - ▣ Engineers shall not solicit or accept financial or other valuable consideration, directly or indirectly, from outside agents in connection with the work for which they are responsible.
 - ▣ Engineers in public service as members, advisors, or employees of a governmental or quasi-governmental body or department shall not participate in decisions with respect to services solicited or provided by them or their organizations in private or public engineering practice
 - ▣ Engineers shall not solicit or accept a contract from a governmental body on which a principal or officer of their organization serves as a member

Rules of Practice

- Engineers shall avoid deceptive acts
 - ▣ Engineers shall not falsify their qualifications or permit misrepresentation of their or their associates' qualifications. They shall not misrepresent or exaggerate their responsibility in or for the subject matter of prior assignments. Brochures or other presentations incident to the solicitation of employment shall not misrepresent pertinent facts concerning employers, employees, associates, joint venturers, or past accomplishments.
 - ▣ 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. They shall not offer any gift or other valuable consideration in order to secure work. They 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.

Professional Obligations

- Engineers shall be guided in all their relations by the highest standards of honesty and integrity
 - ▣ Engineers shall acknowledge their errors and shall not distort or alter the facts
 - ▣ Engineers shall advise their clients or employers when they believe a project will not be successful
 - ▣ Engineers shall not accept outside employment to the detriment of their regular work or interest. Before accepting any outside engineering employment, they will notify their employers
 - ▣ Engineers shall not attempt to attract an engineer from another employer by false or misleading pretenses
 - ▣ Engineers shall not promote their own interest at the expense of the dignity and integrity of the profession.

Professional Obligations

- Engineers shall at all times strive to serve the public interest
 - ▣ Engineers are encouraged to participate in civic affairs; career guidance for youths; and work for the advancement of the safety, health, and well-being of their community
 - ▣ Engineers shall not complete, sign, or seal plans and/or specifications that are not in conformity with applicable engineering standards. If the client or employer insists on such unprofessional conduct, they shall notify the proper authorities and withdraw from further service on the project.
 - ▣ Engineers are encouraged to extend public knowledge and appreciation of engineering and its achievements.
 - ▣ Engineers are encouraged to adhere to the principles of sustainable development in order to protect the environment for future generations.

Professional Obligations

- Engineers shall avoid all conduct or practice that deceives the public
 - ▣ Engineers shall avoid the use of statements containing a material misrepresentation of fact or omitting a material fact
 - ▣ Consistent with the foregoing, engineers may advertise for recruitment of personnel
 - ▣ Consistent with the foregoing, engineers may prepare articles for the lay or technical press, but such articles shall not imply credit to the author for work performed by others

Professional Obligations

- Engineers shall not disclose, without 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
 - ▣ Engineers shall not, without the consent of all interested parties, promote or arrange for new employment or practice in connection with a specific project for which the engineer has gained particular and specialized knowledge
 - ▣ Engineers shall not, without the consent of all interested parties, participate in or represent an adversary interest in connection with a specific project or proceeding in which the engineer has gained particular specialized knowledge on behalf of a former client or employer

Professional Obligations

- Engineers shall not be influenced in their professional duties by conflicting interests
 - ▣ Engineers shall not accept financial or other considerations, including free engineering designs, from material or equipment suppliers for specifying their product
 - ▣ Engineers shall not accept commissions or allowances, directly or indirectly, from contractors or other parties dealing with clients or employers of the engineer in connection with work for which the engineer is responsible.

Professional Obligations

- Engineers shall not attempt to obtain employment or advancement or professional engagements by untruthfully criticizing other engineers, or by other improper or questionable methods
 - ▣ Engineers shall not request, propose, or accept a commission on a contingent basis under circumstances in which their judgment may be compromised
 - ▣ Engineers in salaried positions shall accept part-time engineering work only to the extent consistent with policies of the employer and in accordance with ethical considerations
 - ▣ Engineers shall not, without consent, use equipment, supplies, laboratory, or office facilities of an employer to carry on outside private practice

Professional Obligations

- Engineers shall not attempt to injure, maliciously or falsely, directly or indirectly, the professional reputation, prospects, practice, or employment of other engineers. Engineers who believe others are guilty of unethical or illegal practice shall present such information to the proper authority for action
 - ▣ Engineers in private practice shall not review the work of another engineer for the same client, except with the knowledge of such engineer, or unless the connection of such engineer with the work has been terminated.
 - ▣ Engineers in governmental, industrial, or educational employ are entitled to review and evaluate the work of other engineers when so required by their employment duties
 - ▣ Engineers in sales or industrial employ are entitled to make engineering comparisons of represented products with products of other suppliers

Professional Obligations

- Engineers shall accept personal responsibility for their professional activities, provided, however, that engineers may seek indemnification for services arising out of their practice for other than gross negligence, where the engineer's interests cannot otherwise be protected
 - ▣ Engineers shall conform with state registration laws in the practice of engineering
 - ▣ Engineers shall not use association with a nonengineer, a corporation, or partnership as a “cloak” for unethical acts

Professional Obligations

- Engineers shall give credit for engineering work to those to whom credit is due, and will recognize the proprietary interests of others
 - ▣ Engineers shall, whenever possible, name the person or persons who may be individually responsible for designs, inventions, writings, or other accomplishments
 - ▣ Engineers using designs supplied by a client recognize that the designs remain the property of the client and may not be duplicated by the engineer for others without express permission
 - ▣ Engineers, before undertaking work for others in connection with which the engineer may make improvements, plans, designs, inventions, or other records that may justify copyrights or patents, should enter into a positive agreement regarding ownership
 - ▣ Engineers' designs, data, records, and notes referring exclusively to an employer's work are the employer's property. The employer should indemnify the engineer for use of the information for any purpose other than the original purpose
 - ▣ Engineers shall continue their professional development throughout their careers and should keep current in their specialty fields by engaging in professional practice, participating in continuing education courses, reading in the technical literature, and attending professional meetings and seminars

Code of Ethics: Royal Academy of Engineering (UK)

- Statement of Ethical Principles sets a standard to which members of the engineering profession should aspire in their working habits and relationships
 - ▣ Accuracy and rigor
 - ▣ Honesty and integrity
 - ▣ Respect for life, law and the public good
 - ▣ Responsible leadership: listening and informing

Accuracy and Rigor

- Professional engineers have a duty to ensure that they acquire and use wisely and faithfully the knowledge that is relevant to the engineering skills needed in their work in the service of others. They should:
 - always act with care and competence
 - perform services only in areas of current competence
 - keep their knowledge and skills up to date and assist the development of engineering knowledge and skills in others
 - not knowingly mislead or allow others to be misled about engineering matters
 - present and review engineering evidence, theory and interpretation honestly, accurately and without bias
 - identify and evaluate and, where possible, quantify risks.

Honesty and Integrity

- Professional engineers should adopt the highest standards of professional conduct, openness, fairness and honesty. They should:
 - ▣ be alert to the ways in which their work might affect others and duly respect the rights and reputations of other parties
 - ▣ avoid deceptive acts, take steps to prevent corrupt practices or professional misconduct, and declare conflicts of interest
 - ▣ reject bribery or improper influence
 - ▣ act for each employer or client in a reliable and trustworthy manner.

Respect for Life, Law and Public Good

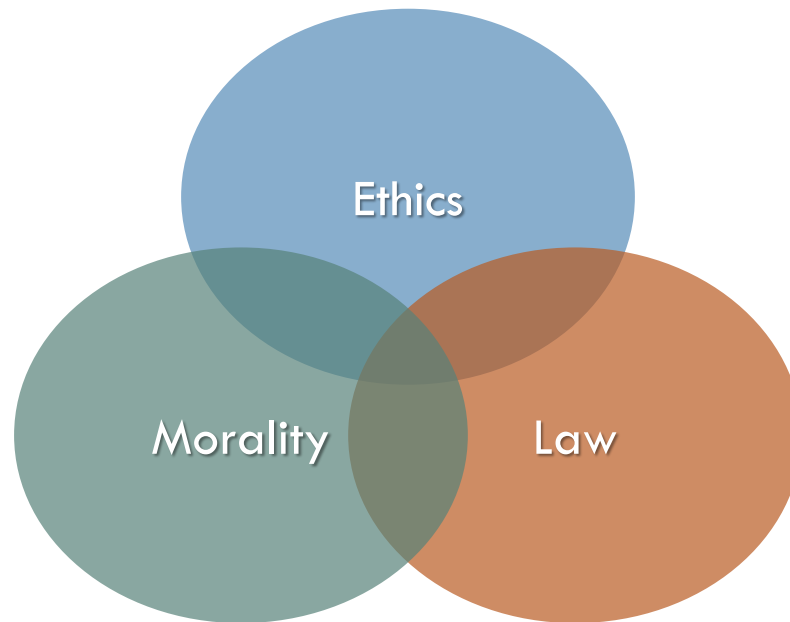
- Professional engineers should give due weight to all relevant law, facts and published guidance, and the wider public interest. They should:
 - ▣ ensure that all work is lawful and justified
 - ▣ minimize and justify any adverse effect on society or on the natural environment for their own and succeeding generations
 - ▣ take due account of the limited availability of natural and human resources
 - ▣ hold paramount the health and safety of others
 - ▣ act honorably, responsibly and lawfully and uphold the reputation, standing and dignity of the profession.

Responsible Leadership: Listening and Informing

- Professional engineers should aspire to high standards of leadership in the exploitation and management of technology. They hold a privileged and trusted position in society, and are expected to demonstrate that they are seeking to serve wider society and to be sensitive to public concerns. They should:
 - ▣ be aware of the issues that engineering and technology raise for society, and listen to the aspirations and concerns of others
 - ▣ actively promote public awareness and understanding of the impact and benefits of engineering achievements
 - ▣ be objective and truthful in any statement made in their professional capacity

Simple Case Study: Bribery

- Why not take a bribe? three reasons
 - ▣ breaks the law (may go to prison)
 - ▣ violates professional ethics (may lose your license)
 - ▣ violates moral norms about cheating (may go to hell in the hereafter!)



Historical Case Study: DC-10 JUMBO JET

- Fuselage of the DC-10 Jumbo jet of which cargo door is a part was developed by Convair, a subcontractor for McDonnell Douglas
- Convair's senior engineer directing the project, Dan Applegate had written to the Vice president of the company: *"The Cargo door could burst open, leading to crash of the plane. Hence the door has to be redesigned and the cabin floor has to be strengthened"*
- Top Management at Convair neither disputed technical facts or predictions made by Applegate. The liabilities and the cost of redesign were too high.
- Two years went by. In 1974 the cargo door of DC-10 Jumbo burst open and the jet crashed near Paris killing 346 !!



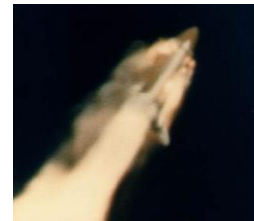
Historical Case Study: Whistle Blowing

- Definition: Whistle blowing is alerting relevant persons to some moral or legal corruption, where “Relevant persons” are those in a position to act in response
 - ▣ No topic in Engineering ethics is more controversial than whistle blowing
- Carl Houston was a welding supervisor for nuclear power facility in Virginia (1970) for Stone & Weber. He saw improper welding procedures, use of wrong materials, welders not trained properly
- He reported to Stone & Weber’s Manager, who ignored him. He threatened to write to Stone & Weber’s Headquarters. Shortly thereafter he was fired on trumped up charges
- Finally he wrote to Senators Howard's Baker and Albert Gore. The Senators prompted the Atomic Energy Commission to investigate, which confirmed his allegations.

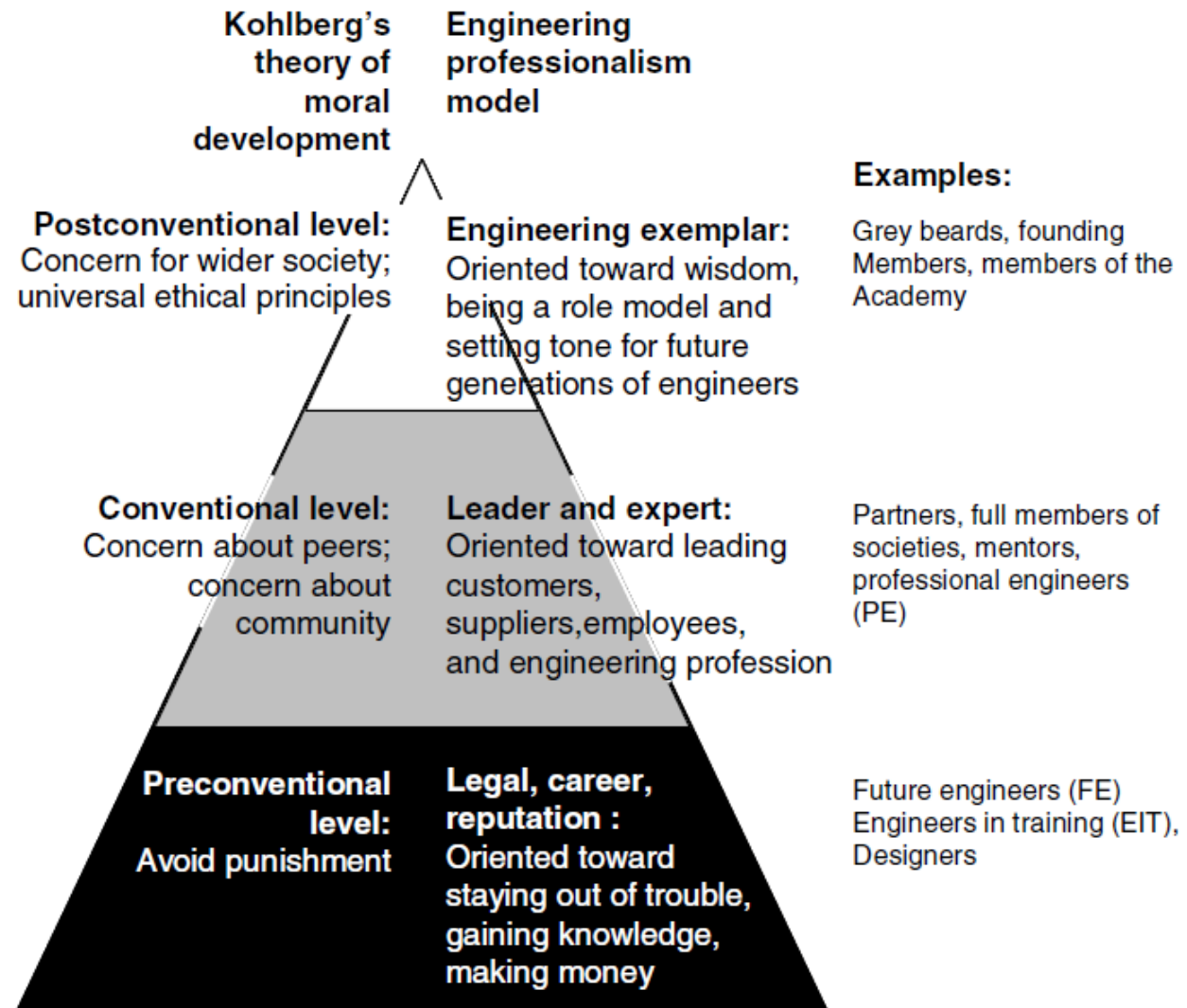


Historical Case Study: Challenger Disaster

- Allan McDonald who designed the solid-rocket booster knew problems with field joints on previous cold weather joints and launch day was expected to be cold
- Seal experts Arnold Thompson and Roger Boisjoly explained to NASA representatives how upon launch the booster rocket walls bulge and combustion gases can blow past one or even both of the O-rings that make up the field joints. O-rings char and erode, as observed on many previous flights. In cold weather, problem is aggravated because the rings and the putty packing are more brittle then
- Senior Vice President Jerry Mason told Bob Lund (Vice President Engineering) **“TO TAKE OFF YOUR ENGINEERING HAT AND PUT ON YOUR MANAGEMENT HAT”**. The managers (not engineers) voted that the seals **COULD NOT BE SHOWN TO BE UNSAFE**.
- The count down ended at 11.38 AM. The temperature was 36 degrees. As the rocket carrying the Challenge Rose from the ground, cameras showed smoke emanating through the O-rings. At 76 seconds into the flight, by the time Challenger and its rocket had reached 50,000 feet, it was totally engulfed in a fire ball.
- All crew members were killed in worst space disaster



Kohlberg's Moral vs. Professional Development



Suggested Readings and Assignments

- Ethics handouts for download on class web site
- Useful links:
 - <http://www.nspe.org/resources/ethics/code-ethics>
 - <http://www.raeng.org.uk/policy/engineering-ethics/ethics>
 - http://www.diffen.com/difference/Ethics_vs_Morals
 - http://www.scu.edu/ethics/practicing/focusareas/technology/occidental_engineering/occidental_engineering.html
 - <http://www.clemson.edu/caah/history/FacultyPages/PamMack/lec122/engeth.htm>
- Homework posted on web site