IIT KHARAGPUR

NPTEL ONLINE CERTIFICATION COURSES

NPTEL

# Ethics in Engineering Practice

## Lecture No (1,2,3): Introduction to Ethical Reasoning and Engineering Ethics

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# Outline of the module

- ❖Engineering Profession – Own self views vs. Public views
- ❖Why Ethics in Engineering
- ❖Professional vs. Personal ethics
- ❖What is Engineering Ethics?
- ❖Situations of ethical issues for Engineers
- ❖Understanding the distinction between Ethics, Morals and Laws
- ❖Opinions vs. Judgments – Can we base our ethics on opinions and judgments ?
- ❖An overview of ethical theories
- ❖Which theory should we use
- ❖The Classic Case on Engineering ethics – The Aberdeen Three

Source: Engineering Ethics, Fourth edition Charles B. Fleddermann, Prentice Hall and
Ethics in Engineering Practice and Resercah, Caroline Whitback, Cambridge University Press
Introduction to Engineering Ethics, Martin and Schinzinger, McGraw-Hill

# Herbert Hoover (views 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."*

(Terman, 1965)

# The Engineering Profession

How Engineers view themselves?

How engineers view themselves:

Problem-solvers

Engineering is enjoyable; *esprit de corps*

Engineering benefits people, provides a public service

Engineering provides the most freedom of all professions (Florman, 1976)

Engineering is an honorable profession

How Public views engineering ?

The Engineer's Role

- Engineers as Utilitarians
- Engineers as Positivists
- Applied Physical Scientists

A socialist approach – Engineers are drivers for converting technology to their benefit

Rational, logical and systematic approaches to problem solving tend to alienate the engineer from the public because of the technicalities

# Why Ethics in engineering?

The National Society of Professional Engineers (NSPE) is most widely recognized governing body of engineers which decides the overall standards and codes of ethics for all the engineering professions in US and serves as a reference point for others bodies in the world.

The Preamble of the NSPE *Code of Conduct for Engineers* (2007) states

*"Engineers shall at all times recognize that their primary obligation is to protect the safety, health, property, and welfare of the public. If their professional judgment is overruled under circumstances where the safety, health, property, or welfare of the public are endangered, they shall notify their employer or client and such other authority as may be appropriate."*

# Continued

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

Thus,  it becomes importance for engineers to make sure that the interest of the groups to be affected prevails over their own interest of profit.

# Personal vs. Professional Ethics

It is important to make a distinction between personal ethics and professional, or business, ethics, although there isn't always a clear boundary between the two.

Personal ethics deals with how we treat others in our day-to-day lives. Many of these principles are applicable to ethical situations that occur in business and engineering.

However, professional ethics often involves choices on an organizational level rather than a personal level. Many of the problems will seem different because they involve relationships between two corporations, between a corporation and the government, or between corporations and groups of individuals.

(Fleddermann, 2012)

# What is Engineering Ethics

According to Martin and Schinzinger (1996), Engineering ethics relate to;

"(1) the study of the moral issues and decisions confronting individuals and organizations involved in engineering;

(2) the study of related questions about moral conduct, character, policies, and relationships of people and corporations involved in technological activity"

(Martin and Schinzinger 1996, pp. 23)

# Situations of Ethical issues

Engineering ethics is concerned with the question of what the standards in engineering ethics should be and how to apply these standards to particular situations. (Harris, Pritchard, and Rabins 1995, pp. 14)

Situations where 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

Other fields where ethics are critical

- Medical Ethics
- Legal Ethics
- Business Ethics
- Scientific Ethics

# Engineering Tasks and Possible Outcomes

**Table 1–1 Engineering tasks and possible problems**

| Tasks | A selection of possible problems |
|---|---|
| Conceptual design | Blind to new concepts. Violation of patents or trade secrets. Product to be used illegally. |
| Goals; performance specifications | Unrealistic assumptions. Design depends on unavailable or untested materials. |
| Preliminary analysis | Uneven: Overly detailed in designer's area of expertise, marginal elsewhere. |
| Detailed analysis | Uncritical use of handbook data and computer programs based on unidentified methodologies. |
| Simulation, prototyping | Testing of prototype done only under most favorable conditions or not completed. |
| Design specifications | Too tight for adjustments during manufacture and use. Design changes not carefully checked. |
| Scheduling of tasks | Promise of unrealistic completion date based on insufficient allowance for unexpected events. |
| Purchasing | Specifications written to favor one vendor. Bribes, kickbacks. Inadequate testing of purchased parts. |
| Fabrication of parts | Variable quality of materials and workmanship. Bogus materials and components not detected. |
| Assembly/ construction | Workplace safety. Disregard of repetitive-motion stress on workers. Poor control of toxic wastes. |
| Quality control/testing | Not independent, but controlled by production manager. Hence, tests rushed or results falsified. |
| Advertising and sales | False advertising (availability, quality). Product oversold beyond client's needs or means. |
| Shipping, installation, training | Product too large to ship by land. Installation and training subcontracted out, inadequately supervised. |
| Safety measures and devices | Reliance on overly complex, failure-prone safety devices. Lack of a simple "safety exit." |
| Use | Used inappropriately or for illegal applications. Overloaded. Operations manuals not ready. |
| Maintenance, parts, repairs | Inadequate supply of spare parts. Hesitation to recall the product when found to be faulty. |

# Engineer’s ethical decisions have a far reaching impact on :

- The Products and 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)

# Mistakes (made by engineers) can be costly

**Lethal Treatment: The Therac-25 X-Ray Machine**

The Therac-25, a radiation therapy machine, killed or injured patients at several North American health care facilities between June 1985 and January 1987.

When the technician operating the Therac-25 made a typographical error in entering instructions and tried to correct this mistake by using the delete key, the filter on the machine dropped out of position. The result was that the patient undergoing radiation treatment received a massive dose of X-ray. Several patients were injured or killed as result before it was realized that the machine was dangerously defective.

The Therac-25 had been poorly designed and inadequately tested. The story is a complicated one that highlights many subtle as well as gross mistakes. In particular, the design and testing of the linking of the hardware and software were totally inadequate. Competitive machines had a shield that would engage if the power were at a high level. Furthermore, management decisions in the face of evidence of safety problems varied from shortsighted to negligent.

The manufacturer, Atomic Energy of Canada, Ltd., had many problems and has since gone bankrupt.[a] (A fuller account of this case is available at http://computingcases.org/case_materials/therac/supporting_docs/therac_case_narr/therac_toc.html.)

[a] Leveson, Nancy G. and Clark S. Turner. 1993. "An Investigation of the Therac-25 Accidents," *Computer* (published by IEEE) (July): 18–41, and Helen Nissenbaum. 1996. "Accountability in a Computerized Society," *Science and Engineering Ethics*, 2(1). An abstract of the study is available in the Online Ethics Center.

# Ethics, Morals, and the Law

Morals

Principles of right and wrong

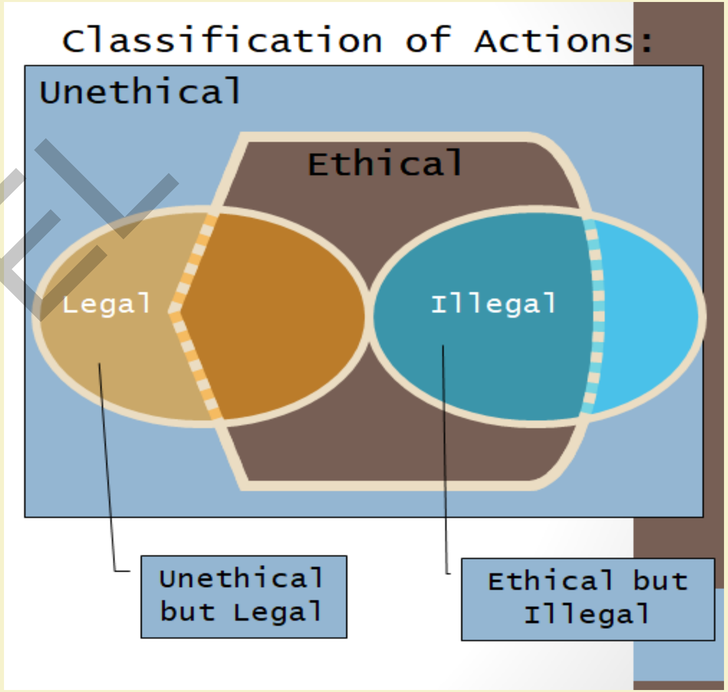
Ethics

A set of moral principles guiding behavior and action

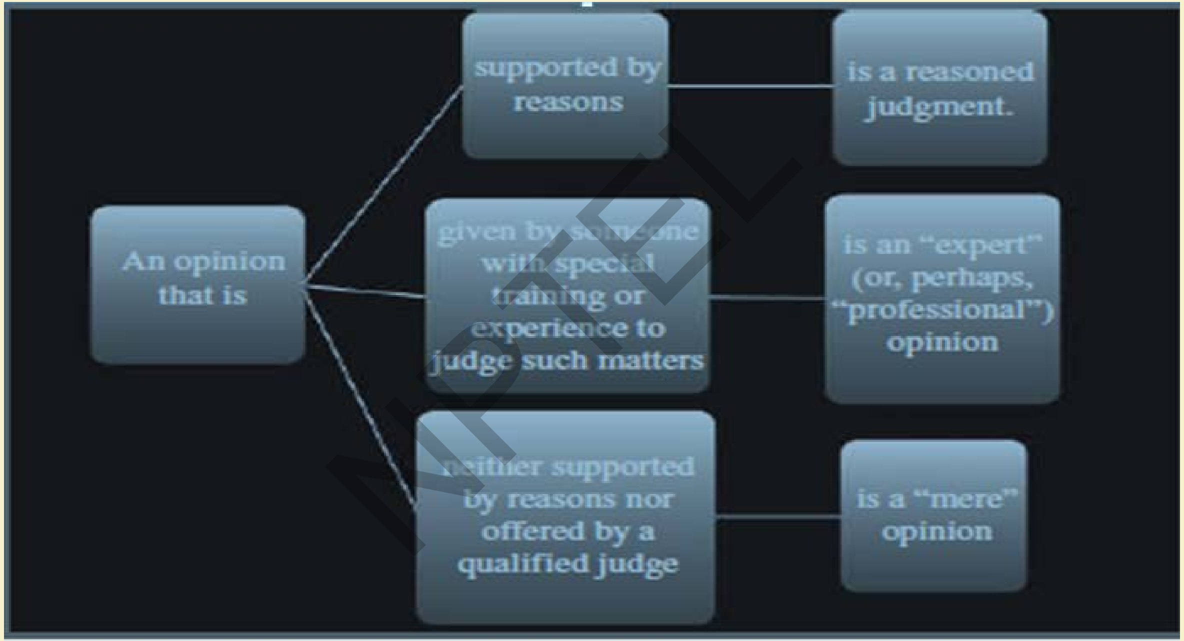
Laws

*<u>Binding</u>* codes of conduct; formally recognized and enforced

Company Policies



# Opinions vs. Judgments




(Ref: Whitbeck , 2011)

# Ethical theories that are a matter of concern

There are There are four ethical theories that will be considered here, each differing according to what is held to be the most important moral concept.

Utilitarianism seeks to produce the most utility, defined as a balance between good and bad consequences of an action, taking into account the consequences for everyone affected.

A different approach is provided by duty ethics. Duty ethics contends that there are duties that should be performed (for example, the duty to treat others fairly or the duty not to injure others) regardless of whether these acts lead to the most good.

Rights ethics emphasizes that we all have moral rights, and any action that violates these rights is ethically unacceptable. Like duty ethics, the ultimate overall good of the actions is not taken into account.

Finally, virtue ethics regards actions as right that manifest good character traits (virtues) and regards actions as bad that display bad character traits (vices); this ethical theory focuses on the type of person we should strive for to be.

# Utilitarianism

**Utilitarianism** – Utilitarianism holds that those actions are good that serve to maximize human well-being. emphasis in utilitarianism is not on maximizing the well-being of the individual, but rather on maximizing the well-being of society as a whole, and as such it is somewhat of a collectivist approach.

An example of this theory that has been played out in this country many times over the past century is the building of dams.

Dams often lead to great benefit t to society by providing stable supplies of drinking water, flood control, and recreational opportunities. However, these benefits often come at the expense of people who live in areas that will be flooded by the dam and are required to find new homes, or lose the use of their land. Utilitarianism tries to balance the needs of society with the needs of the individual.

# Tenets of utilitarianism

Act utilitarianism focuses on individual actions rather than on rules. The best known proponent of act utilitarianism was John Stuart Mill (1806–1873), who felt that most of the common rules of morality (e.g., don’t steal, be honest, don’t harm others) are good guidelines derived from centuries of human experience.

Rule utilitarianism differs from act utilitarianism in holding that moral rules are most important. As mentioned previously, these rules include “do not harm others” and “do not steal.” Rule utilitarians hold that although adhering to these rules might not always maximize good in a particular situation, overall, adhering to moral rules will ultimately lead to the most good.

# Criticism of Utilitarian approach

Sometimes what is best for everyone may be bad for a particular individual or a group of individuals.

Another objection to utilitarianism is that its implementation depends greatly on knowing what will lead to the most good. Frequently, it is impossible to know exactly what the consequences of an action are.

# Cost–Benefit Analysis in engineering

In cost–benefit analysis, the costs of a project are assessed, as are the benefits. Only those projects with the highest ratio of benefits to costs will be implemented. This principle is similar to the utilitarian goal of maximizing the overall good.

The Pitfalls of Cost-benefit analysis

*For eg. from a pure cost–benefit discussion, it might seem that the building of a dam is an excellent idea. But this analysis won't include other issues such as whether the benefits outweigh the loss of a scenic wilderness area or the loss of an endangered species with no current economic value. Finally, it is also important to determine whether those who stand to reap the benefits are also those who will pay the costs. It is unfair to place all of the costs on one group while another reaps the benefits.*

# Duty ethics

Two other ethical theories—duty ethics and rights ethics—are similar to each other and will be considered together.

These theories hold that those actions are good that respect the rights of the individual. Here, good consequences for society as a whole are not the only moral consideration.

A major proponent of duty ethics was Immanuel Kant (1724–1804), who held that moral duties are fundamental. Ethical actions are those actions that could be written down on a list of duties: be honest, don’t cause suffering to other people, be fair to others, etc.

These actions are our duties because they express respect for persons, express an unqualified regard for autonomous moral agents, and are universal principles [ Schinzinger and Martin, 2000 ].

Once one’s duties are recognized, the ethically correct moral actions are obvious. In this formulation, ethical acts are a result of proper performance of one’s duties.

# Rights ethics

Rights ethics was largely formulated by John Locke (1632–1704), whose statement that humans have the right to life, liberty, and property was paraphrased in the Declaration of Independence of the soon-to-be United States of America in 1776. Rights ethics holds that people have fundamental rights that other people have a duty to respect.

# Criticism of Rights and Duty Ethics

First the basic rights of one person (or group) may conflict with the basic rights of another group.

How do we decide whose rights have priority? Using our previous example of the building of a dam, people have the right to use their property. If their land happens to be in the way of a proposed dam, then rights ethics would hold that this property right is paramount and is sufficient to stop the dam project. A single property holder's objection would require that the project be terminated.

The second problem with duty and rights ethics is that these theories don't always account for the overall good of society very well.

# Virtue Ethics

Virtue ethics is interested in determining what kind of people we should be.

Virtue is often defined as moral distinction and goodness. A virtuous person exhibits good and beneficial qualities.

In virtue ethics, actions are considered right if they support good character traits (virtues) and wrong if they support bad character traits (vices) [ Schinzinger and Martin, 2000 ].

Virtue ethics focuses on words such as responsibility, honesty, competence, and loyalty, which are virtues. Other virtues might include trustworthiness, fairness, caring, citizenship, and respect. Vices could include dishonesty, disloyalty, irresponsibility, or incompetence.

# Continued

We can use virtue ethics in our engineering career by answering questions such as:

Is this action honest? Will this action demonstrate loyalty to my community and/or my employer? Have I acted in a responsible fashion? Often, the answer to these questions makes the proper course of action obvious. To use virtue ethics in an analysis of an ethical problem, you should first identify the virtues or vices that are applicable to the situation. Then, determine what course of action each of these suggests.

In using virtue ethics, it is important to ensure that the traits you identify as virtues are indeed virtuous and will not lead to negative consequences

# McCuen's Ethical Dimensions

| LEVEL 1 Pre-professional | LEVEL 2 Professional | LEVEL 3 Principled Professional |
|---|---|---|
| **Stage 1**: Concern is for the gain of the individual (not the company, client, or profession) | **Stage 3:** Loyalty to company is primary focus. Team-player behavior precludes concern for society and environment. | **Stage 5**: Service to human welfare is paramount. Societal rules, morays and values may trump professional standards and corporate loyalty. |
| **Stage 2**: Corporate loyalty, client confidence, proper conduct are pursued but again only for personal gain and advancement. | **Stage 4:** Loyalty to company is connected to loyalty to the profession. Good engineering is good for the profession, but the societal concerns are not emphasized. | **Stage 6**: Professional conduct is guided solely by a sense of fairness and genuine concern for society, individuals, and the environment. Decisions are based only on well-established personal principles and may contradict professional codes and even social rules. |

McCuen's Six Categories of Professional Engineering Morality (McCuen, R. H. (1979). "The Ethical Dimensions of Professionalism." Issues in Engineering **105**(E12): 89-105.)

# Which theory to use?

Now that we have discussed four different ethical theories, the question arises: How do we decide which theory is applicable to a given problem?

The good news is that in solving ethical problems, we don't have to choose from among these theories.

Rather, we can use all of them to analyze a problem from different angles and see what result each of the theories gives us.

This allows us to examine a problem from different perspectives to see what conclusion each one reaches. Frequently, the result will be the same even though the theories are very different.

# Continued

Take, for example, a chemical plant near a small city that discharges a hazardous waste into the groundwater. If the city takes its water from wells, the water supply for the city will be compromised and significant health problems for the community may result.

Rights ethics indicates that this pollution is unethical, since it causes harm to many of the residents.

A utilitarian analysis would probably also come to the same conclusion, since the economic benefits of the plant would almost certainly be outweighed by the negative effects of the pollution and the costs required to ensure a safe municipal water supply.

Virtue ethics would say that discharging wastes into groundwater is irresponsible and harmful to individuals and so shouldn't be done. In this case, all of the ethical theories lead to the same conclusion.

# Classic case of engineering ethics

**The Aberdeen Three**

The Aberdeen Three is one of the classic cases often used in engineering ethics classes and texts to illustrate the importance of environmental protection and the safety of workers exposed to hazardous and toxic chemicals. The Aberdeen Proving Ground is a U.S. Army weapons development and test center located on a military base in Maryland with no access by civilian nonemployees. Since World War II, Aberdeen has been used to develop and test chemical weapons. Aberdeen has also been used for the storage and disposal of some of these chemicals.

This case involves three civilian managers at the Pilot Plant at the Proving Grounds: Carl Gepp, manager of the Pilot Plant; William Dee, who headed the chemical weapons development team; and Robert Lentz, who was in charge of developing manufacturing processes for the chemical weapons [Weisskopf, 1989]. Between 1983 and 1986, inspections at the Pilot Plant indicated that there were serious safety hazards. These hazards included carcinogenic and flammable substances left in open containers, chemicals that can become lethal when mixed together being stored in the same room, barrels of toxic chemicals that were leaking, and

# Continued

unlabeled containers of chemicals. There was also an external tank used to store sulfuric acid that had leaked 200 gallons of acid into a local river. This incident triggered state and federal safety investigations that revealed inadequate chemical retaining dikes and a system for containing and treating chemical hazards that was corroded and leaking.

In June of 1988, the three engineer/managers were indicted for violation of RCRA, the Resource Conservation and Recovery Act. RCRA had been passed by Congress in 1976 and was intended to provide incentives for the recovery of important resources from wastes, the conservation of resources, and the control of the disposal of hazardous wastes. RCRA banned the dumping of solid hazardous wastes and included criminal penalties for violations of hazardous-waste disposal guidelines. The three managers claimed that they were not aware that the plant's storage practices were illegal and that they did things according to accepted practices at the Pilot Plant. Interestingly, since this was a criminal prosecution, the Army could not help defray the costs of the manager's defense, and each of them incurred great costs defending themselves.

In 1989, the three engineer/managers were tried and convicted of illegally storing, treating, and disposing of hazardous wastes. There was no indication that these three were the ones who actually handled chemicals in an unsafe manner, but as managers of the plant, the three were ultimately responsible for how the chemicals were stored and for the maintenance of the safety equipment. The potential penalty for these crimes was up to 15 years in prison and a fine of up to $750,000. Gepp, Dee, and Lentz were each found guilty and sentenced to three years' probation and 1,000 hours of community service. The relative leniency of the sentences was based partly on the large court costs each had already incurred.

# Other ethical theories for reference

Lawrence Kohlberg's theory of moral reasoning development which is Built on Jean Piaget's theory of developmental stages

Cognitive-Dissonance and Ethical Reasoning - C-D Theory proposed by Leon Festinger (1959)

# Thank You!!

# Ethics in Engineering Practice

## Lecture No (4,5) :Professional Practice in Engineering

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# Outline of the module

- ❖Defining Profession
- ❖Attributes of a profession
- ❖Engineering as profession
- ❖Difference in Engineering and other professions
- ❖Ethical dilemma
- ❖ Code of Ethics
- ❖What a code of ethics is not
- ❖ Essentialities of a code of ethic
- ❖Abuse of codes
- ❖Ethical Relativism
- ❖Cases for discussion
- ❖Code of ethics for engineers in India

Source: Ethics in Engineering Practice and Resercah, Caroline Whitback, Cambridge University Press and Introduction to Engineering Ethics, Martin and Schinzinger, McGraw-Hill

# Defining Profession

Professions are those occupations that both require advanced study and mastery of a specialized body of knowledge, and undertake to promote, ensure, or safeguard some aspect of others' well-being.

***Attributes of a profession-***

1. Work that requires sophisticated skills, the use of judgment, and the exercise of discretion. Also, the work is not routine and is not capable of being mechanized.

2. Membership in the profession requires extensive formal education, not simply practical training or apprenticeship.

# Continued

The public allows special societies or organizations that are controlled by members of the profession to set standards for admission to the profession, to set standards of conduct for members, and to enforce these standards.

4. Significant public good results from the practice of the profession [ Schinzinger and Martin, 2000 ].

# Essence of Judgment and Discretion

The terms "judgment" and "discretion" mentioned in attributes of a profession require a little amplification. In a profession, "judgment" refers to making significant decisions based on formal training and experience. In general, the decisions will have serious impacts on people's lives and will often have important implications regarding the spending of large amounts of money.

Discretion" involves being discrete in the performance of one's duties by keeping information about customers, clients, and patients confidential. This confidentiality is essential for engendering a trusting relationship and is a hallmark of professions. One thing not mentioned in the attributes of a profession is the compensation received by a professional for his services. Although most professionals tend to be relatively well compensated, high pay is not a sufficient condition for professional status.

# Well-being and Profession

What is distinctive about the ethical demands professions make on their practitioners is the combination of the responsibility for some aspect of others' well-being and the complexity of the knowledge and information that they must integrate in acting to promote that well-being.

Professional practice requires acquisition of the special knowledge and skill peculiar to one's profession and application of that knowledge to achieve certain ends.

The further requirement for an occupation to be a profession, namely, that the ends it seeks are to preserve or promote some aspect of human well-being, distinguishes professions from disciplines, such as mathematics or philosophy. Code of ethics are formulated to make sure that professions clearly address aspects of human well-being.

# Engineering as a Profession

Certainly, engineering requires extensive and sophisticated skills. Otherwise, why spend four years in college just to get a start in engineering? The essence of engineering design is judgment: how to use the available materials, components, and devices to reach a specified objective.

Discretion is required in engineering: Engineers are required to keep their employers' or clients' intellectual property and business information confidential.

# Continued

Engineering requires extensive formal training. Four years of undergraduate training leading to a bachelor's degree in an engineering program is essential, followed by work under the supervision of an experienced engineer. Many engineering jobs even require advanced degrees beyond the bachelor's degree. The work of engineers serves the public good by providing communication systems, transportation, energy resources, and medical diagnostic and treatment equipment, to name only a few.

# Differences between Engineering and Other Professions

Although we have determined that engineering is a profession, it should be noted that there are significant differences between how engineering is practiced and how other professions like law and medicine are practiced.

Lawyers are typically self-employed in private practice, essentially an independent business, or in larger group practices with other lawyers. Relatively few are employed by large organizations such as corporations.

Until recently, this was also the case for most physicians, although with the accelerating trend toward managed care and HMOs in the past decade, many more physicians work for large corporations rather than in private practice.

# Continued

Training for engineers is different than for physicians and lawyers.

Finally, engineering doesn’t have the social stature that law and medicine have (a fact that is partly reflected in the lower pay that engineers receive as compared to that of lawyers and doctors). Despite these differences, on balance, engineering is still clearly a profession

In contrast, engineers generally practice their profession very differently from physicians and lawyers.

# Continued

Most engineers are not self-employed, but more often are a small part of larger companies involving many different occupations, including accountants, marketing specialists, and extensive numbers of less skilled manufacturing employees

The exception to this rule is civil engineers, who generally practice as independent consultants either on their own or in engineering firms similar in many ways to law firms.

When employed by large corporations, engineers are rarely in significant managerial positions, except with regard to managing other engineers. Although engineers are paid well compared to the rest of society, they are generally less well compensated than physicians and lawyers.

# Ethical dilemmas

Ethical (or moral) dilemmas are situations in which moral reasons come into conflict, or in which the applications of moral values are unclear, and it is not immediately obvious what should be done.

Ethical dilemmas arise in engineering, as elsewhere, because moral values are many and varied and can make competing claims. Yet, although moral dilemmas comprise the most difficult occasions for moral reasoning, they constitute a relatively small percentage of *moral choices, that is, decisions* involving moral values.

Code of ethics serve as guide for resolving ethical dilemmas.

# Code of Ethics

Codes of ethics are not limited to professional organizations. They can also be found, for example, in corporations and universities as well.

These codes express the rights, duties, and obligations of the members of the profession.

Primarily, a code of ethics provides a framework for ethical judgment for a professional.

Codes serve as a starting point for ethical decision making.

A code defines the roles and responsibilities of professionals [Harris, Pritchard, and Rabins, 2000 ].

# What a code of ethics is not

It is important also to look at what a code of ethics is not. It is not a recipe for ethical behavior; as previously stated, it is only a framework for arriving at good ethical choices.

A code of ethics is never a substitute for sound judgment. A code of ethics is not a legal document.

A code of ethics doesn't create new moral or ethical principles.

# Right-wrong or Better-worse

We might divide ethical dilemmas into two broad categories. On the one hand, many dilemmas have solutions that are either right or wrong.

"Right" means that one course of action is obligatory, and failing to do that action is unethical (immoral). In most instances a code of ethics specifies what is clearly required:

- Obey the law and heed engineering standards,
- do not offer or accept bribes,
- speak and write truthfully, maintain confidentiality, and so forth.

# Continued

On the other hand, some dilemmas have two or more reasonable solutions, no one of which is mandatory, but one of which should be chosen. These solutions might be better or worse than others in some respects but not necessarily in all respects.

# Code of Ethics – Resolving situations of conflict

Codes of ethics play at least eight essential roles:

1. serving and protecting the public,
2. providing guidance,
3. offering inspiration,
4. establishing shared standards,
5. supporting responsible professionals,
6. contributing to education,
7. deterring wrongdoing, and
8. strengthening a profession's image.

# Continued

1. ***Serving and protecting the public.***

   Engineering involves advanced expertise that professionals have and the public lacks, and also considerable dangers to a vulnerable public. Accordingly, professionals stand in a fiduciary relationship with the public: Trust and trustworthiness are essential. A code of ethics functions as a commitment by the profession as a whole that engineers will serve the public health, safety, and welfare. In one way or another, the remaining functions of codes all contribute to this primary function.

# Continued

2. ***Guidance.***

Codes provide helpful guidance by articulating the main obligations of engineers. Because codes should be brief to be effective, they offer mostly general guidance. Nonetheless,
when well written, they identify primary responsibilities. More specific directions may be given in supplementary statements or guidelines, which tell how to apply the code.

# Continued

**3.** ***Inspiration.***

Because codes express a profession's collective commitment to ethics, they provide a positive stimulus (motivation) for ethical conduct. In a powerful way, they voice what it means to be a member of a profession committed to responsible conduct in promoting the safety, health, and welfare of the public. Although this paramount ideal is somewhat vague, it expresses a collective commitment to the public good that inspires individuals to have similar aspirations.

# Continued

**4.** ***Shared standards.***

The diversity of moral viewpoints among individual engineers makes it essential that professions establish explicit standards, in particular minimum (but hopefully high) standards. In this way, the public is assured of a standard of excellence on which it can depend, and professionals are provided a fair playing field in competing for clients.

# Continued

**5.** ***Support for responsible professionals.***

Codes give positive support to professionals seeking to act ethically. A publicly proclaimed code allows an engineer, under pressure to act unethically, to say: "I am bound by the code of ethics of my profession, which states that . . ." This by itself gives engineers some group backing in taking stands on moral issues. Moreover, codes can potentially serve as legal support for engineers criticized for living up to work-related professional obligations.

# Continued

*6. Education and mutual understanding.*

Codes can be used by professional societies and in the classroom to prompt discussion and reflection on moral issues. Widely circulated an officially approved by professional societies, codes encourage a shared understanding among professionals, the public, and government organizations about the moral responsibilities of engineers. A case in point is NSPE's BER, which actively promotes moral discussion by applying the NSPE code to cases for educational purposes.

# Continued

**7.** ***Deterrence and discipline.***

Codes can also serve as the formal basis for investigating unethical conduct. Where such investigation is possible, a deterrent for immoral behavior is thereby provided. Such an investigation generally requires paralegal proceedings designed to get at the truth about a given charge without violating the personal rights of those being investigated. Unlike the American Bar Association and some other professional groups, engineering societies cannot by themselves revoke the right to practice engineering in the United States. Yet some professional societies do suspend or expel members whose professional conduct has been proven unethical, and this alone can be a powerful sanction when combined with the loss of respect from colleagues and the local community that such action is bound to produce.

# Continued

**8. *Contributing to the profession's image.***

Codes can present a positive image to the public of an ethically committed profession. Where warranted, the image can help engineers more effectively serve the public. It can also win greater powers of self regulation for the profession itself, while lessening the demand for more government regulation. The reputation of a profession, like the reputation of an individual professional or a corporation, is essential in sustaining the trust of the public.

# Abuse of Codes

When codes are not taken seriously within a profession, they amount to a kind of window dressing that ultimately increases.

Probably the worst abuse of engineering codes is to restrict honest moral effort on the part of individual engineers to preserve the profession's public image and protect the status quo.

Preoccupation with keeping a shiny public image may silence healthy dialogue and criticism.

# Ethical Relativism

Does a profession's code of ethics create the obligations that are incumbent on members of the profession, so that engineers' obligations are entirely relative to their code of ethics? Or does the code simply record the obligations that already exist?

One view is that codes try to put into words obligations that already exist, whether or not the code is written.

As Stephen Unger writes, codes "recognize" obligations that already exist: "A code of professional ethics may be thought of as a collective recognition of the responsibilities of the individual practitioners"; codes cannot be "used in cookbook fashion to resolve complex problems," but instead they are "valuable in outlining the factors to be considered.

# Continued

Michael Davis disagrees, and he places far greater emphasis on professional codes of ethics. In his view, codes are conventions established within professions to promote the public good. As such, they are morally authoritative. The code itself generates obligations: "a code of ethics is, as such, not merely good advice or a statement of aspiration. It is a standard of conduct which, if generally realized in the practice of a profession, imposes a *moral* obligation on each member of the profession to act accordingly."

# An important point for discussion

Are codes a substitute for individual responsibility in grappling with concrete dilemmas?

# An engineer who sacrificed his life for ethical concerns

**The Case of Benjamin E. Linder**

As an undergraduate studying mechanical engineering at the University of Washington, Benjamin Linder became intensely interested in the human consequences of engineering and the introduction of technology in undeveloped areas to meet human needs. After graduation in 1983, he went to Nicaragua to work as a volunteer under the sponsorship of the Nicaraguan Appropriate Technology Project. (The name "appropriate technology" is the term widely used for technology suited to the needs of small producers, rural and urban, especially in the developing world.) In the spring of 1984, Linder joined a project to provide power to a rural area in the mountains of northern Nicaragua that had no reliable source of electric power. Refrigeration for medical supplies and electric lights to hold evening classes both required electricity.

A small-scale hydroelectric plant was feasible, but because electricity had not been available, there were neither machine shops nor skilled mechanics. Plans were made to accomplish the construction by teaching local people how to build, operate, and maintain the plant themselves. Linder taught local people how to work with concrete and use hand tools. By May of 1986 when the plant was operational, many peasants had new skills and several were fully competent to run and maintain the plant.

The plant was used to power a small machine shop and support a medical center with a refrigerator. Plans included a future sawmill, carpentry shop, and facilities to make cement blocks, bricks, and roof tiles for the local area.

During the 1980s, the *contras* were working to overthrow the Nicaraguan Sandinista government. Their strategy was to attack farmers, teachers, and medical workers in outlying areas to weaken the government. The *contras* had been especially active in the area where Linder was working. When an organization of American citizens living in Nicaragua sued in U.S. court to stop the U.S. government from funding the *contras*, Linder joined the suit. In his affidavit, he said he believed that his life was endangered. The suit was unsuccessful, but Linder continued to be committed to his work. Two years later, he was killed by the *contras* while making rainfall and flow rate measurements.

In 1988, the IEEE SSIT Award for Outstanding Service in the Public Interest was awarded to Benjamin Linder for his "courageous and altruistic efforts to create human good by applying his technical abilities."[a]

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[a] This account is based on that by Stephen H. Unger, in his book *Controlling Technology: Ethics and the Responsible Engineer*, second edition (New York: Holt, Rinehart and Winston, 1994), 43–48. In that work, Unger also recounts stories of other engineers facing extreme situations.

# A case of negligence

**Prosecution of Three Engineers for Negligent Violation of the RCRA**

In 1988 Carl Gepp, William Dee, and Robert Lentz, three chemical engineers at the U.S. Army's Aberdeen Proving Ground in Maryland, were criminally indicted for violating the Resource Conservation and Recovery Act (RCRA), which the U.S. Congress had passed in 1976. All three were civilians and specialists in chemical weapons work. At issue were the storage, treatment, and disposal of hazardous wastes at the chemical weapons plant, the Pilot Plant where all three worked. Although they were not the ones who were actually performing the illegal acts, they were the highest-level managers who knew of and allowed the improper handling of the chemicals.

In their defense, the three engineers said that they did not believe the plant's storage practices were illegal, and that their job description did not include responsibility for specific environmental rules. They were just doing things the way they had always been done at the Pilot Plant.[a]

Each defendant was charged with four counts of illegally storing and disposing of waste. They were tried and convicted in 1989. William Dee was found guilty on one count of violating the RCRA. Robert Lentz and Carl Gepp, who reported to Dee, were found guilty on three counts each.

Among the violations observed were:

> "... flammable and cancer-causing substances left in the open; chemicals that become lethal if mixed were kept in the same room; drums of toxic substances were leaking. There were chemicals everywhere – misplaced, unlabeled, or poorly contained. When part of the roof collapsed, smashing several chemical drums stored below, no one cleaned up or moved the spilled substance and broken containers for weeks."[b]

[a] Harris, C. E., Pritchard, M. S., and Rabins, M. J., *op. cit*.
[b] Weisskoph, Steven. 1989. "The Aberdeen Mess," *Washington Post Magazine*, January 15, p. 55, quoted in Harris, C. E., Pritchard, M. S., and Rabins, M. J., *Engineering Ethics*. "Aberdeen Three" in *Introducing Ethics Case Studies into Required Undergraduate Engineering Courses*, C. E. Harris, Department of Philosophy and M. J. Rabins, Department of Mechanical Engineering, Texas A&M University, NSF Grant Number DIR-9012252.

# Code of Ethics for engineers in India

**Engineering Council of India**

**Registration of PE/APE/SE**

**CODE OF ETHICS**

**Preamble**
Engineering is a profession that puts scientific knowledge to practical use. Professional Engineers and Consulting Engineering Organisations , in the pursuit of their profession, affect the quality of life of all people in the society and the quality of all sectors of the economy. Therefore, ethics are fundamental to the values of the profession. Accordingly, the services provided by Professional Engineers and Consulting Engineering Organisations (referred to as 'Engineers) should adhere to the following code of ethics while dealing with the public, clients, employers, employees and the associates.

**Article 1. Social Responsibility to Uphold Ethical Values of the Society:**

1.1 **Public Safety:** Engineers shall ensure the safety, health and welfare of the public in the performance of their professional duties. Safety of the people must always come first. They should promptly disclose to all concerned the factors that might endanger the public safety or the environment.

1.2 **Compliance with Social Order:** Engineers shall abide by the laws of the land in which the work is performed, respect the local customs, uphold the human rights, safeguard public property; abjure violence and acts of terrorism.

1.3 **Impartiality and Fairness.** Engineers shall treat fairly all persons regardless of such factors as race, caste, religion, state, gender or national origin.

1.4 **Environment Protection & Improvement.** Engineers shall strive to protect and maintain clean, healthy and safe environments and comply with the statutory requirements.

# Continued

**Article 2. Responsibility to Maintain High Standards of Professional Quality.** These professional responsibilities include the following:

2.1 **Development of Technical and Managerial Skills:** Engineers shall maintain state-of-the-art professional skills, continue professional development and provide opportunity for the professional development of those working under their command.

2.2 **Undertake Assignment where Professionally Competent.** Engineers shall perform service only in the area of their technical competence.

2.3 **Performance Responsibility.** Engineers shall seek work through fair and proper methods, and shall take full responsibility for the task undertaken by them.

2.4 **Proper Verification of Documents and Production Processes.** Engineers shall approve only those designs, which safely and economically meet the requirement of the client and shall not approve any engineering document, design, materials, stages of work which they consider to be unsound.

**Article 3. Obligation to Maintain High Standard of Personal Behaviour in a Responsible Manner.**

3.1 **Honesty and Integrity in Professional Dealing.** Engineers shall maintain high degree of honesty and personal integrity in all their professional dealings. They shall conduct themselves in a fair, honest and respectable manner.

# Continued

3.2 **Compensation for Services Rendered.** Engineers shall not engage in unhealthy competition.

3.3 **Professional Opinion.** Engineers shall seek and offer honest criticism of technical work, acknowledge errors, and give proper credit for the contribution of others. Where necessary, engineers shall issue public statements in an objective and truthful manner.

3.4 **Professional Relationship with the Employer.** Engineers shall act faithfully as trustee of the employer / client on professional matters.

3.5 **Information Communication with Employers.** Engineers shall keep their employer and client fully informed on all matters relating to progress of business including financial aspects, which may affect the assigned work.

3.6 **Mutual Obligation & Trust.** Engineers shall not, maliciously or falsely, injure the professional reputation of another engineer or organisation.

3.7 **Self Promotion**. Engineers shall build their reputation based on the merits of services to the customers and shall not falsify or misrepresent their contribution.

3.8 **Employers' Business Secrets.** Engineers shall not disclose by any means, confidential information of the employer or client, unless otherwise authorized.

3.9 **Personal Conflict**. Engineers shall disclose real or perceived conflicts of interest to affected parties and avoid these where possible.

Source: http://www.cidc.in/new/support/PE/ECI-Code%20of%20%20Ethics

# Thank You!!