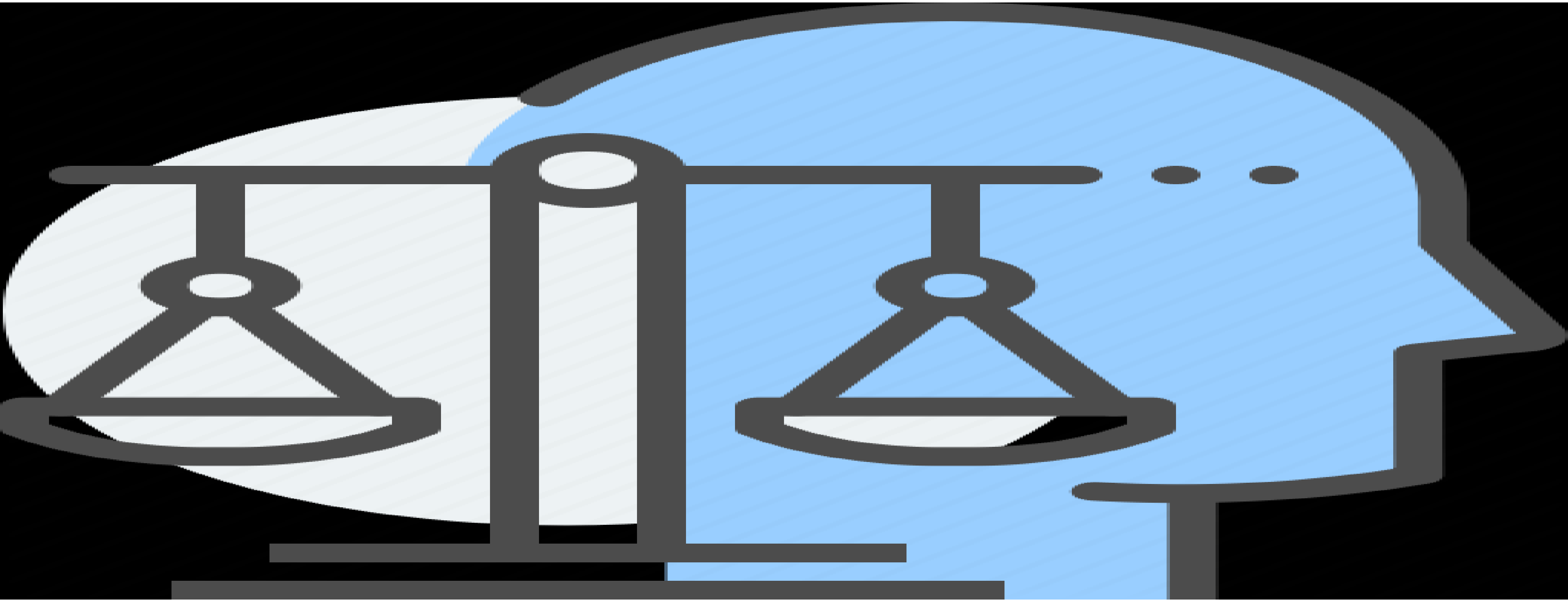
Chapter 1

An Introduction to Engineering Ethics



E. Esraa Hyarat
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Engineering Ethics (CHARLES B. FLEDDERMANN)

The Goals of this course

- Sensitize you to important ethical issues before you have to confront them

- Study important cases from past ethical engineering situations

- Foster moral autonomy of future engineers

- To gain experience in making the right choice in ethical decisions

- Train you to analyze complex problems and learn to resolve these problems in the most ethical manner

Objective of chapter one

- Know why it important to study engineering ethics.
- Understand the distinction between professional and personal ethics.
- Ethics Problems Are Like Design Problems

Ethics Course

➢ To give the engineer students a principle to solve the ethical problems – that have one or more solution. Also to increase awareness in ethical business practice, ethical safety.

Business practice **Safety**

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Issues of public safety and may involve:

- Bribery.
- Fraud.
- Environmental Protection.
- Fairness.
- Honesty in research and testing.
- Conflicts of interest

ABET

The Accreditation Board for Engineering and Technology (ABET)

Mandates ethics to be incorporated into education to educate future engineers in ethical practice

Definition

- **Ethics** is the study of the characteristics of morals.

Ethics also deals with the moral choices that are made by each person in his or her relationship with other persons.

- **Engineering ethics** is the rules and standards governing the conduct of engineers in their role as professionals.

- **Engineering ethics** is the field of system of moral principles that apply to the practice of engineering. The field examines and sets the obligations by engineers to society, to their clients, and to the profession.

Definition

- **Engineering ethics** The philosophy indicating ways that engineers should conduct themselves in their professional capacity

Why Study Engineering Ethics?

- Several notorious cases that have received a great deal of media attention in the past few years have led engineers to gain an increased sense of their professional responsibilities.

- These cases have led to an awareness of the importance of ethics within the engineering profession as engineers realize how their technical work has far-reaching impacts on society.

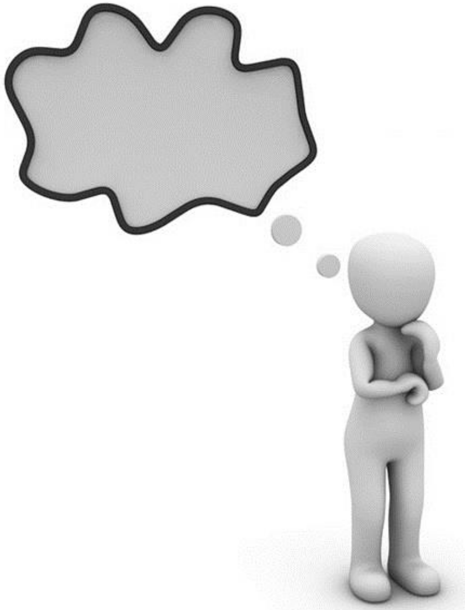
- The work of engineers can affect public health and safety and can influence business practices and even politics.

Moral Autonomy

- The ability to think critically and independently about moral issues

- Apply this moral thinking to situations that arise in professional engineering practice

Moral autonomy is at the heart of engineering ethics.

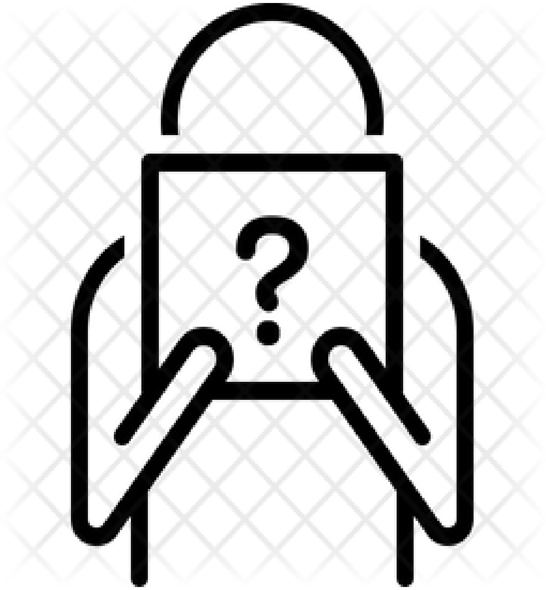


Why should a future engineer bother study ethics at all?

After all, at this point in your life, you’re already either a good person or a bad person.

Good people already know the right thing to do, and bad people aren’t going to do the right thing no matter how much ethical training they receive. The answer to this question lies in the nature of the ethical problems that are often encountered by an engineer. In most situations, the correct response to an ethical problem is obvious.

Managing the Unknown



Engineering design is about creating NEW devices and products. When something is new, ask . . . .

How well does it work? How will it affect people?

Is it safe? What changes will this lead to in Society?

How well will this work under all the conditions that it will be exposed to?

If there are safety concerns, how bad are they?

What are the effects of doing nothing ?

Ford Pinto case

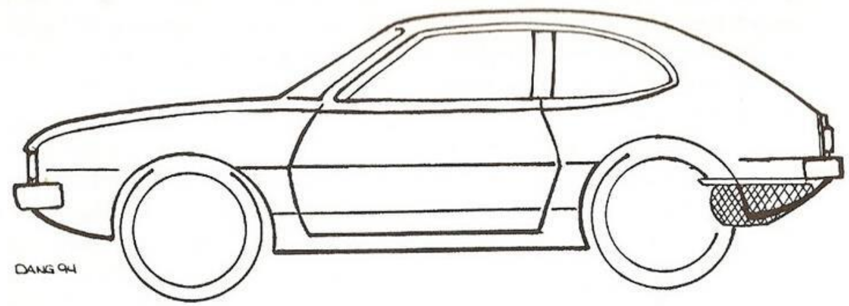


FIGURE 1
This diagram shows the placement of the fuel tank in the Ford Pinto.

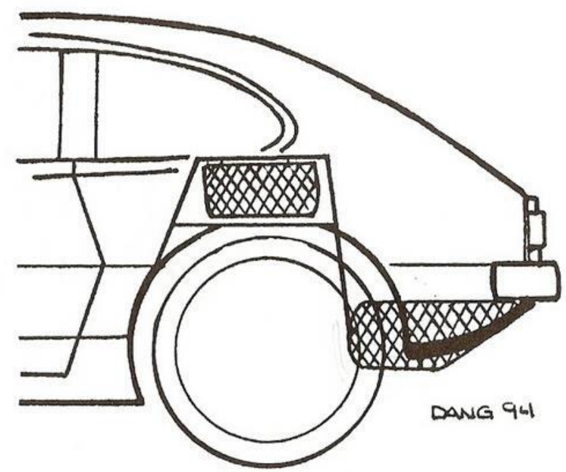


FIGURE 2
This diagram shows the actual placement of the fuel tank, as well as the alternative placement above the rear axle.

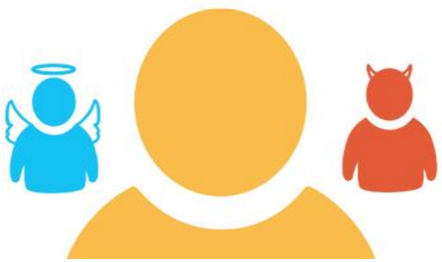
- On August 10, 1978, a Ford Pinto was hit from behind on a highway in Indiana.
- The impact of the collision caused the Pinto's fuel tank to rupture and burst into flames, leading to the deaths of three teenage girls.
- A civil lawsuit could only result in Ford being required to pay damages to the victim's estates.
- The case against ford hinged on charges that it was known that the gas tank design was Flawed and was not in line with accepted engineering standards.

- Ford engineers were aware of the dangers of this design, but management, concerned with getting the pinto to market rapidly at a price competition with subcompact cars already introduced or planned by other manufacturers had constrained the engineers to use this design.

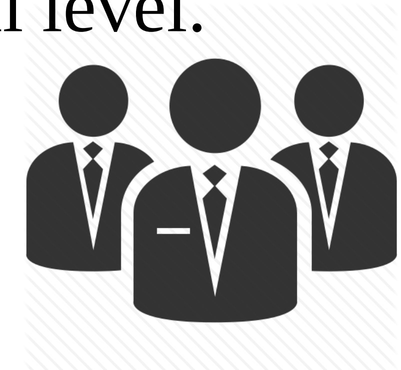
- The dilemma faced by the design engineers who worked on the Pinto was to balance the safety of the people who would be riding in the car against the need to produce the Pinto at a price that would be competitive in the market

Personal vs Professional

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.



Professional ethics often involves choices on an organizational level rather than a personal level.



The Origins Of Ethical Thought

- The western ethical thought that is discussed here originated in the philosophy of ancient Greeks and their predecessors.
- Many thinkers in the Judeo – Christian tradition had developed the western ethical thought through subsequent centuries.
- Only ethical principles were independently developed in western cultures.

- Some individuals think that personal ethics are rooted in religious beliefs but it isn’t true for everyone because there are numerous examples of people who appear to be religious but who aren’t ethical and also the opposite of that.

- Religious ethics concerns teaching and practices of what is right or wrong from a religious point of view.

- While the ethical principles that we will discuss come to us filtered through a religious tradition, these principles are now the cultural norm in the west, there are widely accepted regardless of their origin.

Ethics And The Law

- Engineering has ethics and principles just like any other specialization, and in real life, we will see that more than one specialty are working together.

- So in engineering law has a big role, because it’s governed by many laws internationally, federals, states, and locals

- Engineering considers being a scientific and a practical job, but the law is literary, but it's actually more complicated than that, I will show you what I mean in two cases:

1- laws that are legal consider unethical but they're practical, get the job done(that's why they're legal) for example, designing a process that releases known toxic, harms our environment, that's why it's unethical and the exact opposite is

2- when we have an illegal process but it's ethical, like as Substances that were thought to be harmful but by time turned out to be safe, in this case as an engineer you will start thinking in making use of it, but the law does not know engineering latest news, so it's considered illegal.

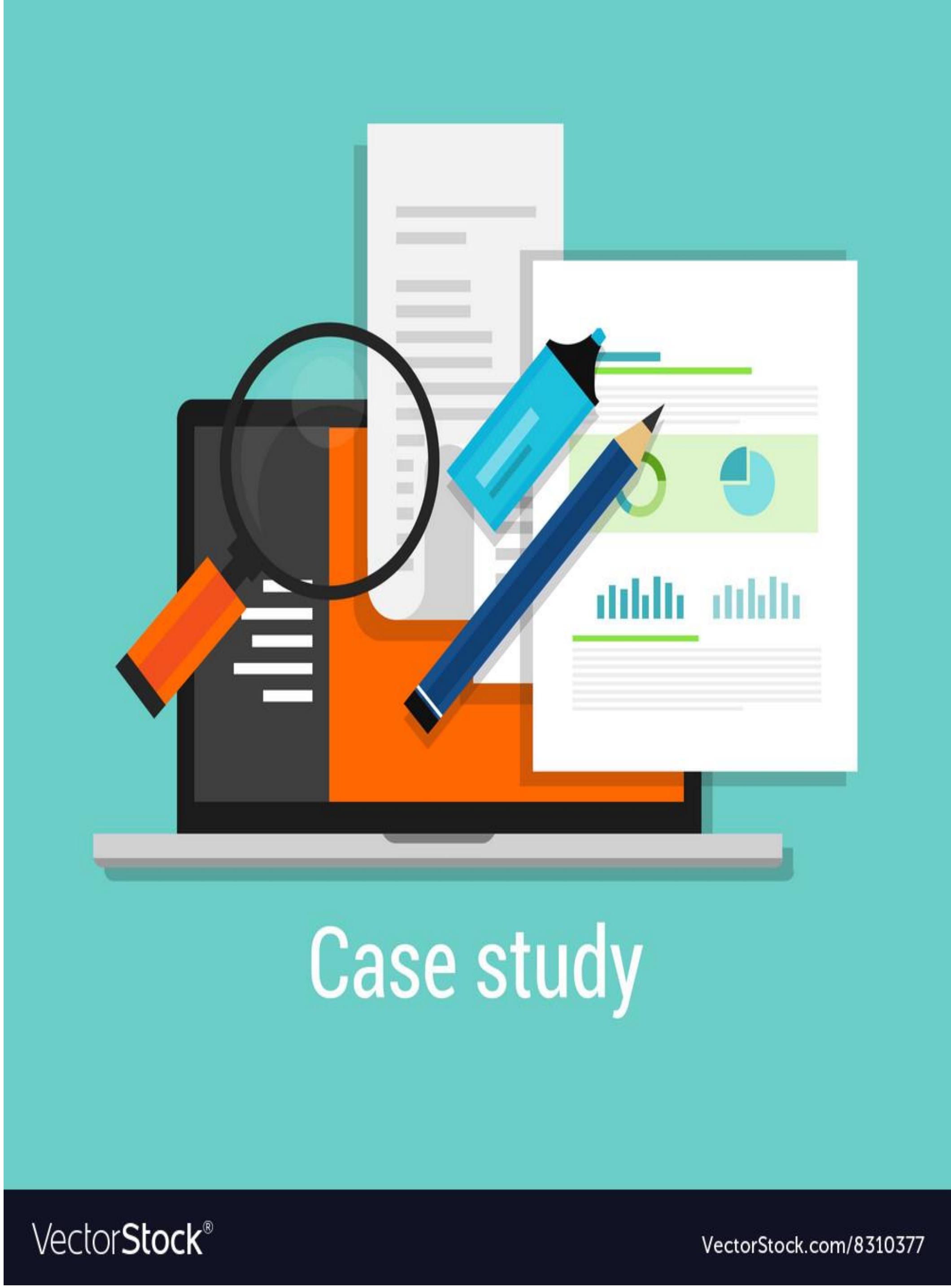
Ethics Problems Are Like Design Problems

- Ethical problems are open-ended and there is no formula for an answer
- These problems rarely have a correct answer that will be arrived to by EVERYONE.
- However, these problems are similar to engineering Design

- We might see two designs that are very different yet perform identically, for example: competing for automobile manufacturers which are suitable for market, each manufacturer's solution will be different, like the pinto, it was susceptible to the explosion, but other similar subcompacts were not.

- There is no correct answer, ethical problem-solving shares attributes with engineering design, both apply a large body of knowledge to the solution of a problem, and both involve the use of analytical skills

Case Studies

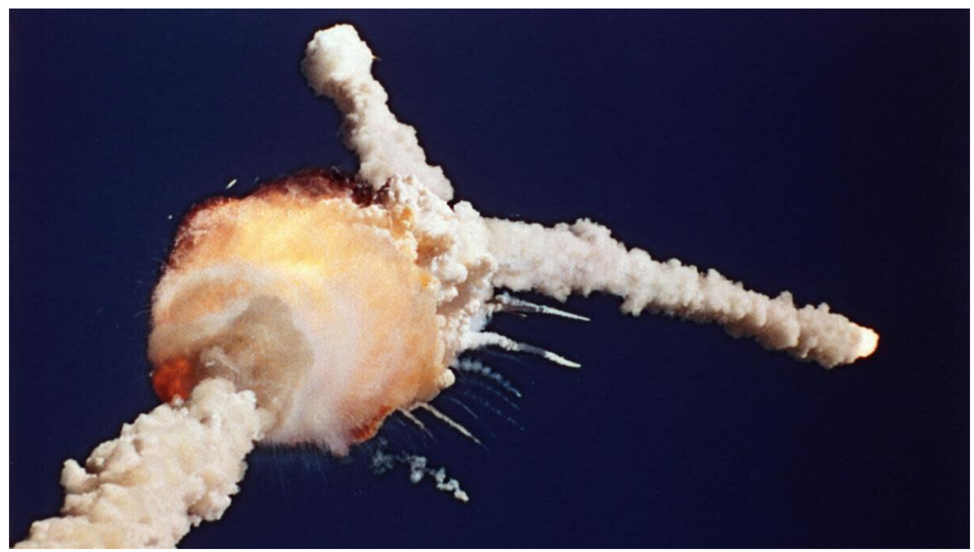


The space shuttle is one of the most complex engineered systems So, Not surprisingly there have been several accidents in the U.S. space program

like the space shuttles Challenger and Columbia.

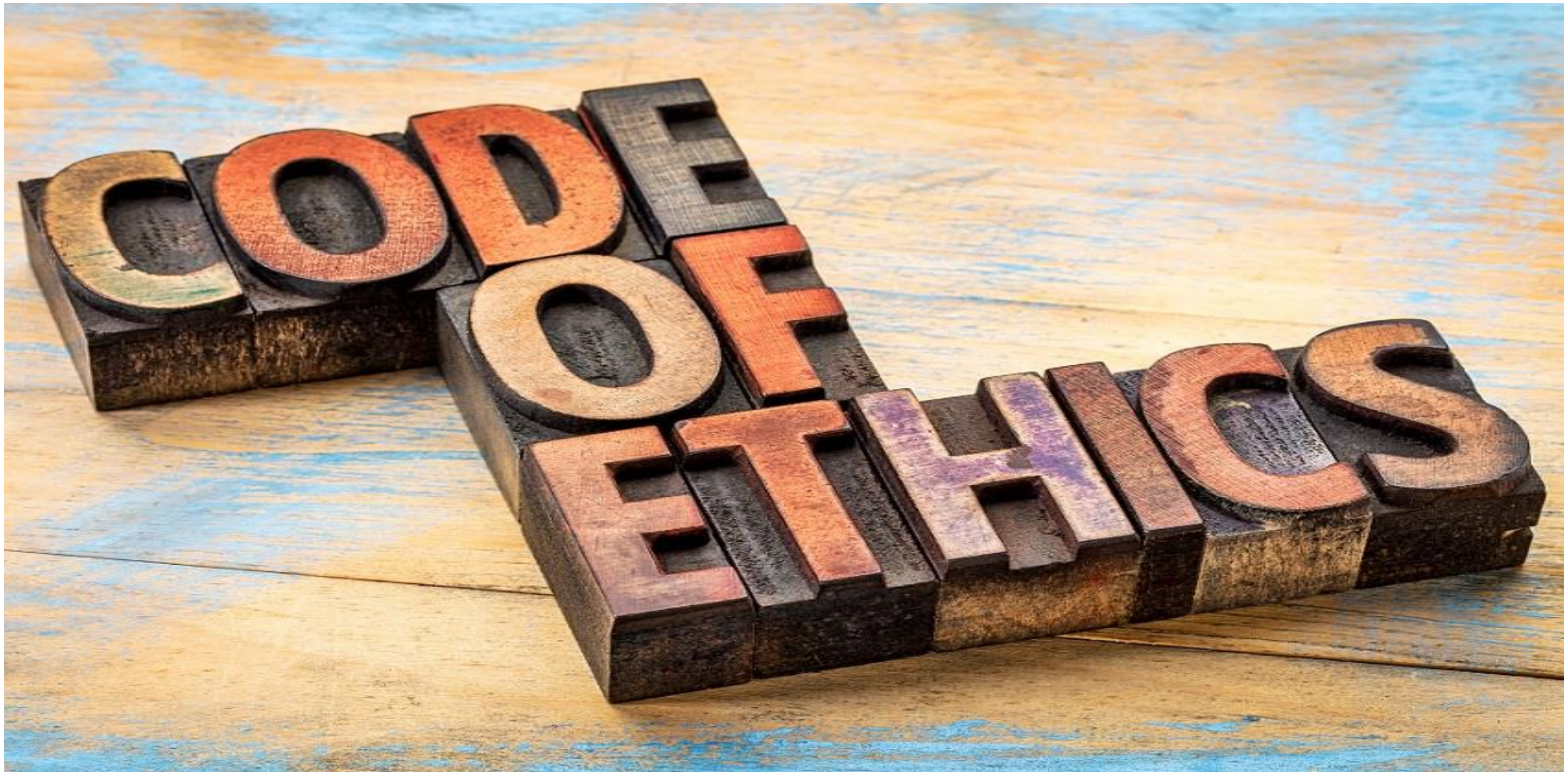
Your first case study will be on the space shuttle Challenger.
Read the case study in the textbook and the UC Berkeley Analysis.


USA
NASA
Discovery



Chapter two

Professionalism and Code of Ethics



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Engineering Ethics (CHARLES B. FLEDDERMANN)

Goals of this chapter

- Determine whether engineering is a profession.
- Understand what codes of ethics are ,examine some codes of ethics of professional engineering societies.
- The importance of being sensitive to the many ethical issues that you will deal with it as an engineer.

Intel Pentium Debacle

- In the year 1994, reports began to appear in news media that the latest generation of Pentium microprocessors was flawed.

- These reports appeared in journals and magazines aimed at computer specifications, also in the New York times and other daily news papers.

- At first Intel denied that there was a problem, later they argued that although there was a problem, but the error wouldn’t be significant to all applications only the sophisticated one.
- Many people who purchased Pentium-based computers asked to have the defective chip replaced.
- Pentium was aware of the problem throughout and was working on a solution, Intel refused to replace chips until the public became outraged
- Finally ,when it was clear, Intel agreed to replace the defective chips when customers requested it.

Did Intel do anything unethical?

- We need a framework for understanding ethical problems.
- This framework includes codes of ethics established by professional engineering organizations

When confronted by an ethical problem What resources are available to an engineer to help find a solution?

One of the hallmarks of modern professions are **codes of ethics** promulgated by various professional societies. These codes can guide practitioners of the profession in making decision about the problem they face

Are these codes of ethics applicable to engineering?

Before answering this question we must first consider what **professions** are and how they function and then decide if this definition applies to engineering or not.

In order to determine whether engineering is profession or not we should know the difference between “job” and “occupation”.

Any work for hire can be considered a job, regardless of the skill level and the responsibility granted.

<u>Engineering is a job</u> (engineers are paid for their serves), but skills and responsibilities make it more than a job.

The word **occupation** implies employment through which someone makes a living.

Then engineering is also an occupation.

How do the words “job” and “occupation” differs from “profession” ?

Some uses of the word professional in our life:

- We say “professional athletes” used to distinguish the practitioner from an unpaid amateur.
- We say “professional carpenter” to show some degree of skill, of many years of experience

Attributes of a Profession

- Work that required sophisticated skills. The use of judgment , and the exercise of discretion .
- Membership in the profession requires extensive formal education .
- The public allows special societies or organization that are controlled by members of the profession to set standards for admission to the profession .
- Achieve a public good by practice the profession

Judgment

Many occupation required judgment everyday . Like secretary (must decide what work to tackle first), and auto mechanic (must decide if a part is sufficiently worn to require complete replacement)

- ***This not the type of judgment implied in this definition (profession definition).***

In profession “judgment” refers to making significant decisions based on formal training and experience.

In general . The decision will have serious impacts on people’s lives and will often have important implication regarding the spending of large amount of money .

discretion

Discretion can have two different meaning:

A. Being discrete in the performance of one's duties by keeping information about customers confidential. (the quality of behaving or speaking in such a way as to avoid causing offence or revealing confidential information).

B. The ability to make decision autonomously (Moral autonomy). The freedom to decide what should be done in a particular situation.

It is time to consider whether engineering is a profession .

- Engineering requires extensive and sophisticated skills .
- The essence of engineering design is judgment . How to use available materials , component and devices , to reach specified objectives .
- Discretion is required in engineering . Engineers are required to keep their employers intellectual -property and business information confidential .
- A primary concern of any engineers is the safety of the public .

Differences between engineering and other professions

Most engineers are not self-employed, while lawyers and physicians are self-employed .

Who is the Self-employed person?

He is a person who works for him self or her self instead of works for an employer who pays a salary or wage for him or her .

There are differences between training for engineers and training for physicians and lawyers.

Law and Medicine

Require licenses to practicing the work unlike many engineers who don’t have engineering license to work.

If engineer were practiced more like medicine

Engineers would get a four year " pre-engineering " degree in mathematics , physics , computer science or any combination of these fields .

After that, they could enter a three or four year engineering professional program " Doctor of Engineering ".

-There are two different models of professions:

- The social contract model :

Professional societies have priority for the public good.

- The business model:

Professions function as a means for furthering the economic advantage of the member.

After understanding the previous two points, we can show that the **engineering is certainly a service-oriented professions and thus fits the social contract model.**

Code Of Ethics

Express the **rights**, **duties**, and **obligations** of members of the Profession.

Code of Ethics is a guide of principles designed to help professionals conduct business honestly and with integrity.

Code of Ethics do not express new ethical principles, but coherently restate existing standards of responsible engineering practice. Also, create an environment within the profession where ethical behavior is the norm.

On the other hand, code of ethics are not legally binding; and an engineer cannot be arrested for violating an ethical code.

May be expelled from or censured by the engineering society

Primarily, a code of ethics provide us a **framework** for ethical judgment for a professional.

Code of ethics serve as starting point for ethical decision making.

Ethical code don’t establish new ethical principle.

A code can also express the commitment to ethical conduct shared by member of profession.

Although codes of ethics are widely used by many organization including engineer societies there are many objections to code of ethics specifically as they apply to engineer practice.

Despite these objection codes are in widespread use today and are generally thought to serve a useful function.

Objection to codes

- Few practicing engineers are members of professional their societies and so don’t necessary to work with their codes.
- Many engineers are members of professional societies and they don’t know any thing about codes.
- Engineering codes have an internal conflict and don’t give method to solve it.

Codes of the Engineering Societies

Professional engineering societies in the United States began to be organized in the late 19th century. As these societies matured, many of them created codes of ethics to guide practicing engineers.

Early in the 20th century, these codes were mostly concerned with issues of how to **conduct business**. For example, many early codes had clauses forbidding advertising of services or prohibiting competitive bidding by engineers for design projects.

Codes also spelled out the duties that engineers had toward their employers. Relatively less emphasis than today was given to issues of service to the public and safety. This imbalance has changed greatly in recent decades as public perceptions and concerns about the safety of engineered products and devices have changed.

Now, most codes emphasize commitments to safety, public health, and even environmental protection as the most important duties of the engineer.

A Closer Look at Two Codes of Ethics

Two codes of ethics: the codes of the **IEEE** and the **NSPE**.

Although these codes have some common content, the structures of the codes are very different.

The IEEE code	The NSPE code
Short and deals in generalities. Doesn’t mention a duty to one’s employer. Mention a duty to protect the environment	Much longer and more details. Has a preamble that Succinctly present the duties of the engineer before going to on the more explicit Discussion of the rest of The code . Mention the engineer duty to His or her employer. Also concern about public health

Resolving internal conflict in codes.

The internal conflicts is one objection to codes of ethics.

Example: when an employer "boss" asks or orders an engineer to implement a design, but the engineer feels that the design will be unsafe, so in this situation the engineer's job is at stake if he doesn't do as instructed

In this situation the **NSPE** tells the engineer to go ahead in his work because he has a duty to his employer.(clause 1.4), however (clause 1.1) and the preamble make it clear that the safety of the public is an important concern to the engineer.

To solve this conflict we have to know the priority of the codes.

So in the previous example the public safety takes the priority over the duty to the employer so the engineer has to convince his supervisor that the product can't be designed as requested.

Unfortunately not all the internal conflicts in codes of ethics are easily solved.

Can Codes and Professional Societies Protect employees ?????

One important area where professional societies can and should function is as protectors of the rights of employees who are being pressured by their employer to do something unethical or who are accusing their employers or the government of unethical conduct.

The code of the professional societies are of some use in this since they can be used by employees as ammunition against an employer who is sanctioning them for pointing out unethical behavior.

Other Type of Ethics

The professional societies are not the only organizations that have codified their ethical standards.

There are other **organizations** developed codes for different purposes.

Example: codes for the ethical use of computer, and student organizations in universities have framed student code of ethics.

Many of the important **ethical questions** faced by engineers come up in the context of their work for corporations. Since most practicing engineers are not members of professional organizations, it seems that for many engineers, there is little ethical guidance in the course of their daily work. This problem has led to the adoption of codes of ethics by many corporations.

Many corporations have developed corporate codes of ethics:

- Help heighten employee's awareness of ethical issues.
- Establish a corporate ethics culture.

Remember that these codes can't cover all possible situations that an employee might face.

Intel Pentium Debacle

Intel

An American semiconductor chip maker corporation in Santa Clara, California, United States.

- ❖It is the inventor of the x86 series of microprocessors, the processors found in most personal computers .the word "Intel" is derived from the word intelligence.

- ❖ Intel also makes motherboard chipsets, flash memory, graphic chips ,and other devices related to communications and computing

Microprocessor : is the heart of a personal computer and controls all of the operations and calculations that

How does the problem began and **when**??

In 1994 the media began to report that there was a flaw in the new Pentium microprocessor produced by Intel

What is the problem???

There was a flaw in the floating point unit (FBU) which caused a wrong answer when double precision arithmetic was performed ..

How to detect the flaw

	Normal case	With flawed chip
Operation	4,195,835 × 3,145,727 ÷ 3,145,727	4,195,835 × 3,145,727 ÷ 3,145,727
Result	**4,195,835**	**4,195,579**
Error percentage	0 %	0.006 %

Intel Response

At first Intel deny that there was any problem with the chip

Then it become very clear that there is a problem they stated that although there was indeed a defect in the chip, it was insignificant (Intel's point view)

With the **negative** publicity Finally Intel agreed to replace the flawed chip with unflawed one for any customer asked to have it ..

- Intel switched its policy ; It now seems to feel that problems need to be fixed immediately.

- The decision is now based on the customers (customers decide if the flaw significant or not)

- This procedure cost them 475 million dollars

In 1997 similar flaws were found but this time Intel immediately confirmed that and offered customers software that would correct it…

Read the other CASES from the textbook :

- Runway Concrete at the Denver International Airport
- Competitive Bidding and the Paradyne Case
- Application of Biomedical Engineering

Chapter Three

Understanding Ethical Problem

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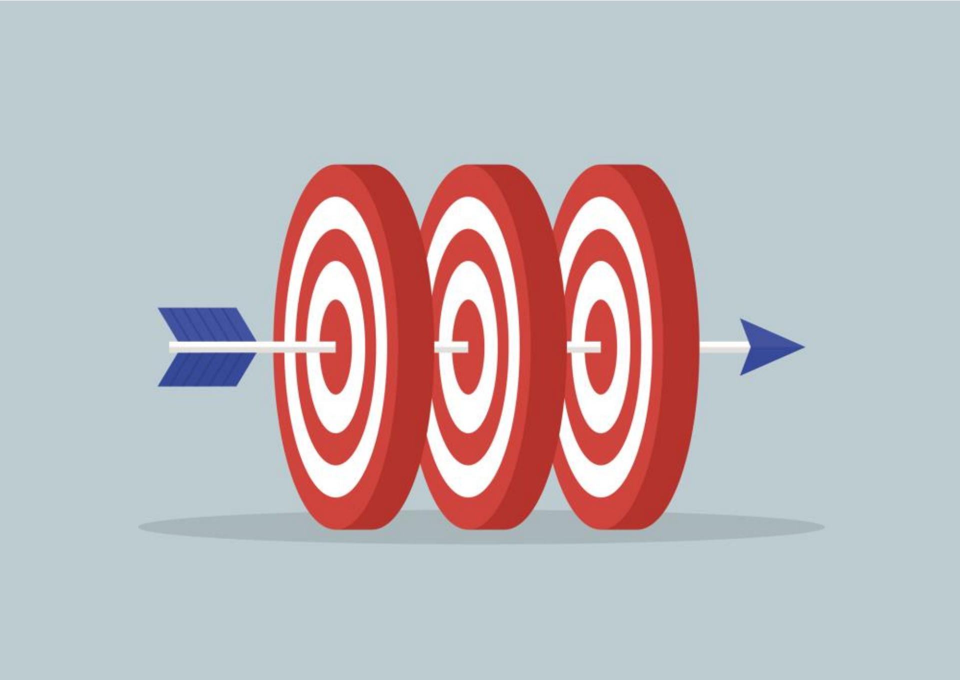
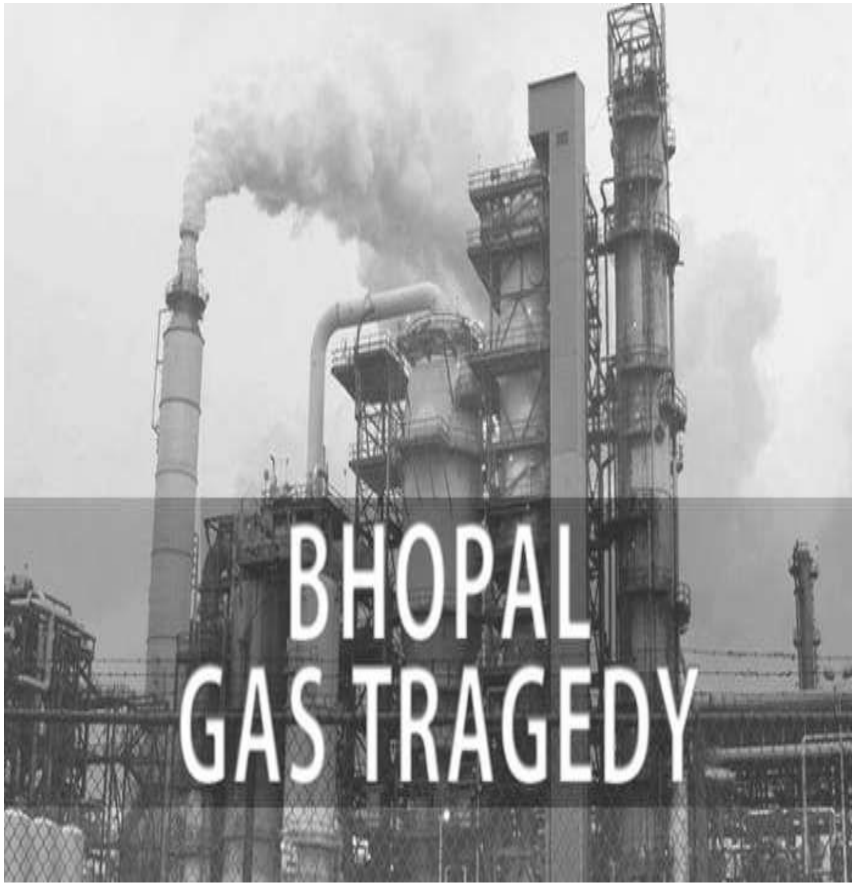
Goals of this chapter

- Discuss several ethical theories
- See how these theories can be applied to engineering situations.



Bhopal disaster



In late 1984, a pressure-relief valve on a tank used to store methyl isocyanate (MIC) in a Union Carbide plant in Bhopal, India, accidentally opened.

MIC is a poisonous compound used in the manufacture of pesticides.

When the valve opened, MIC was released from the tank, and a cloud of toxic gas formed over the area surrounding the plant. Unfortunately, this neighborhood was very densely populated. Some two thousand people were killed, and thousands more were injured as a result of the accident. Many of the injured have remained permanently disabled.

The causes of the accident **are not completely clear**, but there appear to have been many contributing factors.

Pipes in the plant were misconnected, and essential safety systems were either broken or had been taken off-line for maintenance. The effects of the leak were intensified by the presence of so many people living in close proximity to the plant.

Among the many important issues this case brings up are questions of balancing risk to the local community with the economic benefits to the larger community of the state or nation. Undoubtedly, the presence of this chemical plant brought significant local economic benefit. However, the accident at the plant also brought disaster to the local community at an enormous cost in human lives and suffering.

How can we decide if on balance the economic benefit brought by this plant outweighed the potential safety hazards?

We need a **Frame Work** to analyze the engineering ethical problem.

Codes of ethics can be used as an aid in analyzing ethical issues. But this chapter, we will examine moral theories and see how they can also be used as a means for analyzing ethical cases such as the Bhopal disaster.

Introduction

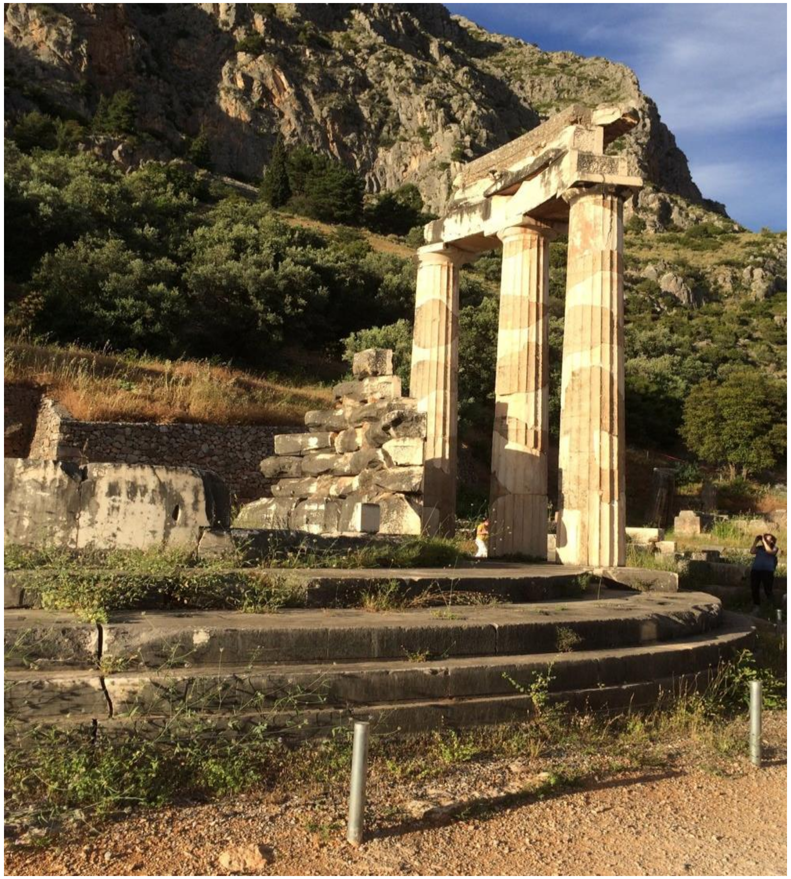
Ethical problem solving will be similar to problem solving strategies in other engineering classes.

Example: to learn how to build a bridge, you must first learn the basics of physics and then apply this knowledge to engineering statics and dynamics. Only when the basic understanding of these topics has been acquired can problems in structures be solved and bridges built.

Similarly, in ethical problem solving, we will need some knowledge of **ethical theory** to provide a framework for understanding and reaching solutions in ethical problems.

Brief History of Ethical Thoughts

The moral and ethical theories that we will be applying in engineering ethics are derived from a Western cultural tradition.

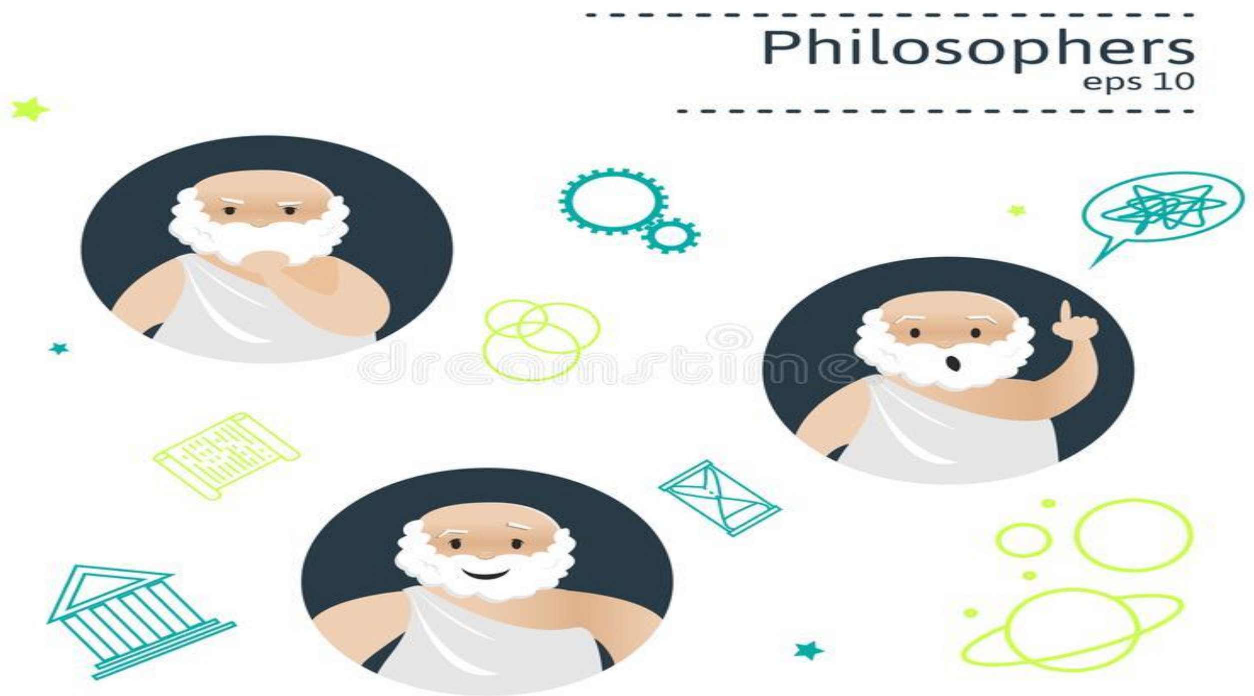


Western moral thought it is derived both from :

- **The thinking of the ancient Greeks**: Greek ethical thought originated with the famous Greek philosophers Socrates and Aristotle, who discussed ethics at great length in his *Nichomachean Ethics.*

- **From ancient religious thinking and writing**, starting with Judaism and its foundations. The written sources of the Jewish moral traditions are the Torah and the Old Testament of the Bible and their enumeration of moral laws, including the Ten Commandments.

- **Other philosophers such as** Locke, Kant, and Mill wrote about moral and ethical issues. The thinking of these philosophers is especially important for our study of engineering ethics, since they did not rely on religion to underpin their moral thinking. Rather, they acknowledged that moral principles are universal, regardless of their origin, and are applicable even in secular settings.

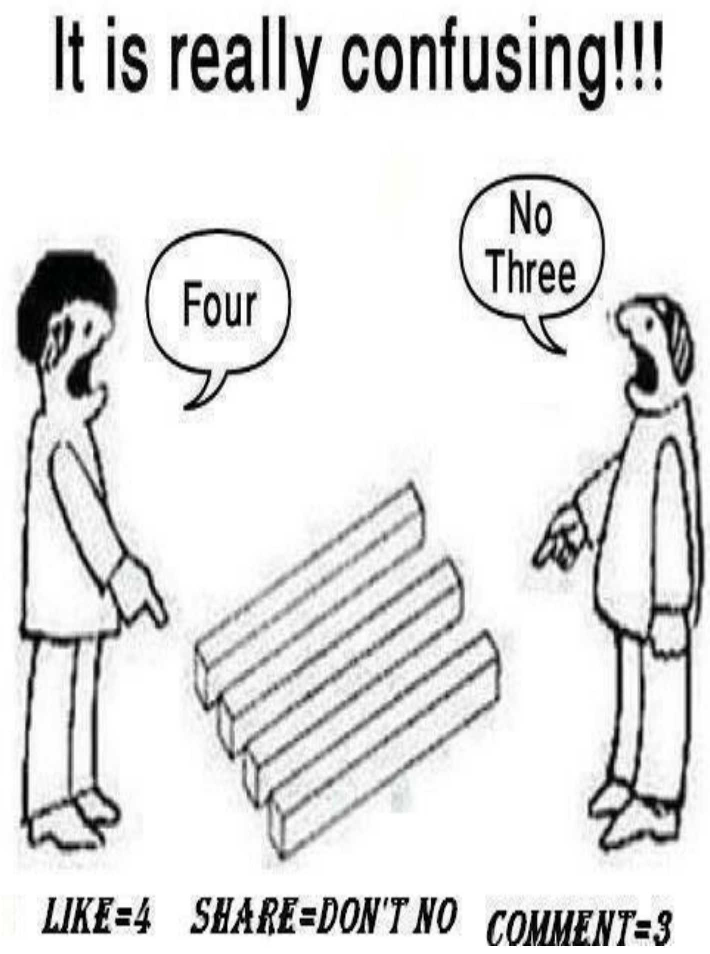


Ethical Theories

While studying engineering ethics, there are several theories that will be considered.

The relatively large number of theories doesn't indicate a weakness in theoretical understanding.

Rather, Having multiple theories to apply actually enriches the problem solving process, allowing problems to be looked at from different angles, since each theory stresses different aspects of a problem.

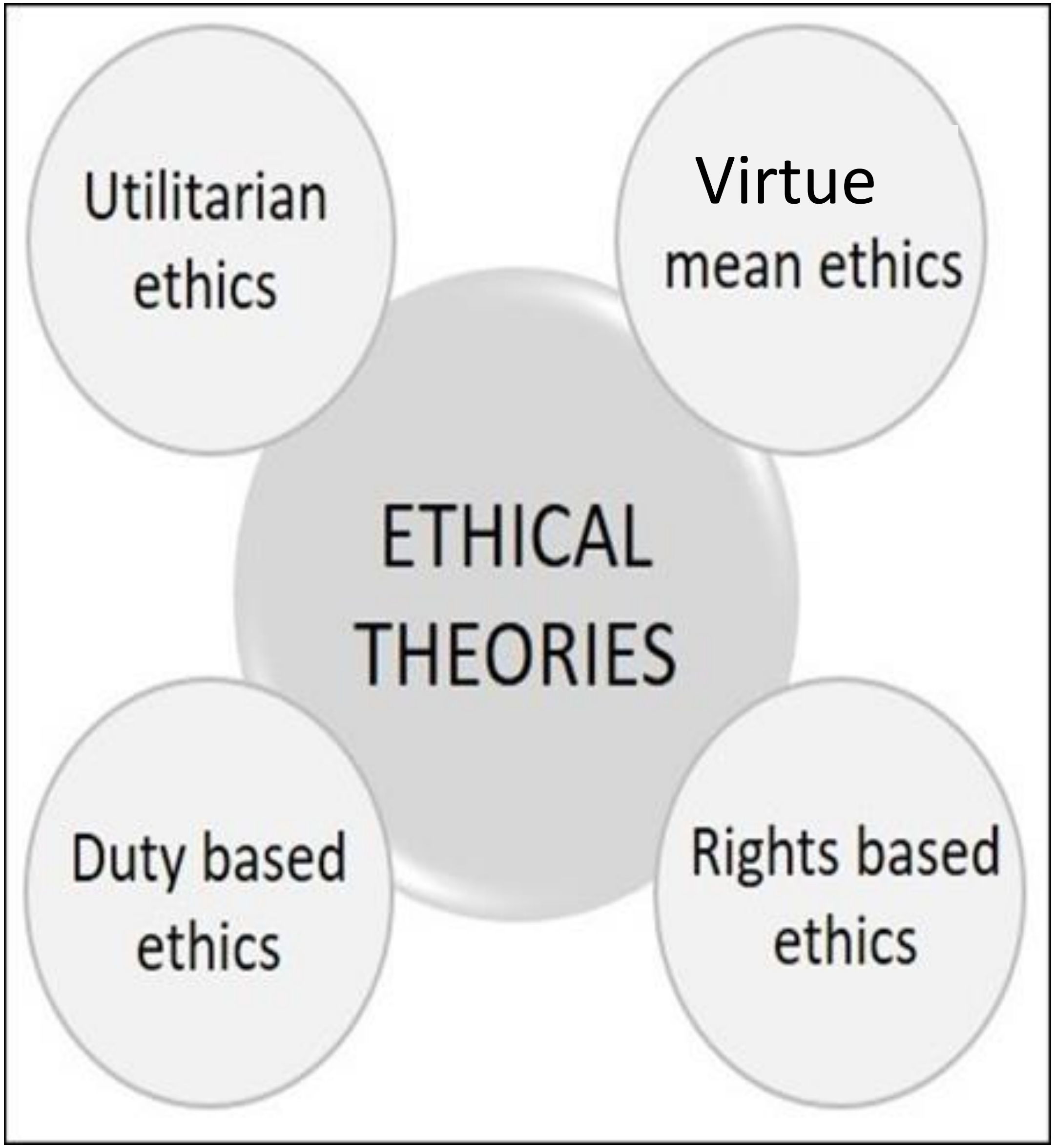


Our basic ethical problem-solving technique will **utilize different theories** and approaches to analyze the problem and then try to determine the best solution.

What Is a Moral Theory?

Moral theory defines terms in uniform ways and links ideas and problems together in consistent ways.

- This is exactly how the scientific theories used in other engineering classes function. Scientific theories also organize ideas, define terms, and facilitate problem solving.
- There are four ethical theories that will be considered here, each differing according to what is held to be the most important moral concept.



Utilitarian ethics
Virtue mean ethics
ETHICAL THEORIES
Duty based ethics
Rights based ethics

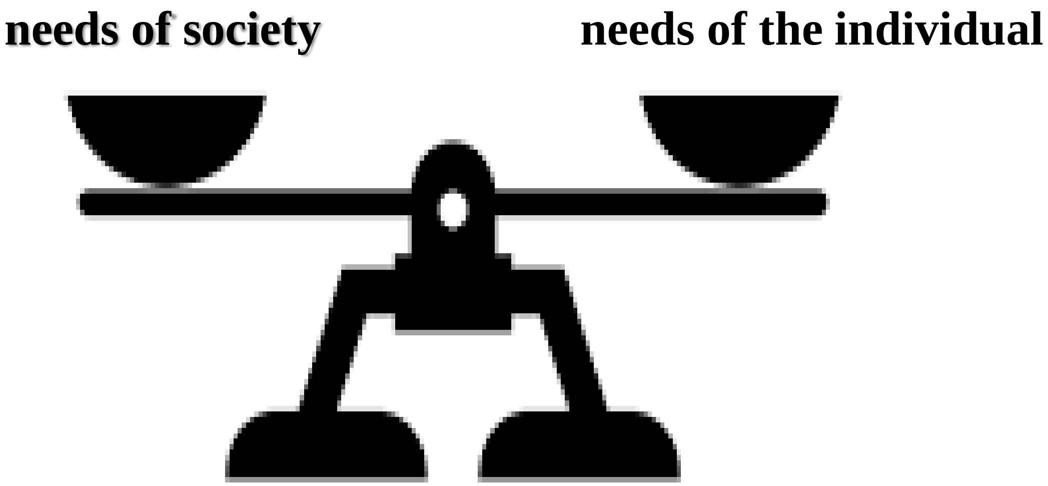
Utilitarianism

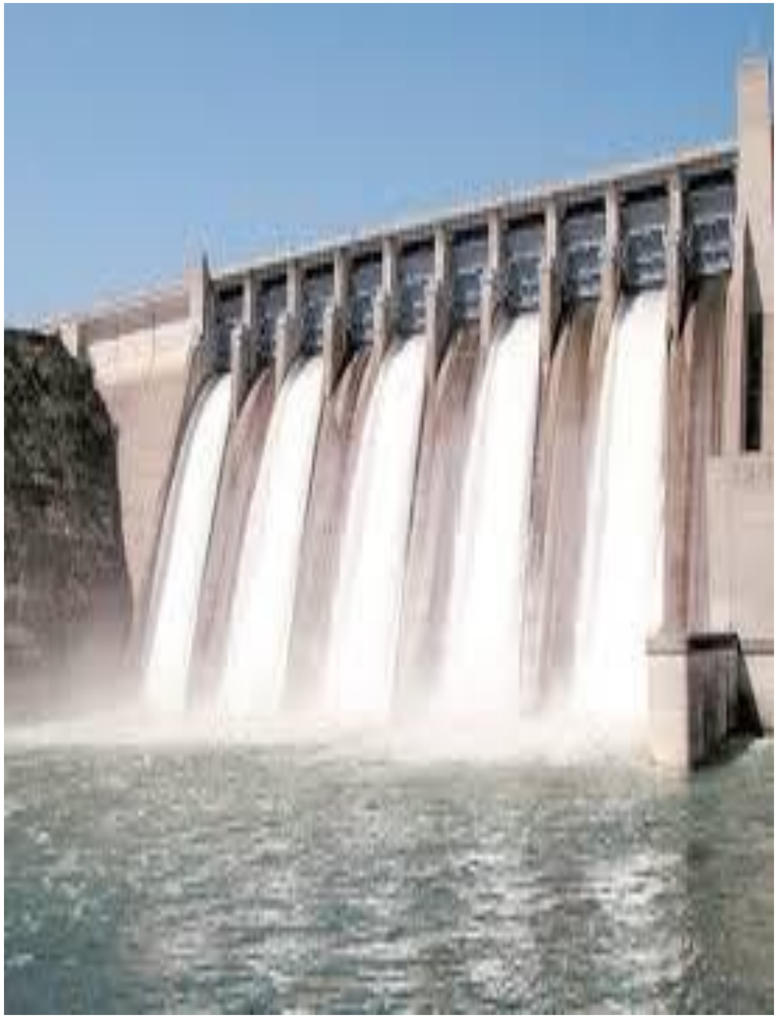
Utilitarianism emphases on maximizing the well-being of society as a whole.

Example: Building of dams which lead to great benefit to society by providing a stable supplies of drinking water , flood control and recreational opportunities.

But, sometimes the benefits Utilitarianism actions come at the expense of some people .

Utilitarianism tries to balance the **needs of society** with the **needs of the individual** .





Building of dams come at the expense of people who live in areas near the dams .

Waste isolation pilot plant (WIPP) which designed for nuclear waste in US . (it consists of a system to put the wastes into underground as a salt . This salt may incursion of water which lead to seepage of the nuclear wastes into ground-water.)

Good effect of (WIPP):

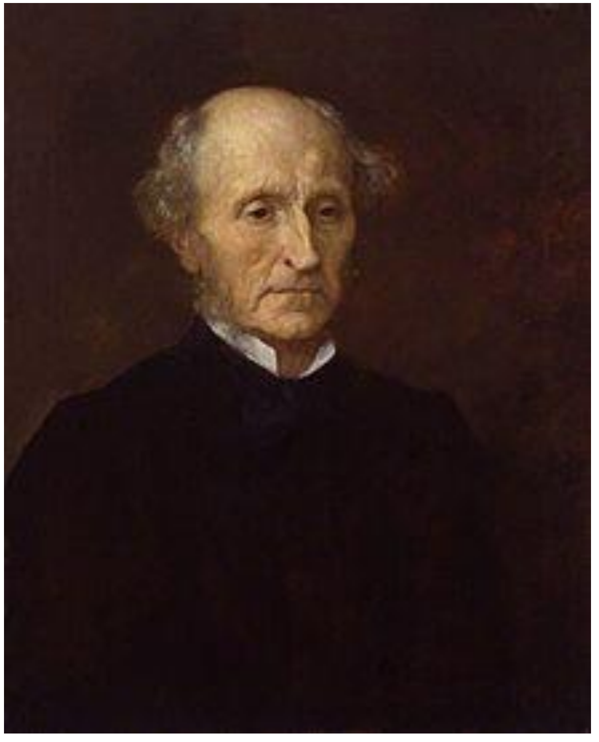
The disposal of nuclear wastes is a major problem hindering the implementation of many useful technologies , such as:

- Medicinal uses of radioisotopes .
- Nuclear generation of electricity .

Bad effect of (WIPP):

Health effect if the individuals living near the transportation routes .

So utilitarianism theory sees that the WIPP should be allowed to open .



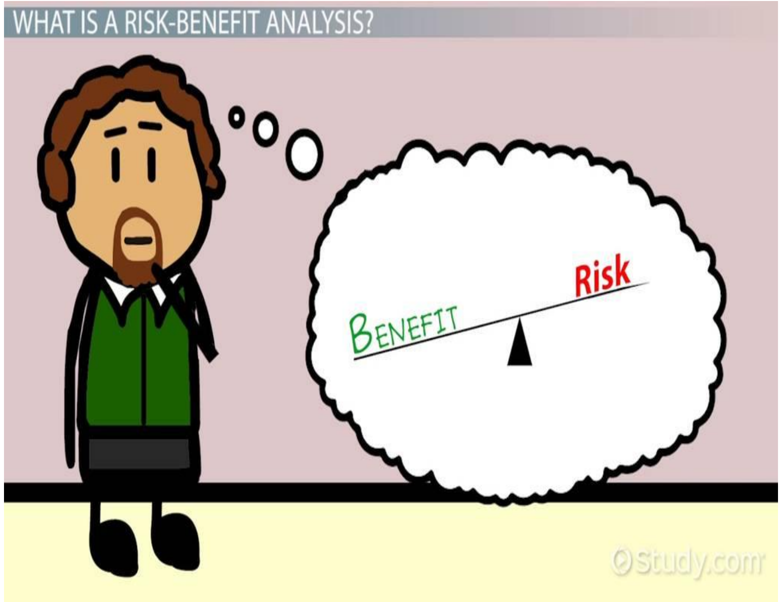
There are many flavors of utilitarianism, Two of these:

Act Utilitarianism **:** focus on individual actions rather than on rules . The best known proponent of act utilitarianism was John Stuart Mill **.**

Rule Utilitarianism : focus on moral rules and consider it most important.

These two different types of utilitarianism can lead to slightly different results when applied in specific situation .

Utilitarianism is fundamental to many types of engineering analysis :



Risk-benefit analysis

cost-benefit analysis

Utilitarianism principle has some problems such as:

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

Risk-benefit analysis
Discuss in Chapter Five

Cost-Benefit Analysis

It is a tool used in engineering analysis especially when trying to determine if a project makes sense.

- It is an application of utilitarianism. In cost-benefit analysis , the cost of a project 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.

It should be noted that although cost–benefit analysis shares many similarities with utilitarianism, cost benefit analysis isn’t really an ethical analysis tool. The goal of an ethical analysis is to determine what the ethical path is.

The goal of a cost benefit analysis is to determine the feasibility of a project based on costs. When looking at an ethical problem, the first step should be to determine what the right course of action is and then factor in the financial costs in choosing between ethical alternatives.

Duty ethics and Rights ethics

These two theories are really just two different sides of the same coin.

These theories hold that those actions are good if respect the rights of the individual, and 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.

Rights ethics was largely formulated by John Locke.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.

Example of Rights Ethics :

The Right to life.
The Right to pursue happiness.
The Right to a lawyer.
The Right to work.
The Right to free education.

In **duty ethic**, people have duties, an important one of which is to protect the rights of other.

In **rights ethics**, people have fundamental rights that others have duties to protect.

Any complete analysis of an ethical problem must incorporate multiple theories if valid conclusions are to be drawn.

The problem of duty ethics and right ethics:-

The basic rights of a person (or group) may conflict with the basic rights of another group.

Example:- building of a dam and the people's land happens to be in the way of proposed dam.

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 ethics is closely tied to personal character. Virtue is often defined as moral distinction and goodness.

Also, are normative ethical theories which emphasize virtues of mind, character and sense of honesty.

In virtue ethics actions are divided into two types:

- Actions are considered right if they support good character traits (virtues)
- wrong if they support bad character Traits(vices).

Virtue ethics is closely tied to personal character.

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?

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.

Personal Vs. Corporate Morality

Corporations should be considered pseudo-moral agents and should be held accountable in the same way that individuals are, even if the ability to do this within the legal system is limited.

In other words, with regard to an ethical problem, responsibility for corporate wrongdoing shouldn't be hidden behind a corporate mask. Just because it isn't really a moral agent like a person doesn't mean that a corporation can do whatever it pleases.

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Instead, in its interactions with individuals or communities, a corporation must respect the rights of individuals and should exhibit the same virtues that we expect of individuals.

So what is the company's duty?

- A corporation cannot do whatever it pleases.
- Must respect right of others.
- Demonstrate same virtues that we expect of individuals.
- It should be held accountable in the same way that individuals are.

Business is a very competitive field aimed at making profits and this does not mean that a company can ignore basic ethical principles. If it adheres to its responsibility towards its employees, it will enhance its reputation and build a loyal employee base.

Now,

The question is what theory should be used to solve ethical problem???????

We can use all of them to solve problems

This allows us to examine a problem from different perspectives to see what conclusion each one reaches.

Sometime, Right & duty ethics take precedence over utilitarianism.

Frequently, the result will be the same even though the theories are very different.

NON-WESTERN ETHICAL THINKING

It is tempting to think that the ethical theories that have been described here are applicable only in business relations within cultures that share our Western ethical traditions: Europe and the Americas.

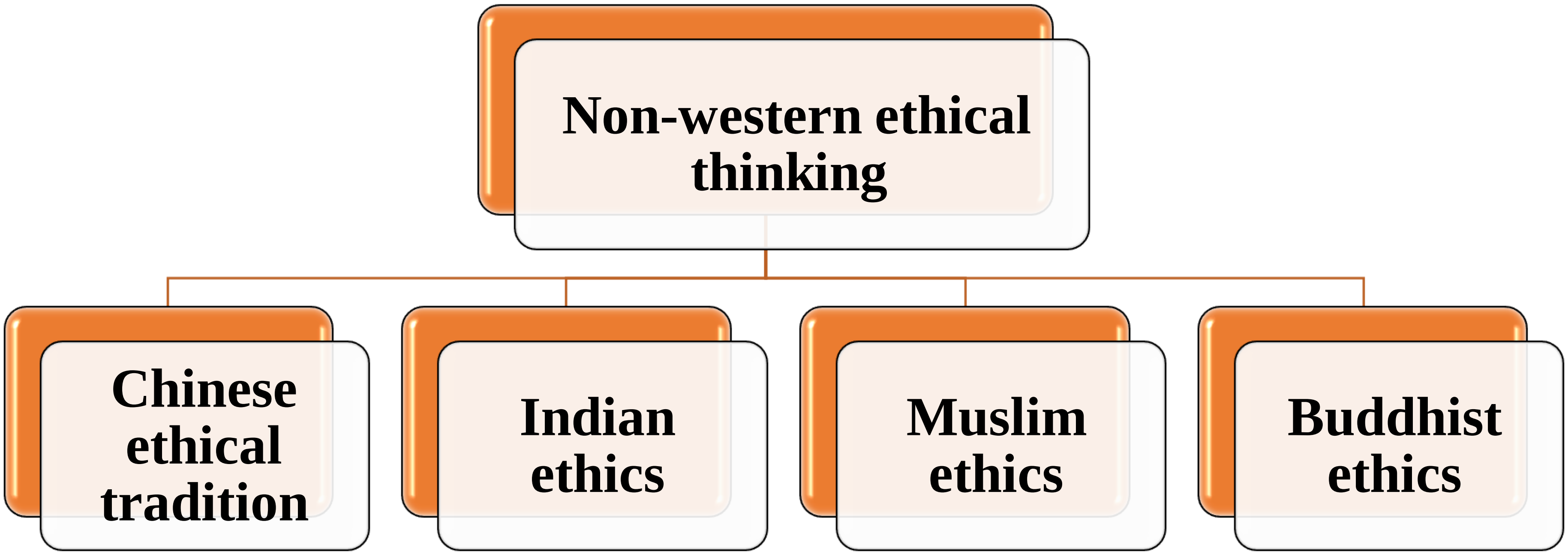
Since the rest of the world has different foundations for its ethical systems, it might seem that what we learn here won't be applicable in our business dealings in other countries.

Ethics are not geographic or cultural. The world has different foundations for its ethical systems, but this will not change the nature of ethics because its independent to the place the foundation found in .

It is important that we understand the origins of ethical thinking from places outside the Western world.

The foundations of ethical principles relating to engineering and business in Islamic countries are thus very similar to those in Western countries.

Similarly, ethical principles of Hindus, Buddhists, and practitioners of all the world's major religion are similar.


Non-western ethical thinking
Chinese ethical tradition
Indian ethics
Muslim ethics
Buddhist ethics

Chinese Ethical Traditions

Kongzi (Confucius) writings : with kongzi writings Chinese ethical philosophy originates . Who lived from 551 to 479 BCE.

Pre-theoretical : it is a way to think of work practically rather than theoretical approach to solve moral problems. unlike Western philosophy after Plato that emphasizes more theoretical thinking.

Confucian ethics emphasizes :

The importance of balancing individual right with the needs of the larger community. Either individual rights are paramount or the rights of society as a whole are paramount.

The interdependence of the group and the individual.

How might Confucian ethics inform our decision making as engineers?

- ❖Importance of leading a virtuous life in terms of integrity, honesty .
- ❖We do not harm others by our actions.

Indian Ethics

The philosophical traditions of the Indian subcontinent are the oldest surviving written philosophical systems in human civilization. Indian philosophical and ethical thinking have their origins in the ancient texts known as the Vedas.

Indian philosophy and ethics, like many other non-Western philosophies, focuses less on the theoretical and intellectual aspects of philosophy, and more on the practical and the spiritual.

In a very general way, like Chinese ethics, Indian ethical philosophy has much in common with virtue ethics discussed in Western ethical traditions.

How do Indian philosophical and ethical traditions speak to modern engineering practice????

The emphasis on the practical everyday nature of philosophy directly speaks to modern engineers and engineering practice. In addition, the emphasis on reinforcing virtues and avoiding vices directly mirrors the language used in modern engineering codes of ethics.

Muslim Ethics

The early philosopher who formulated the Muslim ethical were influenced by the early Greek philosophers, so the Muslim ethics related to Western ethics and have much in common with it. Muslim ethics forth to the Qur’an

The Qur'an mention a **VIRTUES** such as : humanity , honesty ,trustworthiness , kindness , giving poor people , and VICES such as : boasting, blasphemy and slander.

The root of Islamic ethics are different from the western , but the impact is the same, and the codes of Islamic ethics similar to those in the United states.

Buddhist ethics

Buddhist ethics based the teaching of Siddhartha Gautama , also known as Buddha . Its root comes from ancient religious and philosophy written in Sanskrit.

Buddhism was very influential outside India , and it's very similar to the western concept .

- **Buddhist vices and virtues , which are common with western thinkers :**

Vices	Virtues
Destruction of life	Friendship
Taking what is not giving	Learning
Licentiousness	Filial piety
Lying	Generosity
Taking intoxicant	Teaching

Read the CASES from the textbook :

- The Disaster at Bhopal
- The Aberdeen Three

TEAMWORK

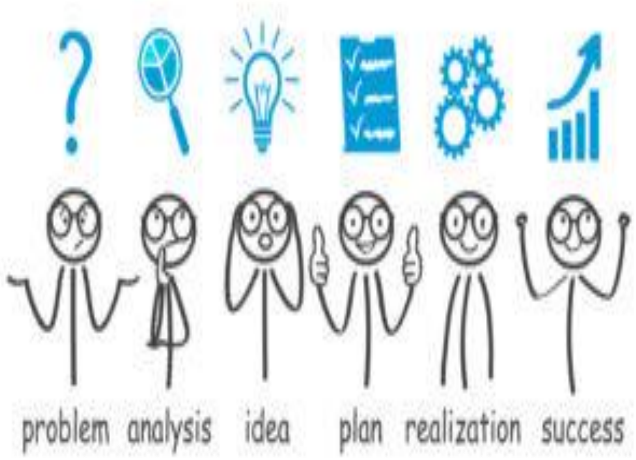
Ethical issues can arise when working on projects in groups or teams.

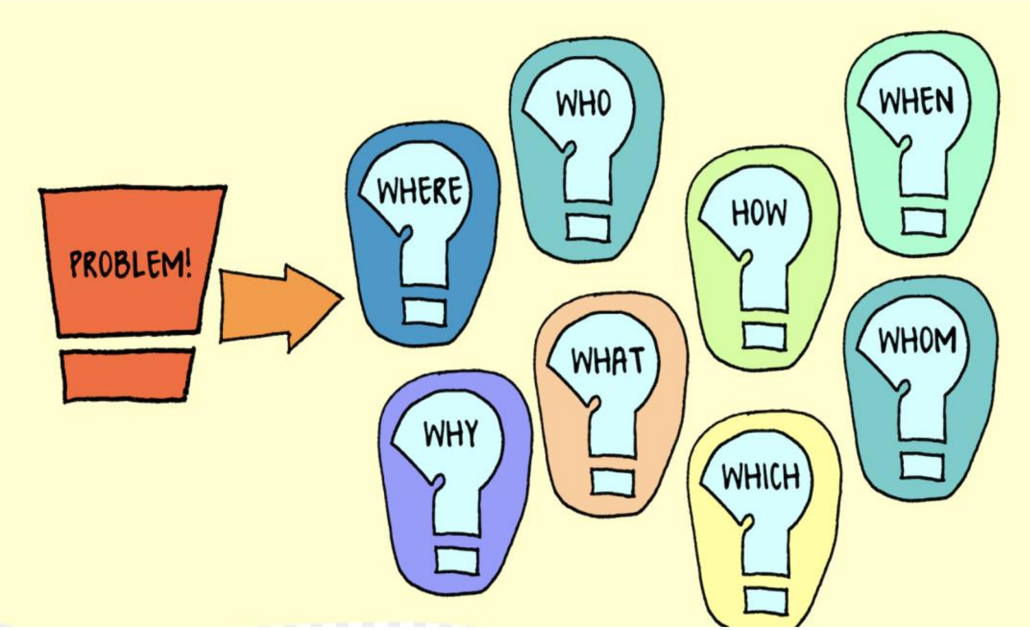
Many of your engineering classes are designed so that labs or projects are performed in groups . In order for a project to be completed successfully, cooperation among team members is essential.

Problems can arise when ;

- team member doesn’t do a good job on his part .
- one team member tries to do everything This shuts out teammates
- individuals who try to do it all “ballhogs” can harm the team

Chapter Four
Ethical Problem-Solving Techniques





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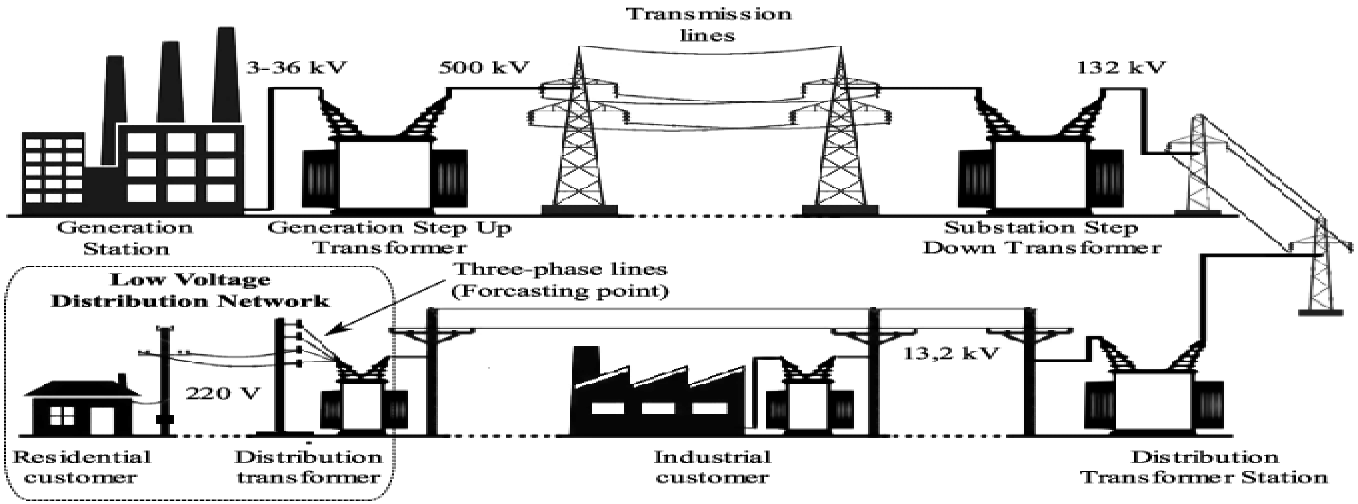
Objectives

- Apply ethical problem- solving methods to hypothetical and real cases
- See how flow charting can be used to solve ethical problems
- Learn what bribery is and how to avoid it.

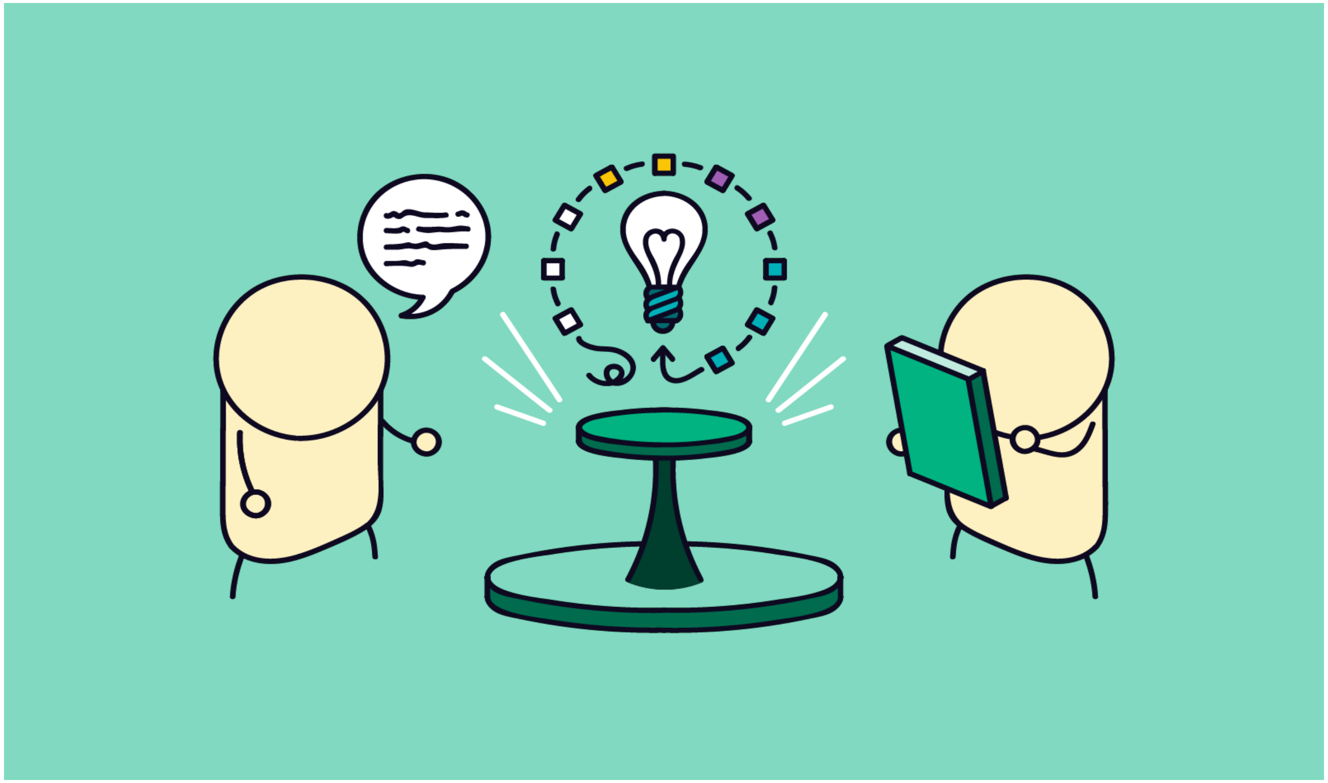
In the early 1990s, newspapers began to report on studies indicating that living near electrical-power distribution systems leads to an increased risk of cancer, especially in children.



The risk was attributed to the effects of the weak, low-frequency magnetic fields present near such systems. Further reports indicated that there might also be some risk associated with the use of common household items such as electric blankets and clock radios.

There was much concern among the public about this problem, and many studies were performed to verify these results.

Power companies began to look into methods for reducing the fields, and many engineers sought ways to design products that emitted reduced amounts of this radiation.

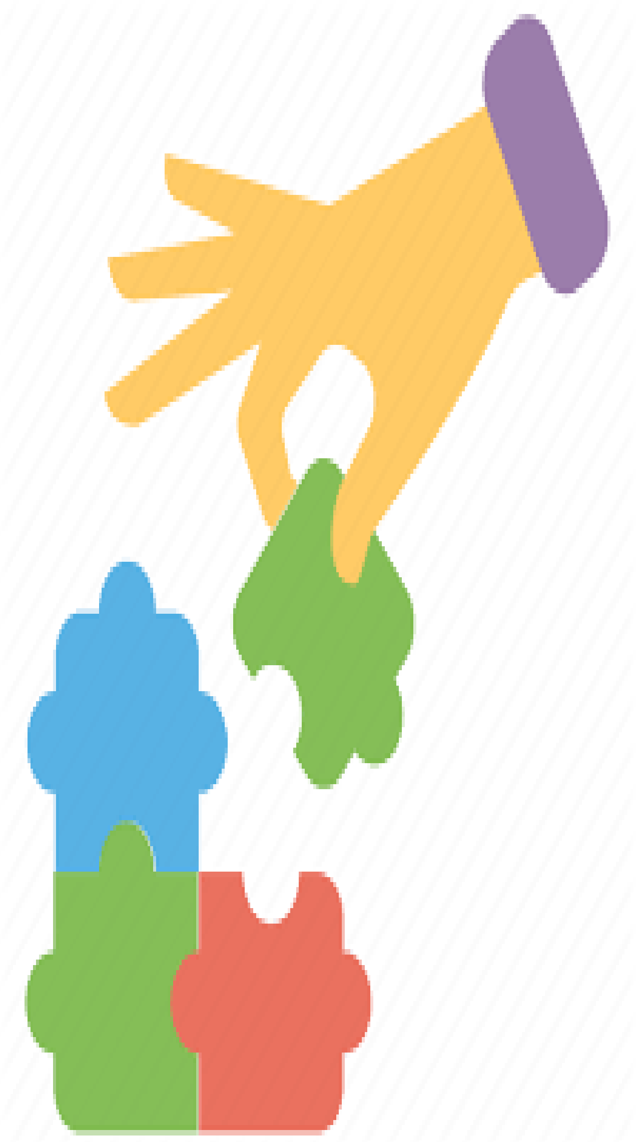


How then does an engineer decide whether it is ethical to work on a particular product or process?

What tools are there for an engineer who needs to decide which is the ethically correct path to take?

In this chapter, we will develop analysis and problem-solving strategies to help answer these questions.

These techniques will allow us to put ethical problems in the proper perspective and will point us in the direction of the correct solution.



Analysis Of Issues In Ethical Problems

A first step in solving any ethical problem is to completely understand all of the issues involved. Once these issues are determined, frequently a solution to the problem becomes apparent.

The issues involved in understanding ethical problems can be split into three categories:

- Factual
- Conceptual
- Moral

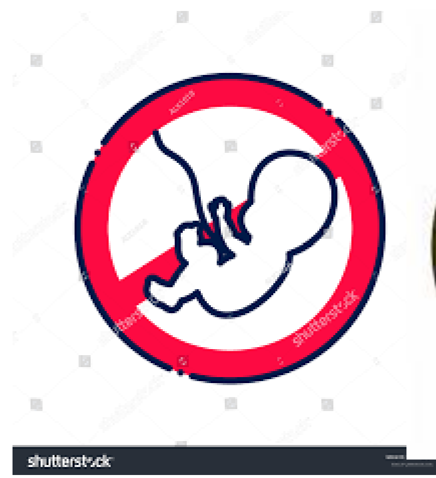
Types of issues in ethical problem solving

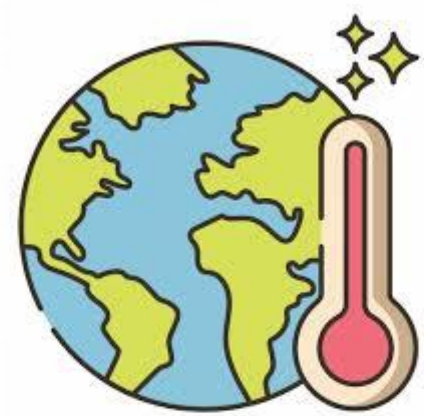
Factual issues

Factual issues involve what the facts are.

Although this concept seems straightforward, the facts of a particular case are not always clear and may be controversial.

Example: Abortion rights
Global Warming

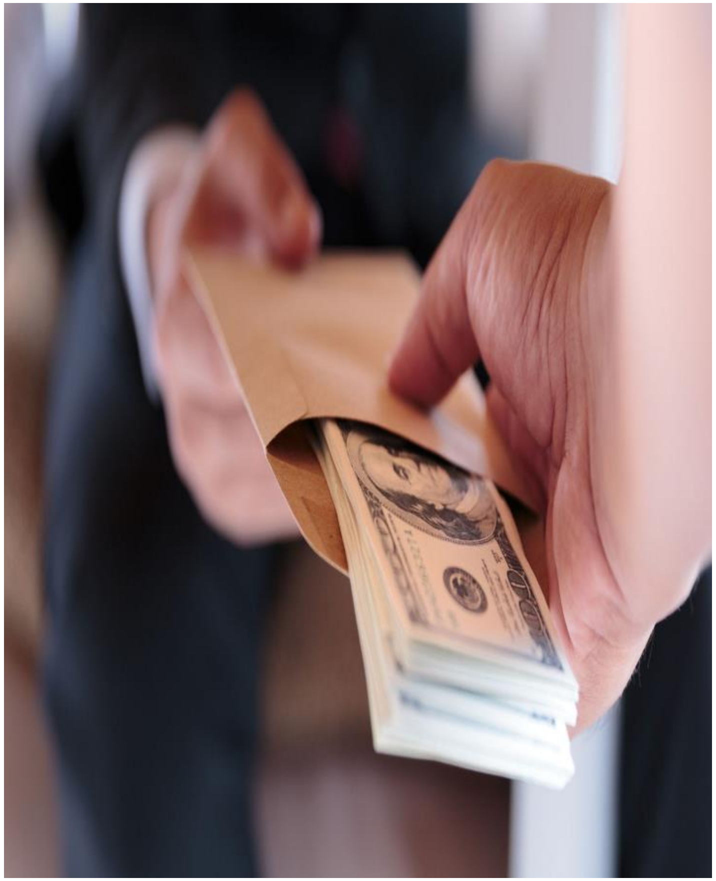




Global warming is of great concern to society as we continue to emit greenhouse gases into the atmosphere. Engineers might be required to design new products or redesign old ones to comply with stricter environmental standards .

Factual issues can often be resolved through research to establish the truth. It is not always possible to achieve a final determination of the "truth" that every one can agree on.

Conceptual issues



Conceptual issues have to do with the meaning or applicability of an idea.

What constitutes a bribe as opposed to an acceptable gift?

In case of bribe the value of the gift is probably a well known fact. What isn't known is whether accepting it will lead to unfair influence on a business decision .

Moral Issue

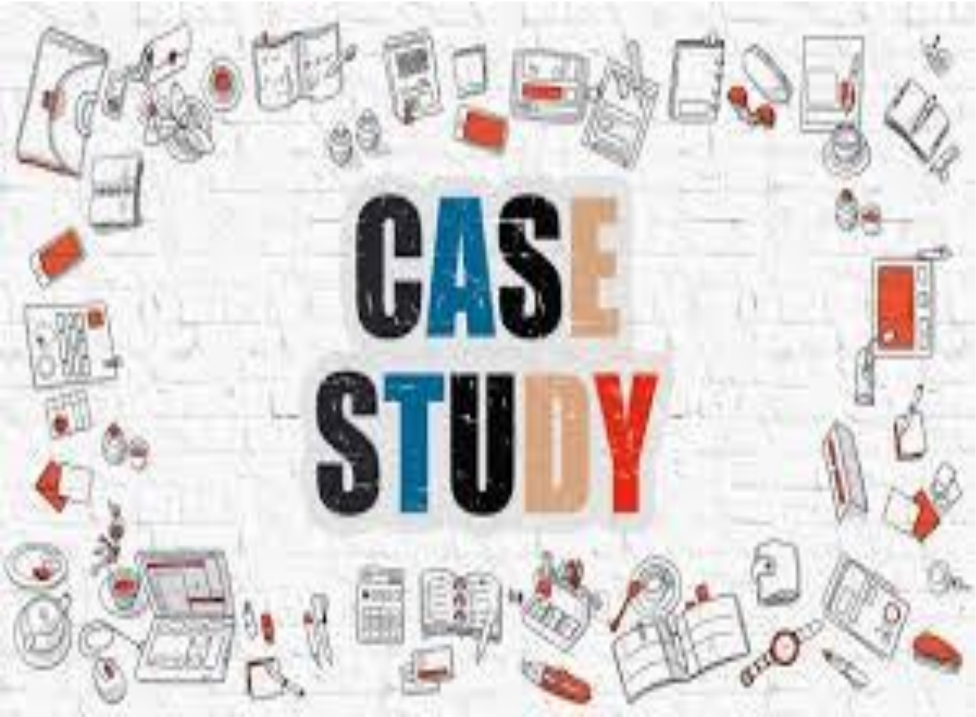
Resolution of moral issues is often more obvious. Once the problem is defined, it is usually clear which moral concept applies, and the correct decision becomes obvious.

Moral issue are resolved by agreement as to which moral principles are pertinent and how they should be applied.

- All that is required to solve a particular ethical problem is a deeper analysis of the issues involved according to the appropriate principles
- Once the issues are analyzed and agreement is reached on the applicable moral principles.
- It is clear what the resolution should be.

Application to a Case Study: Paradyne Computers

To illustrate the use of this problem-solving method, let's analyze a case study.



Scenario:

In 1980, Paradyne, a computer company, bid to supply the Social Security Administration with new computers systems.

The Factual Issues:

The request for proposals clearly specified that only existing systems would be considered. Paradyne did not have any such systems running and had never tested the operating system on the product the actually proposed to sell to the Social Security Administration (SSA). The employment of a former SSA worker by Paradyne to help lobby SSA for the contract is also clear.

In this case, the factual issues do not appear particularly controversial.

The Conceptual Issue:

The Conceptual issues involve whether bidding to provide an off-the-shelf product when the actual product is only the planning stages is lying or is an acceptable business practice.

Is placing a Paradyne label over the real manufacturer's label deceptive? Does lobbying your former employer on behalf of your current employer constitute a conflict of interest ?

Indeed, Paradyne asserted that it had done nothing wrong and was simply engaging in common business practices.

The issues of the conflict of interest is so hard to decide that laws have been enacted making it illegal for workers who have left government employ to lobby their former employers for specified periods of time.

The Moral Issues:

The moral issues then include the following:

Is lying an acceptable business practice? Is it alright to be deceptive if doing so allows your company to get a contract?

The answers to these questions are obvious : lying and deceit are no more acceptable in your business life than in your personal life.

So, if conceptually we decide that Paradyne's practices were deceptive, then our analysis indicates that their actions were unethical.

Line drawing

One of the Techniques that solving ethical problems. In the past it was known as casuistry that's mean the use of false and subtle reasoning to achieve incorrect solutions.

Useful for situations in which the applicable moral principles are clear but there seems to be great deal of gray area about which ethical principle applies. It is performed by drawing a line along which various examples and hypothetical situations are placed.

How we can perform this technique?

performed by drawing a line and At one end is placed the “positive paradigm,” an example of something that is unambiguously morally acceptable.

At the other end, the “negative paradigm,” an example of something that is unambiguously not morally acceptable, is placed. In between the hypothetical examples and the problem.

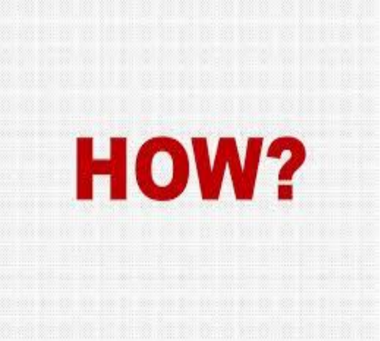
How we can classification the problem?

By carefully examining this continuum and placing the moral problem under consideration in the appropriate place along the line, it is possible to determine whether the problem is more like the positive or negative paradigm and therefore whether it is acceptable or unacceptable.

Example:

Our company would like to dispose of a slightly toxic waste by dumping it into a local lake from which a nearby town gets its drinking water.

How can we determine if this practice is acceptable?

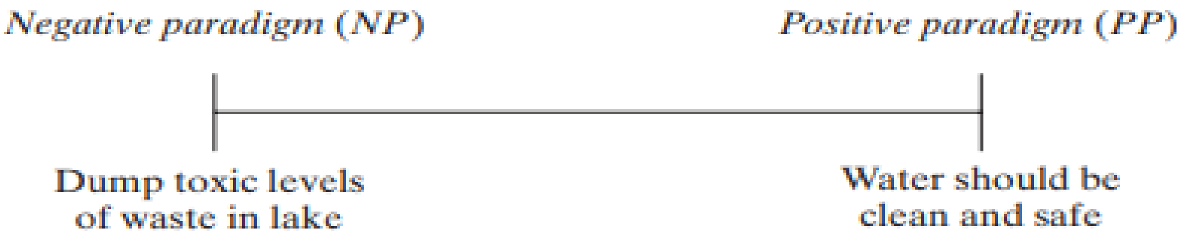


Problem analyzing:

Problem: It is proposed that our company dispose of a slightly hazardous waste by dumping it into a lake.

A nearby town takes its drinking water supply from this lake. Our research shows that with the amount of waste we plan to put into the lake, the average concentration of the waste in the lake will be 5 (ppm). The EPA limit for this material has been set at 10 ppm.

- Positive paradigm: The water supply for the town should be clean and safe
- Negative paradigm: Toxic levels of waste are put into the lake.

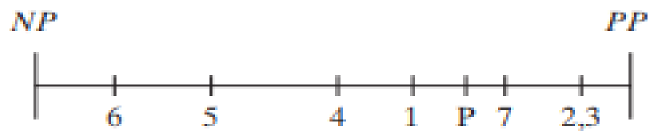


Hypothetical examples:

1. The company dumps the chemical into the lake. At 5 ppm, the chemical will be harmless, but the town's water will have an unusual taste.
2. The chemical can be effectively removed by the town's existing water-treatment system.
3. The chemical can be removed by the town with new equipment that will be purchased by the company.
4. The chemical can be removed by the town with new equipment for which the taxpayer will pay.
5. Occasionally, exposure to the chemical can make people feel ill, but this only lasts for an hour and is rare.
6. At 5 ppm, some people can get fairly sick, but the sickness only lasts a week, and there is no long-term harm.
7. Equipment can be installed at the plant to further reduce the waste level to 1 ppm.

Redrawing the line with example inserted appropriately and the problem

we need more information on seasonal variations in waste concentration and water usage of the town. We also could use information on potential interactions of the chemical with other pollutants, such as the runoff of pesticides from local farms. Note that there is some subjectivity in determining exactly where along the line each of the examples :

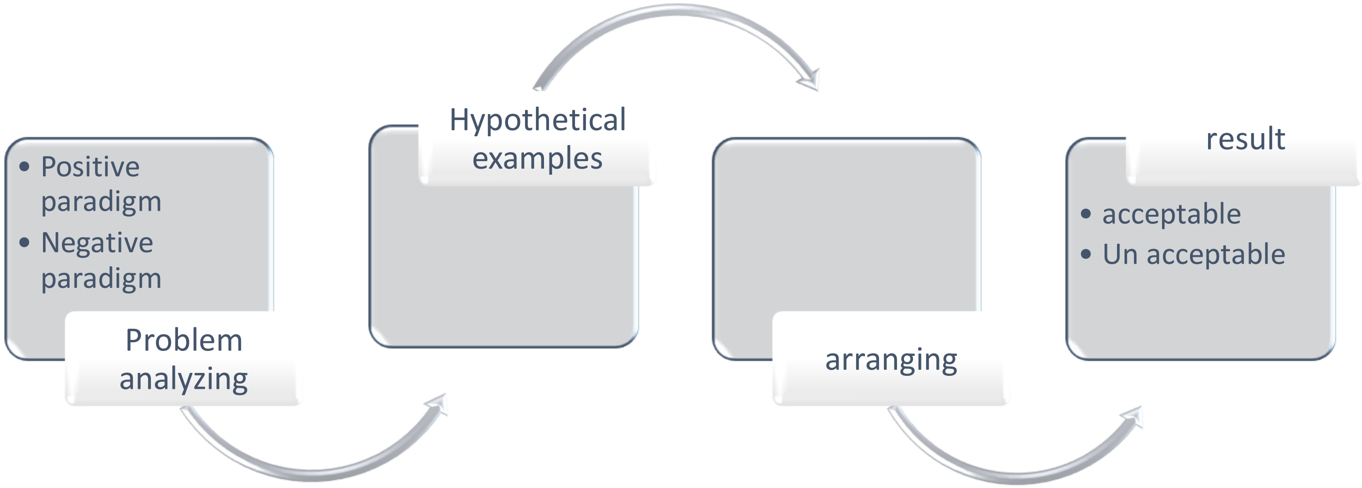


Result: because there is nobody harm and the waste concentration is below that causes harm the problem classify as moral acceptable.

Disadvantage for the method:

If not used properly, line drawing can lead to incorrect results.

For example, line drawing can easily be used to prove that something is right when it is actually wrong



Flow Chart

Flow charts are very familiar to engineering students. They are most often used in developing computer programs .

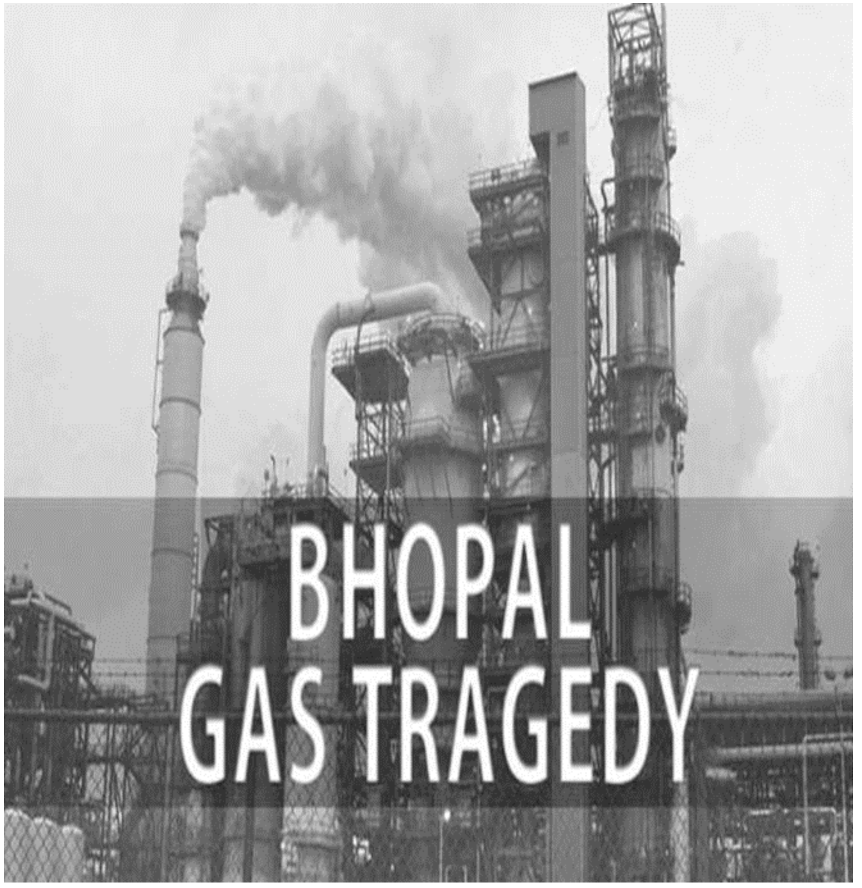
In engineering ethics, flow charting will be helpful for analysing a variety of cases, especially those in which there is a sequence of events to be considered or a series of consequences that flows from each decision .

There is no unique flow chart that is applicable to a given problem. In fact, different flow charts can be used to emphasize different aspects of the same problem.

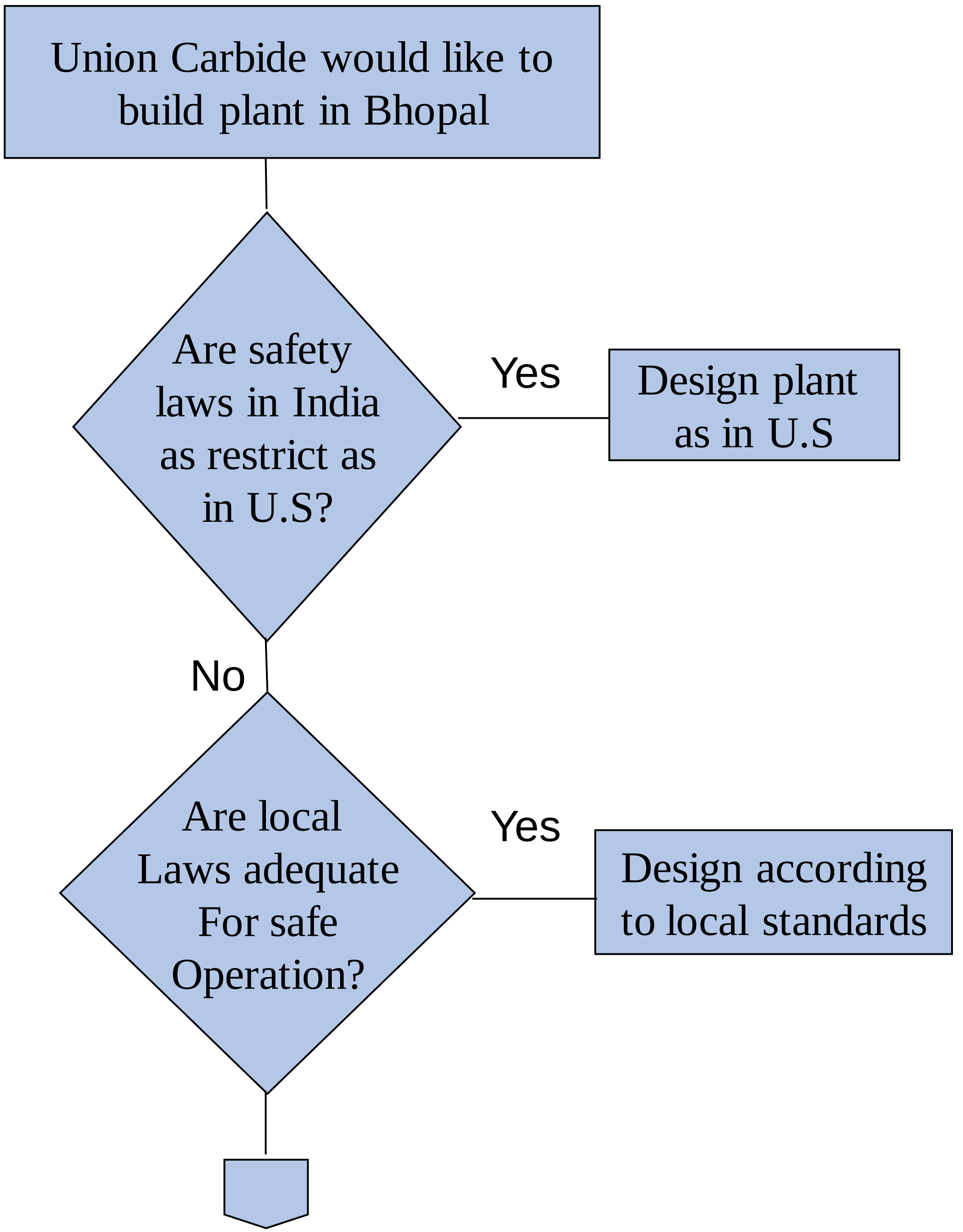
Advantage of using a flow chart to analyse ethical problems:

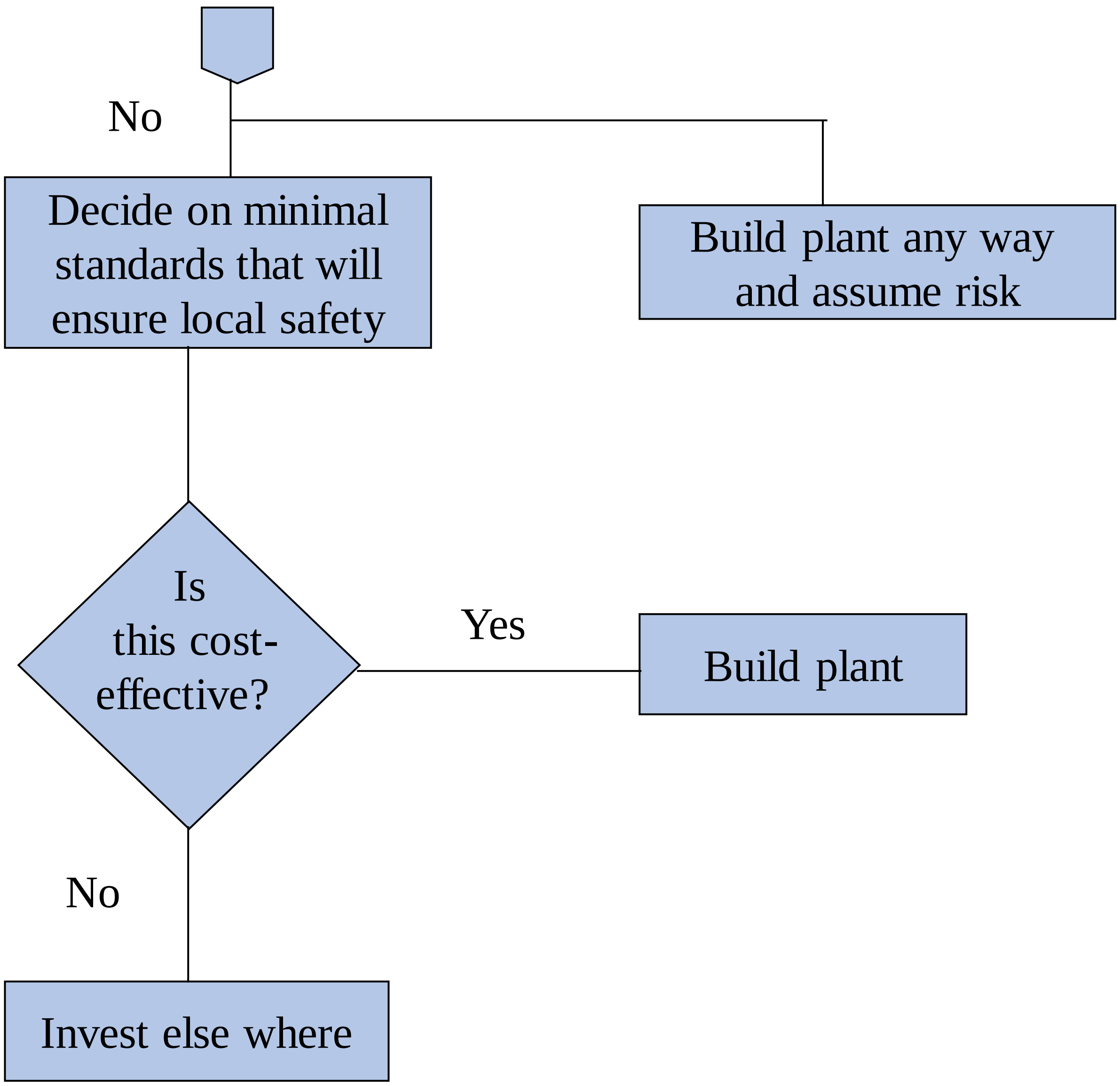
- Visual picture of a situation.
- Allows you to readily see the consequences that flow from each decision.
- Possible to draw any conclusion you want.

For example , We can explain this technique by applying a simple flow chart to a disaster that happened at Union Carbide’s plant in Bhopal, India, where MIC, a toxic substance, was mixed with water, creating toxic fumes. One possible flow chart, in next Figure .



(case in chapter three)


Union Carbide would like to build plant in Bhopal
Are safety laws in India as restrict as in U.S?
Yes
Design plant as in U.S
No
Are local Laws adequate For safe Operation?
Yes
Design according to local standards



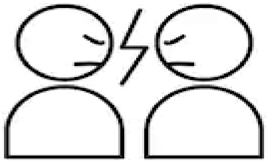
Application of a simple flow chart to the Bhopal case.

This chart emphasizes safety issues for surrounding community.

there were many paths that might have been taken and multiple decisions that had to be made .

flow chart helps you to decide which choice is good and which is not good .

Conflict Problem



What is a Conflict Problem ?

Often there are conflicting moral choices, but one is more significant than the other.

conflict problems are defined as a misunderstanding or disagreement between two or more people

HOW DO WE MAKE THE CORRECT CHOICE BETWEEN TWO CONFLICTING MORAL VALUES ?

1-Easy choice

2-The middle choice (creative)

3-Hard choice

EASY CHOICE

Is a choice that is so clear and there is no hesitation of taking it since there is no risk

Example: , (protecting the safety of the public or protecting the duty of your employee) .

Well... it's so clear that the public has the priority here, so we protect the public

The middle choice (creative)

Trying to compromise that will work for everyone

This solution attempts to reach the middle ground and try to satisfy everyone in the argument. You should focus on "Creative" because it’s the big deal here since it's hard to find a middle ground that would be acceptable for everyone.

Example

Lowering the cost of the industry of a product by dumping the waste into a local lake

So as we said in the last example that is the **priority** for people then you must find another solution that won't affect the people's health

In this case you can **redesign** the production process to minimize the amount of waste
or you can **pretreat** the waste to minimize the toxicity
also you can **pay for installing** the equipment municipal water system to treat the water and remove the chemicals

After all you should cut the toxicity or minimize it as much as you can. It's **hard** to satisfy everyone but at least you tried.

Hard choice

Choose an option that has its risks.

There are no clear choices and no way for a middle ground , so you have to bite the bullet and make the best choices with the information you have got. You must believe in your "gut feelings" while taking the choice.

Example :
Challenger shuttle

Bob Lund, the engineering manager , had responsibility to his company and workers. He had a problem related to shuttle and to the launch time.

- There was an unknown probability that the shuttle would explode, perhaps killing all aboard.
- There were consequences of postponing the launch: potentially leading to loss of future contracts from NASA, and loss of jobs to many Thiokol workers.

Bob Lund, the engineering manager had a three choice

1-easy choice : Not launching the shuttle

(Protect the lives of astronauts)

2- middle choice: Inform the astronauts of the engineer's concerns and let them choose whether or not to launch them.

3-Hard choice : to risk the launch

 (Success or failure)

He chose to risk the launch, perhaps because the data were ambiguous. He might also have wanted to help ensure the future health of the shuttle program and to save the jobs of the Thiokol workers. As we know, his gamble didn’t pay off.

The shuttle did explode, causing the deaths of the astronauts and leading to lengthy delays in the shuttle program, political problems for NASA, and business difficulties for Thiokol.

An Application of Problem Solving Methods (bribery/ acceptance of gifts)

We will look at what bribery is and see how some of problem-solving technique can be used to decide when a gift is a bribe.

The difficulty comes because of the potential for gifts to become bribes or to be perceived of as bribes.

Bribery is illegal but there are some places where bribery may be overlooked or even expected.

A bribe: is something, such as money or favour, offered or given to someone in a position of trust in order to induce him to act dishonestly.

There is a fine line between bribery and a simple gift. The distinction has to do with the value of the gift and the intent of the gift.

What are the ethical reasons for not tolerating a bribery ?

First, bribery corrupts the free market economic system and is anticompetitive. Unlike the practice of buying the best product at the best price, bribery does not reward the most efficient producer.

Second, bribery is a sellout to the rich. It corrupts justice and public policy by allowing rich people to make all the rules, and that leads to the domination of powerful, large corporations, since they are more capable of providing bribes.

Finally, bribery treats people as commodities that can be sold and bought, and this is degrading to us as human beings and corrupts both buyer and seller.

When a Gift is a bribe???

The boundary between a gift and a bribe is very subtle. Gifts of nominal value, such as coffee mugs or calendars with vendor's logo on it, are really just an advertising tool. So, there is no problem accepting these items.

It is important from the point of view of both suppliers and customers that good relations be maintained so that good service can be provided.

Social interaction, such as eating together, often facilitates close and successful interactions required by both sides.

Examples of Gifts vs. Bribes

During a sales visit, a sales representative offers you **a five dollars mug** with his company’s logo on it. **Can you accept it?????**

Does the answer change if it is a **$350 crystal bowl** with company’s name on it?

How about if there is no engraving on it?

Keep in mind that gifts accepted even after the purchase of something from a company might be a bribe directed at securing future sales from you or aimed at engineer at other companies.

An employee of a company like yours might become aware of the gift that you received. He now realizes that if he orders parts from the same supplier that you did, he will receive gift similar to yours.


PROBLEM
SOLUTION

Factual, Conceptual, and Moral issues

The facts will be obvious:

who offered the gift?

what its value was, and what its purpose was??

Conceptual issue:

it must be determined whether is sufficient value to influence a decision or whether the influence is the intent of the gift.

The moral issue:

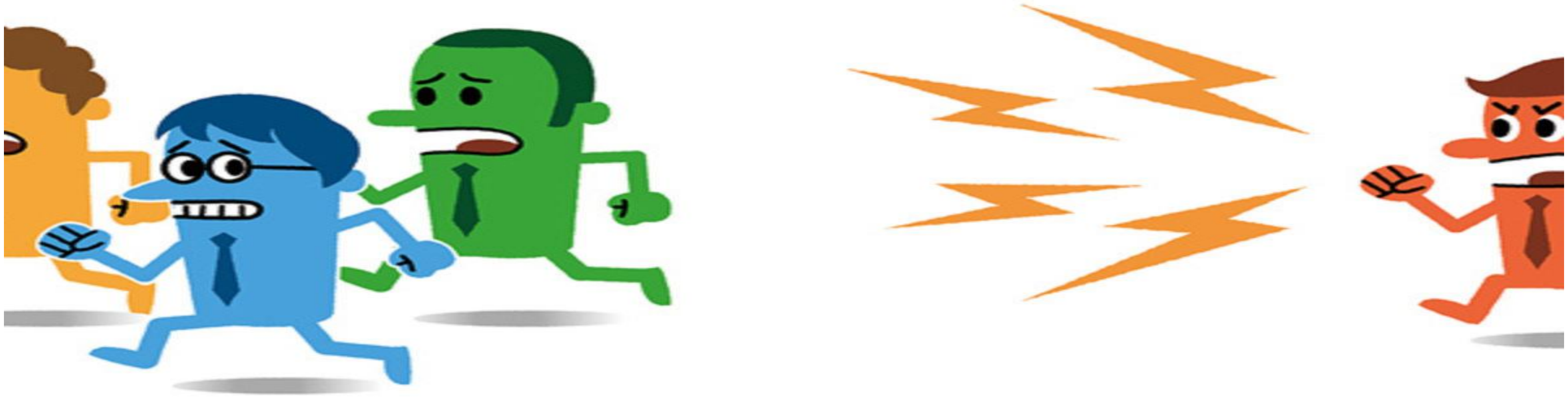
is very clear once the conceptual issues are determined. So, you can make your decision.

Line drawing technique can be used effectively analyzing this problem, We can visualize a line based on:

- *the value Of the gift*
- *The timing Of the gift*
- *The intent Of the gift*

So that we can decide whether accepting this gift is ethical or not.

Avoiding Bribery Problems



How does one ensure that accepting a gift doesn't cross the line into bribery?

First, look at the company policy. Most of companies have very clear rules about what is acceptable.

some companies say that employees are not allowed to accept any thing and any social interaction with vendors or customers must be paid for by your company.

On the other hand, some companies realize the importance of social interactions and allow their employees more discretion in determining what is acceptable.

In the absence of any corporate guidelines, another method referred to as the “New York Times Test” could be applied.

{ if you can’t stand to see your name in a newspaper in an article about the gift you received, then you probably shouldn’t do it}

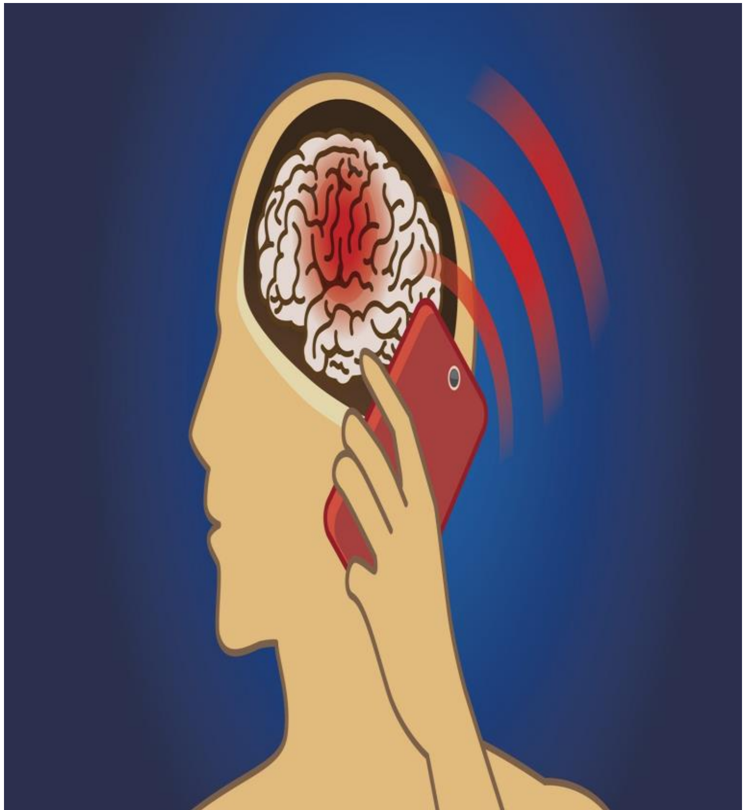
Methods of treatment for bribery

Imposition of a financial penalty
Imprisonment
Removal from work
Defamation

Defamation: when the bribe does not respond to the advice until he passes it to others

Read the CASES from the textbook :

- Cellular Phones and Cancer
- Vice President Spiro Agnew and Construction Kickbacks in Maryland



Chapter Five
Risk, Safety, and Accidents

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In this chapter we will learn about accidents, their nature, what their causes are, how to deal with them when they occur, and how to try and prevent them.

The most important duty of an engineer is to protect the public. now we will see how an engineer does that and how important that job truly is.

Objective

- Know the definitions of risk and safety.
- Discover different factors that affect the perception of risk.
- Study the nature of accidents.
- Know how to ensure that your designs will be as safe as possible.

Safety Rules and Risks

The engineering codes of ethics show that engineers have a responsibility to society to produce products that are safe.

* Safety should be an integral part of any engineering design.

Safety Engineering is the process of designing workplaces to prevent accidents.

Engineering Safety Concepts provides detailed approaches and moderate for accident reduction by using a risk management process to identify and “design out” hazards.

Accidents can and will happen.

Workplaces and factories which may use machinery, chemicals, and other potentially hazardous elements, are always possible sites for accidents which may cause injury, or even deadly if a comprehensive engineering safety approach is not taken.

The multidisciplinary nature of safety engineering means that a very broad array of professionals are actively involved in accident prevention

Definitions

Safety is a precise and, at the same time, very vague concept. Vague because it depends on judgment most times, precise because we can immediately distinguish safe situations from unsafe ones.

When talking about safety one must always include the discussion of risk, as it’s an important part of engineering design.

Safety: freedom from damage, injury, or risk.

Risk: the possibility of suffering harm or loss.

How safe is safe enough?

How much risk is appropriate?

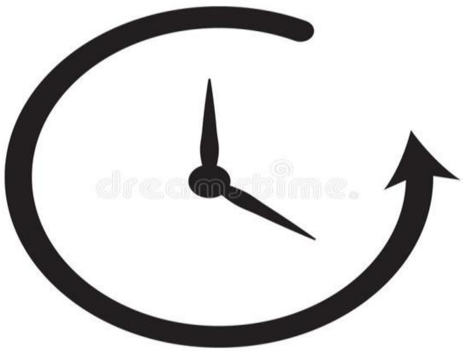
The answer to that depends on many factors, such as:

1. Voluntary vs. involuntary risk: people will consider doing something risky if they want to while knowing the risks but would feel it's a lot riskier if they were forced to do so.

Expected probability: many might think that a small chance of extreme risk is safer than a bigger chance of minor.

Short term vs. long term consequences: something that would cause inconvenience for a short amount of time seems safer than one that causes a lasting inconvenience.

Reversible effects: if the damage is reversible anything would seem less risky.



Threshold levels of risk: something that is only risky when done a lot of times will feel safer than something that has a steady risk rate.

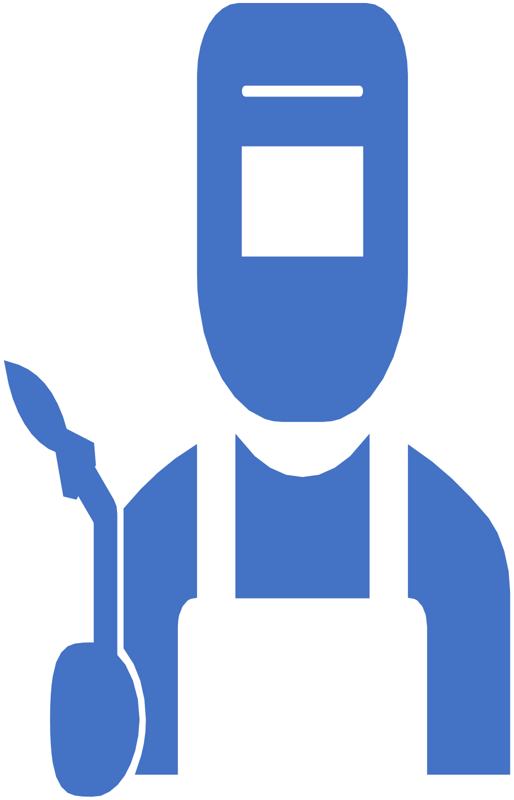
Delayed vs. immediate risk: something that when done the effects would show much later would seem safer than something with immediate effects, even if they were minor.

So Basically, it depends on the person, the judgment of safety varies between people.

Which makes the engineer's job that much harder as they must decide what is safe and what is not.

Some analysis methods might come in handy, such as line drawing and flow charting.

In the end it's up to the engineer to use their judgment to decide weather a project is safe or not.



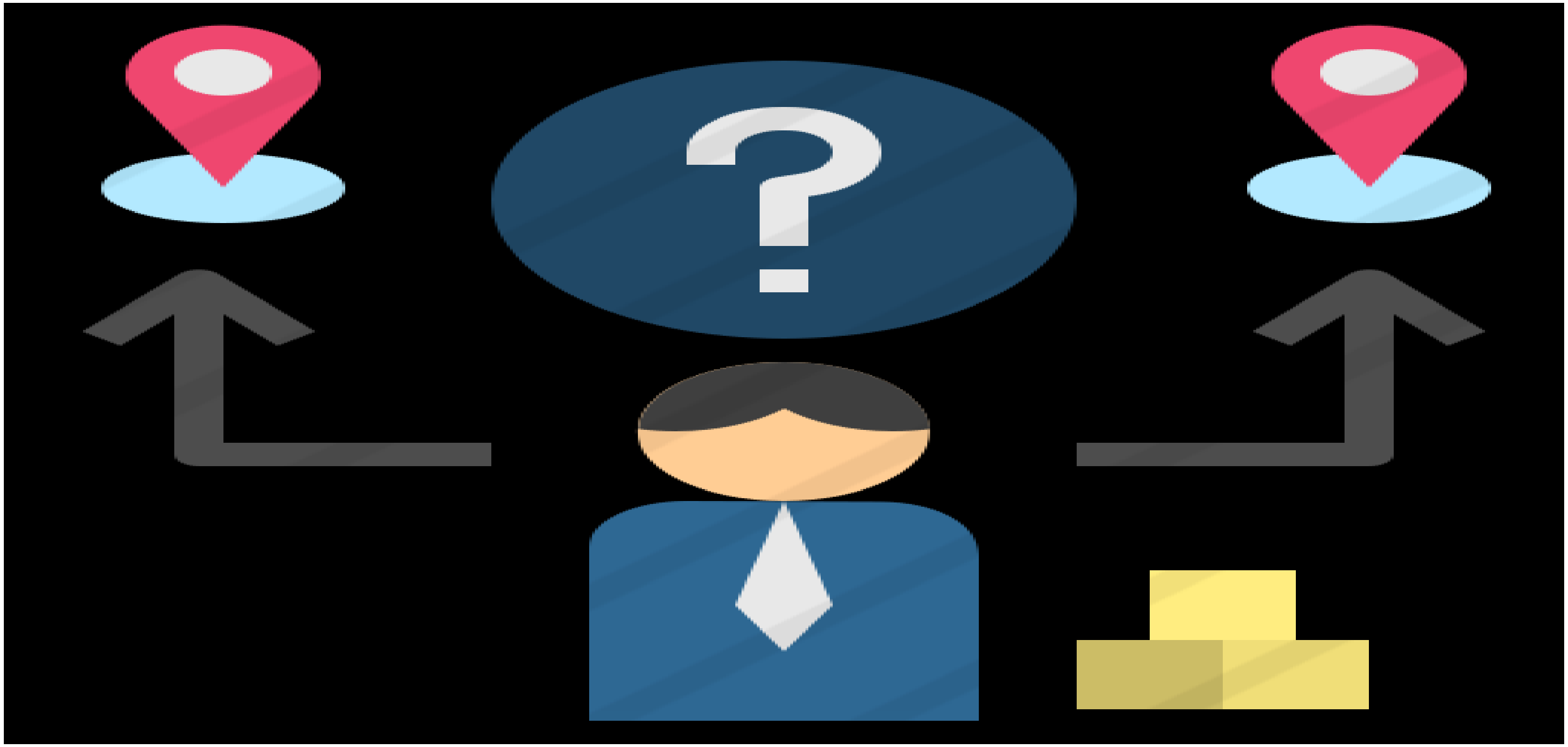
Engineers and Safety

There are four criteria that must be met to help ensure a safe design:

First: The minimum requirement is that a design must comply with the applicable laws.

Second: For a design to be acceptable it must meet the standard of "accepted engineering practice."
Hence we can't create a design that is less safe than what everyone else in the profession understands to be acceptable.

Third: Alternative designs that are potentially safer must be explored. It requires a fair amount of creativity in seeking alternative solutions. This creativity can involve discussing design strategies with others in your field and brainstorming new alternatives with them.



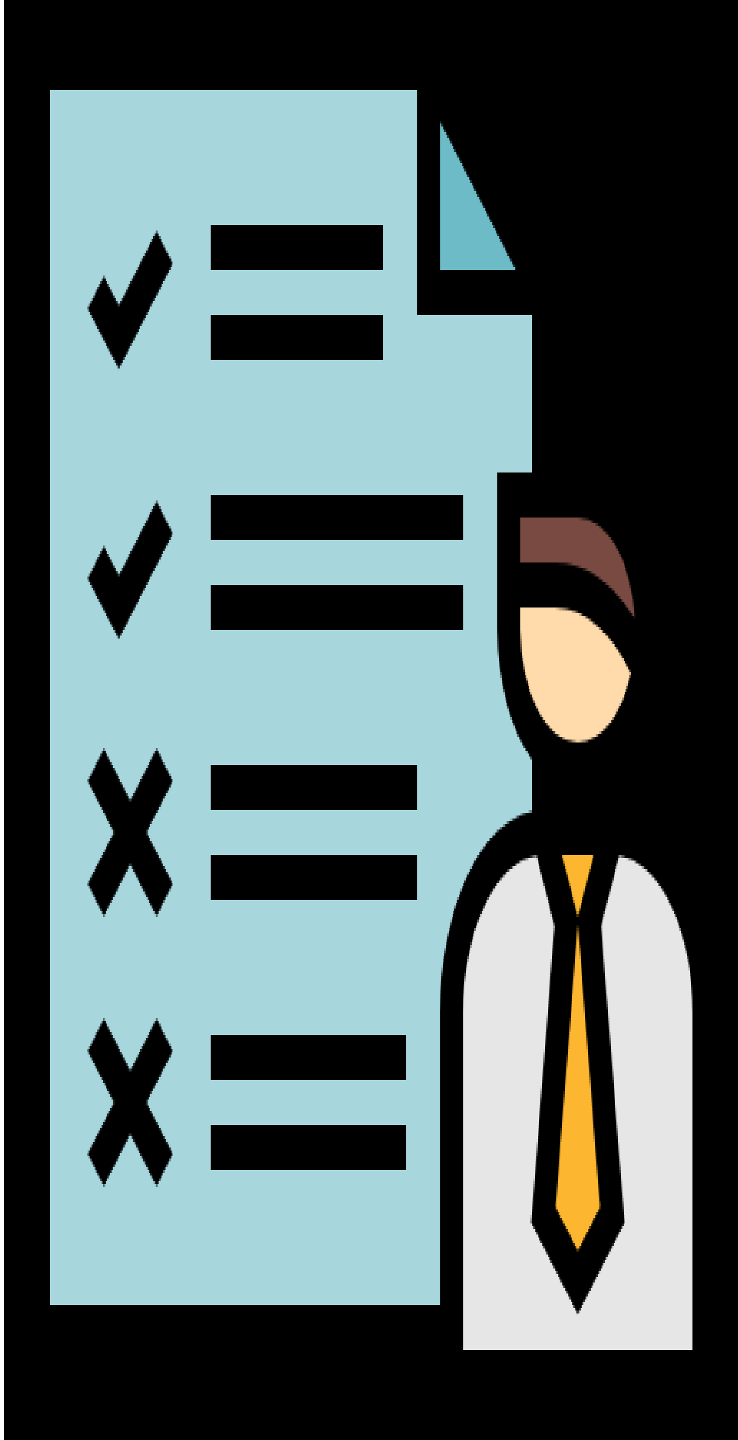
Forth : The engineer must attempt to foresee potential misuses of the product by the consumer and must design to avoid these problems. Again, this requires a fair amount of creativity and research. An engineer can’t know when someone will misuse their product and get injured, also then they can’t blame the user for the misuse and its consequences will backfire.

Hence, an engineer should execute designs in such a way as to protect even someone who misuses the product. Juries aren’t always concerned with the wrong actions of the user and might return a substantial judgment against the engineer if they feel that a product was not properly designed.

So placing a warning label on a product is not sufficient to produce a safe design. Once the product is designed, both prototypes and finished devices must be rigorously tested. This testing is not just to determine whether the product meets the specifications. It should also involve testing to see if the product is safe.

An engineer must continually upgrade their skills by (to meet the harder requirements and safety design):

- Attending conferences and short courses
- Discussing issues with other engineers
- Constantly surveying the literature and trade magazines for more information about their field



For Example: The Kursk was a Russian navy submarine that sank in August of 2000, killing everyone on board.

The sinking has been attributed to an explosion in the torpedo room that ripped open a large hole in the hull.

Many crew members of the Kursk survived the initial explosion, but died because they were unable to escape from the submarine, even with a rescue capsule that allows them to float safely to the surface, but sadly the capsules were never tested.

Designing For Safety

Designing For Safety : Is about incorporating risk determination and risk evaluation methods early in the design process, to eliminate or minimize risks of injury throughout the life of a product.

By using a range of tools and techniques for incorporating safety into the design process.

This necessarily leads to effectively executing engineering designs

Steps for designing for safety:

1- Identify risk: Determine and understand the problem effectively and often involves determining the constraints.
2- Suggesting several solutions: Create multiple alternative designs. Don’t judge whether the ideas are good or bad at this point.
3- Study each solution to determine the pros and cons of each: Specify the results of each solution and decide whether it’s suitable to solve the problem.
4- Test the solutions.
5- Choose the best solution.
6- Execute the chosen solution.

Safety and risks must be considered in every step, especially in the step that includes choosing the **ideal solution** where the engineer must make some **trade-offs** to obtain a successful final design. When choosing these trade-offs, safety **criteria** should be set as a priority over other problems.

There are many challenges that may face the design engineer during risk minimizing process. For example, the engineer must deal with **uncertainties**

These risks are sometimes only possibilities and they are not more than **educated guesses**. Sometimes there are common effects between the possibilities, especially in the new and innovative design in which the risks are unexpected.

The rapid pace in the execution of engineering designs increases the percentage of risks expected to occur. The correct approach to deal with risks is the **go slow** approach, after ensuring that all possibilities are sufficiently studied and that the test is performed correctly. However, this approach is difficult to apply in the real world.

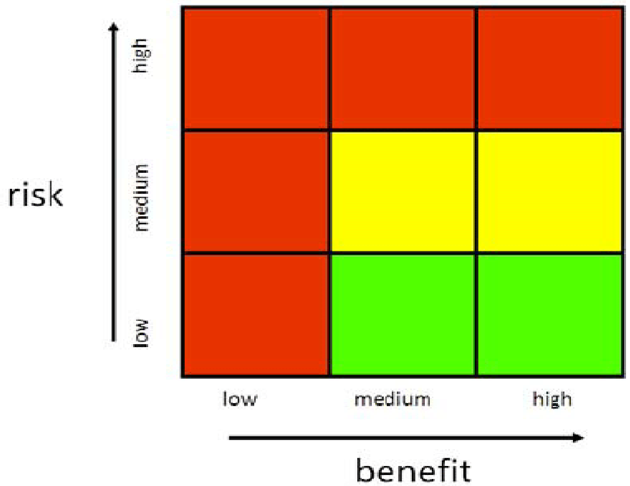
When starting to design a product, the idea of making it safer can seem more **expensive** especially in the early stages of design. However, this is a short-term view.

There is a great deal of guesswork involved here, The obvious thing is that offering an unsafe product to the market will lead to legal problems, so it is wise to spend as much time and expense as possible on product design to avoid such problems.

Risk-Benefit Analysis

Is a method that engineers sometimes use to help analyse risk and to determine whether a project should proceed.

This technique is similar to cost-benefit analysis. In risk benefit analysis, the risks and benefits of a project are assigned dollar amounts, and the most favorable ratio between risks and benefits is sought. Cost benefit analysis is tricky because it is frequently difficult to assign realistic dollar amounts to alternatives.



This task is especially difficult in risk benefit analysis because risks are much harder to quantify and more difficult to put a realistic price tag on.

It is important to be sure that those who are taking the risks are also those who are benefiting. Environmental racism: which is the placing of hazardous-waste sites, factories with unpleasant or noxious emissions, etc. near the least economically advantaged neighborhoods.

Accidents

We have learned about the basics of safety and risk. Now we move on to try and understand the nature of accidents.

An engineer’s most important job is to protect the safety of the public, which includes preventing accidents, knowing how to deal with them properly, and predict them.

One of the methods to try and categorize accidents is to group them into Three major types:

1-Procedural

2-Engineered

3- Systemic

Procedural accidents: procedural accidents are the most common type of accidents and the usually occur due to not abiding by the established procedures or simply making the wrong decision or the wrong call. So procedural accidents are basically the failure to make the right decision and abide by the rules. And so procedural accidents are easy enough to deal with through more training and stricter laws and regulations.

In airlines for instance this is called a “pilot’s error”. It’s caused by a wrong call made by the piolet, such as reading a certain gauge wrong or deciding to fly in a dangerous weather. This type of error is not only made by the pilot alone, it could be caused by any of the staff on the airplane or people in air traffic control. Which means that everybody is responsible in this kind of situation.

Engineered accidents: caused by flaws in the design, Which makes them extremely dangerous as they may not be noticed right away or even disregarded as minor mistakes which could lead to a disaster. They include failure in the materials used or the device not performing as expected. Engineered accidents can be avoided by gaining more knowledge and further testing of the device as well as gaining more experience.

For example the airplane turbines' blades sometimes develop what's known as microcracks which are tiny cracks that are hard to notice or too small to be considered a real problem, However, overtime the cracks grow which causes the blades to break and send hot metal fragments flying at the passengers.

Systemic accidents: these accidents are hard to understand and even harder to control. They are caused by minor mistakes accumulating over time. They occur in complex systems run by multiple complex parts at once. This kind of accident could be averted by being extremely thorough and careful.

This type of accident, considering how complex it is and how many factors come into play, might not seem like it’s the engineer’s responsibility at first sight, but it’s crucial that engineers take all that into account while designing and building, as it’s their job to know what they’re designing inside out, and take all the necessary precautions while doing so to avert as many accidents as possible.

Accidents are hard to predict and prevent, but when everything is done according to procedure and put through thorough testing, then when those accidents do occur, we can get away with minimal damage.

Read the CASES from the textbook :

- Hurricane Katrina
- The Crash of ValuJet Flight 592
- Firestone Tires
- The Collapse of the Hyatt Regency Kansas City Walkways
- The Ford Crown Victoria Police Interceptor
- The Failure of the Teton Dam
- The DC-10 Case
- Cellular Phones and Automotive Safety


NYPD
POLICE
1017

The Rights and Responsibilities of Engineers

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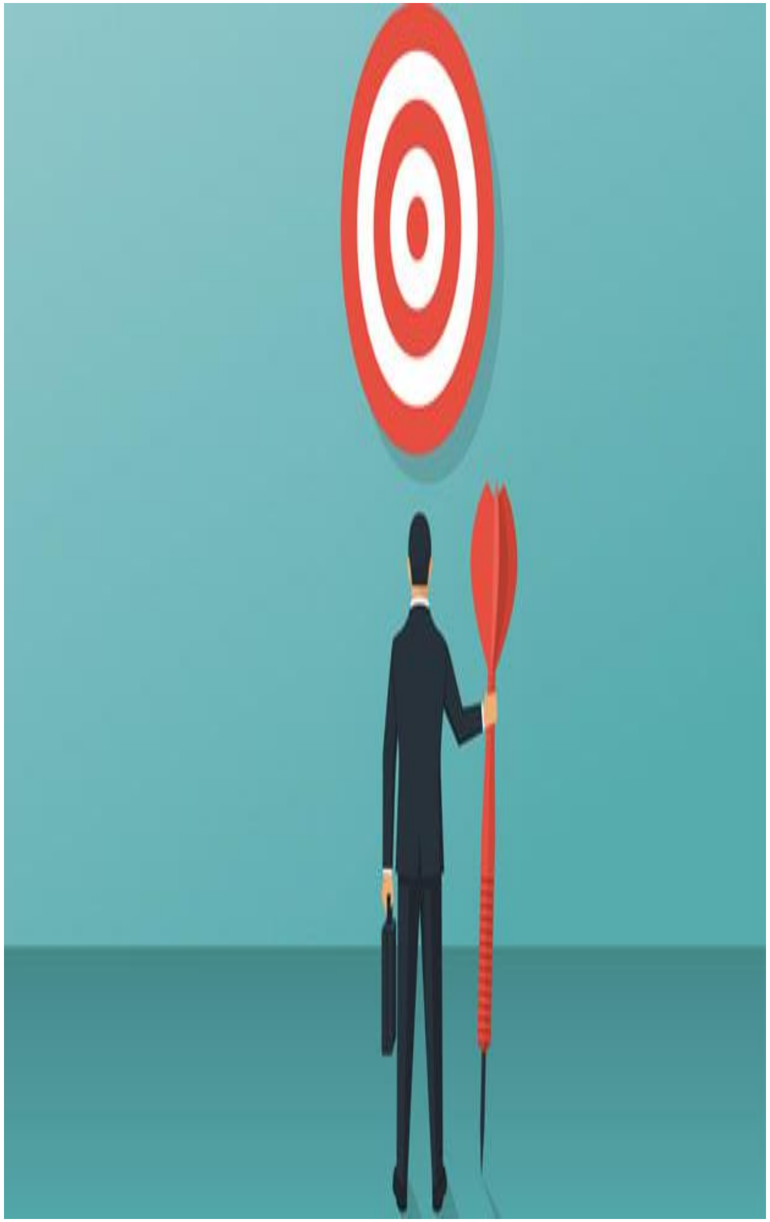
Hashemite University
Engineering Ethics (CHARLES B. FLEDDERMANN)

Objectives

- Discuss the responsibilities and rights that engineers have.
- Understand what a conflict of interest is and know how to manage one.
- Determine what whistleblowing is and when it is appropriate to blow the whistle.



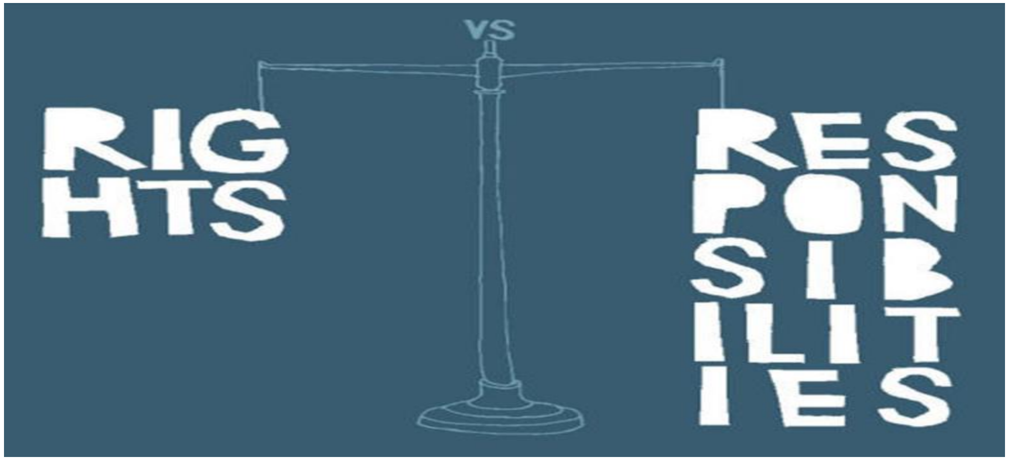
Introduction

There are many **rights and responsibilities** that engineers must exercise in the course of their professional careers. Often, these rights and responsibilities overlap.

Code of ethics :

Define the roles and responsibility for the professionals .

No code can totally cover all ethical situations that engineer is likely to encounter.



Professional Responsibilities

- Confidentiality and Proprietary Information
- Conflict of Interest
- Competitive Bidding

Confidentiality and Proprietary Information

•Engineers have an obligation to keep Proprietary Information of their employer or client confidential .

•Why must some engineering information be kept confidential ?

Some information directly effects the companies ability to compete at the marketplace. Such information can be used by competitor to gain advantage or to catch up.

What types of information should be kept confidential?

There is two type of information :

- **Obvious**

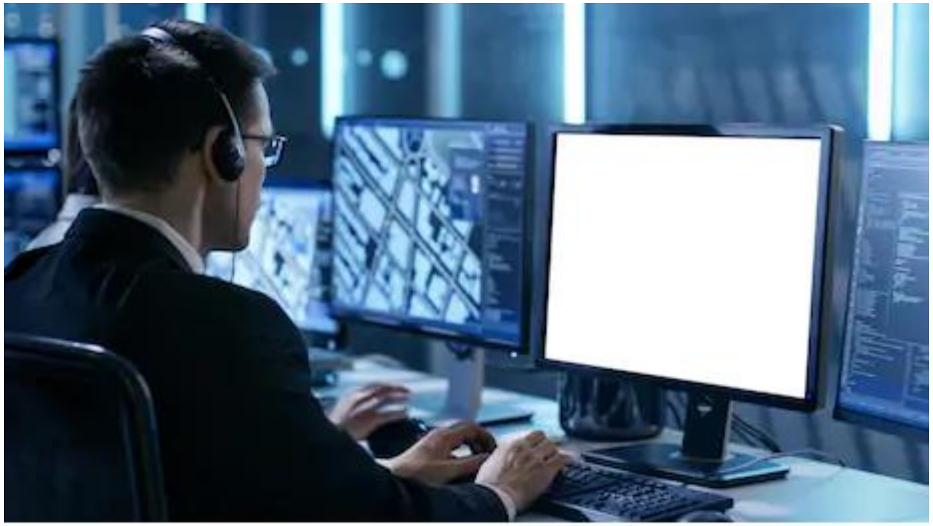
Test results and data
Designs and formulas of products
Information about upcoming unreleased products

- **Not obvious**

Identity of suppliers
Production yields
Production costs
Marketing strategies
The number of employees working on a project

Most companies have strict policies regarding the disclosure of business information and require all employees sign them .

Engineers working for a client are frequently required to sign a nondisclosure agreement. Engineers working for the government , especially in the defense industry have more stringent requirements about secrecy , and may have require security clearance granted after investigation by governmental security agency before being able to work .



How long confidentiality extends after an engineer leaves employment with a company?

Legally engineer is required to keep information even after he has moved to a new employer in the same technical area .

Companies have the right to keep information away from their competitors.

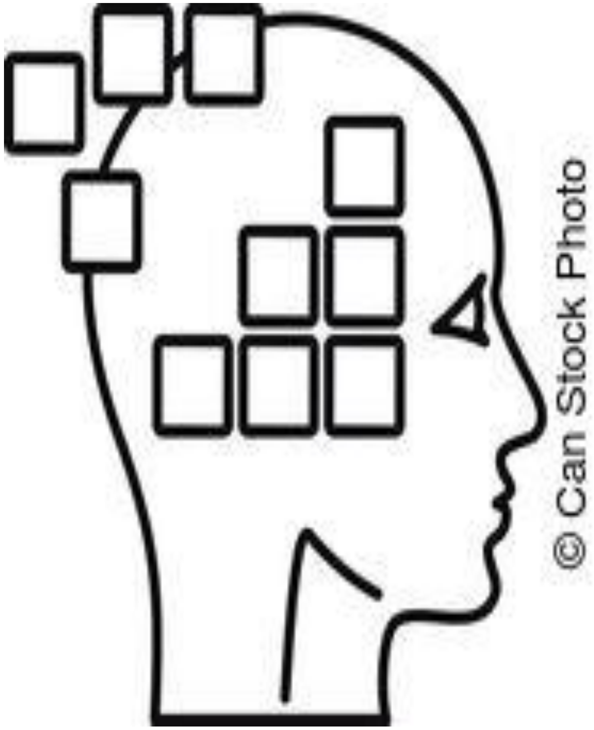
The burden of ensuring that both of these competing interests are recognized and maintained lies with the individual engineer.

However, when going to a new job, an engineer cant be expected to forget all of the knowledge already gained during years of professional experience.

The Solution :

Balancing the needs and competing rights of the individual and the company :

- ✓ An individual has the rights to seek career advancement with his expertise.
- ✓ The company has the rights to keep its information confidential, away from its competitors.



Conflict of Interest

Avoiding conflict of interest is important in any profession, and engineering is no exception.

A conflict of interest arises when an interest, if pursued, could keep a professional from meeting one of his obligations.

Example : a civil engineer working for a state department of high ways might have a financial interest in a company that has a bid on a construction project. This type of conflict is called actual conflict.

Types of Conflict of Interest

Actual conflict of interest

Example: as mentioned in the pervious slide

Potential conflict of interest

which threaten easily to be become actual conflict. Example: an engineer who is becoming friend with a supplier for his company , so engineering judgment might become conflicted by the desire to maintain the friendship.

Appearance of a conflict of interest

Example: when an engineer is paid on a percentage of the cost of the design, it is clearly that there is no incentive to cut the cost

How to avoid conflict of interests:

You can follow the guidance of a company policy.

You can ask co-worker or your manager to give you a second opinion .

You can use the ethical problem solving techniques.

You can look to the statements in the professional ethics codes that uniformly forbid the conflicts of interest.

Competitive Bidding

Historically, the codes of ethics of the engineering societies included a prohibition on competitive bidding for engineering services.

Competitive bidding was prohibited for several reasons:

- **bidding was considered to be undignified.**
- **There were concerns that if engineers engaged in competitive bidding, it would lead to price being the most significant (or perhaps only) basis for awarding engineering contracts.**

In 1978, the U.S. Supreme Court ruled that professional societies may no longer prohibit competitive bidding. Based on the Sherman Anti-trust Act of 1890. Held that banning bidding was an unfair restraint on free trade.

The rationale behind the Supreme Court ruling was:

- ✓That competitive bidding allows less experienced but competent engineers to compete effectively for work
- ✓The public interest by helping to keep engineering costs down.
- ✓Might help promote innovation that leads to better designs and lower costs.

There are many ethical issues related to this practice that engineers should consider:

- ✓Competitive bidding can lead to temptations.
- ✓Overstating of qualifications to secure work.
- ✓Making negative and disparaging comments about potential other bidders.
- ✓Attempting to subvert the bidding process through back channel contacts.

Also there are concerns that if an engineering firm submits a lowball bid that is accepted, they are then in the position of having to cut corners in order to complete the work at the bid price. When participating in a competitive bid process, engineers must be sure to be fair, honest, and ethical

Professional Rights

We have seen how the professional status of engineering confers many responsibilities on the engineer.
Engineers also have rights that go along with these responsibilities. Not all of these rights come about due to the professional status of engineering.

There are rights that individuals have regardless of the professional status, including the right to privacy, the right to participate in activities of one's own choosing outside of work, the right to reasonably object to company policies without fear of retribution, and the right to due process.

The most fundamental right of an engineer is the right of professional conscious. This involves the right to exercise professional judgment in discharging one's duties and to exercise this ethical manner. However, it is no surprise that this right is not always easy for an employer to understand.

The right of professional conscience can have many aspects. For example , One of these aspects might be referred by the:

"Right of conscientious Refusal "

this is the right to refuse to engage in an unethical behavior. Put quite simply , no employer can ask or pressure an employee into doing something that she considers unethical and unacceptable.

Although this issue **It is clear** for which an engineer is asked to falsify a test result or fudge on the safety of a product. **It is less clear** , when an engineer refuses an assignment based on an ethical principles that is not shared by everyone.

For example, an engineer ought to be allowed to refuse to work on defense projects or environmentally hazardous work if his conscience says that such work is immoral.

Engineers and the Defense Industry

Many innovations in engineering and science have come about as the result of the development of weapons. Fundamentally, weapons are designed for one purpose (to kill human beings) it important to look at this type of engineering work in the context of engineering ethics and the rights of engineers.

An engineer may choose either to work or not to work in defense-related industries and be ethically justified in either position. Many reasonable engineering professionals feel that ethically, they cannot work on designs that will ultimately be used to kill other humans. Their remoteness from the killing doesn't change this feeling.

Even though they won't push the button or may never actually see the victims of the use of the weapon, they still find it morally unacceptable to work on such systems.

On the other hand, equally morally responsible engineers find this type of work ethically acceptable. They reason that the defense of our nation or other nations from aggression is a legitimate function of our government and is an honorable goal for engineers to contribute to. Both of these positions can be justified using moral theories and ethical problem-solving techniques.

Even if an engineer finds defense work ethically acceptable, there might be uses of these weapons or certain projects that he considers questionable.

For example, is it acceptable to work on weapons systems that will only be sold to other nations? Is the use of weapons to guarantee our "national interests," such as maintaining a steady supply of foreign oil, an acceptable defense project?

What is an engineer to do when asked to work on a weapons project he considers questionable?

There is no simple solution , but the answer must be determined by each individual after examination of his values and personal feeling a bout the ethical of the defense work
it is important to avoid working on any project that you deem unethical unsafe or bad for environment even if it lead to a career advancement or even if it is a temporary job

Whistle-Blowing

It is the act by an employees of informing the public or higher management of unethical or illegal behavior by an employer or supervisor.

It straddles the line between the rights and responsibilities, because engineers have a duty to protect the health and safety of the public.

Engineers also have the professional right to disclose wrongdoing within their organizations and expect to see appropriate action taken.

Types of Whistle-Blowing

1-Internal

When the employee goes inside the company and reports wrongdoing to supervisor or manager.

2-External

When the employee goes outside the company and reports wrongdoing to newspaper or law enforcement authorities.

3-Anonymous

When the employee refuse to divulge his name when making accusations.

4- Acknowledge

When the employee put his name behind the accusations.

When Should Whistle-Blowing Be Attempted?

1. **Need**. You do not need to blow the whistle about every thing, just the important things. (clear and important harm).
2. **Proximity**. The whistle blower must be in a very clear position to report on the problem. (hearsay is not adequate).
3. **Capability**. The whistle blower must have a reasonable chance of success in stopping the harmful activity.
4. **Last resort**. Whistle blowing should be attempted only if there is no else more capable to blow the whistle.

Preventing Whistle-Blowing

As an employer, I should to seek to minimize the need for employees to blow within my company.

<u>First</u>, there must be a strong corporate ethics culture. This way include: clear commitment to ethical behavior starting at the highest level of management. Mandatory ethics training for all employees.

<u>Second</u>, there should be clear lines of communication within the corporation.

<u>Third</u>, all employees must have meaningful access to high level management in order to bring their concerns forward.

<u>Finally</u>, there should be willingness on the part to of management to admit mistakes, publicly if necessary.

Read the CASES from the textbook :

- The BART Case
- The Collapse of the I-35W Bridge in Minneapolis
- The Goodrich A7-D Brake Case
- The 2010 Earthquake in Haiti
- Sudden Acceleration in Toyota Automobiles
- The Hartford Civic Center Collapse

www.bart.gov
Richmond
El Cerrito del Norte
El Cerrito Plaza
North Berkeley
Downtown Berkeley
Ashby
North Concord/M
Co
Orinda
La
Rockridge
MacArthur
19th St/Oakland
12th St/Oakland C
West Oakland
Embarcadero
Montgomery St
Powell St
Civic Center/
UN Plaza
Lake Merritt
Fruitvale
Coliseum/Oa
San Leand
Bay Fair
Castro Valley
Dublin/
Pleasanto
Air-BART
Oakland
International
Airport (OAK)
16th St Mission
24th St Mission
Daly
City
Glen Park
Balboa Park
Hayward
South Hayward
Colma
South
an Francisco
San Francisco
International Airport (SFO)
Union City
San Bruno
MON-FRI
before 7pm
MON-FRI after 7pm
SAT-SUN all day
Millbrae
Fremont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Chapter 7

Ethical Issue in Engineering Practice

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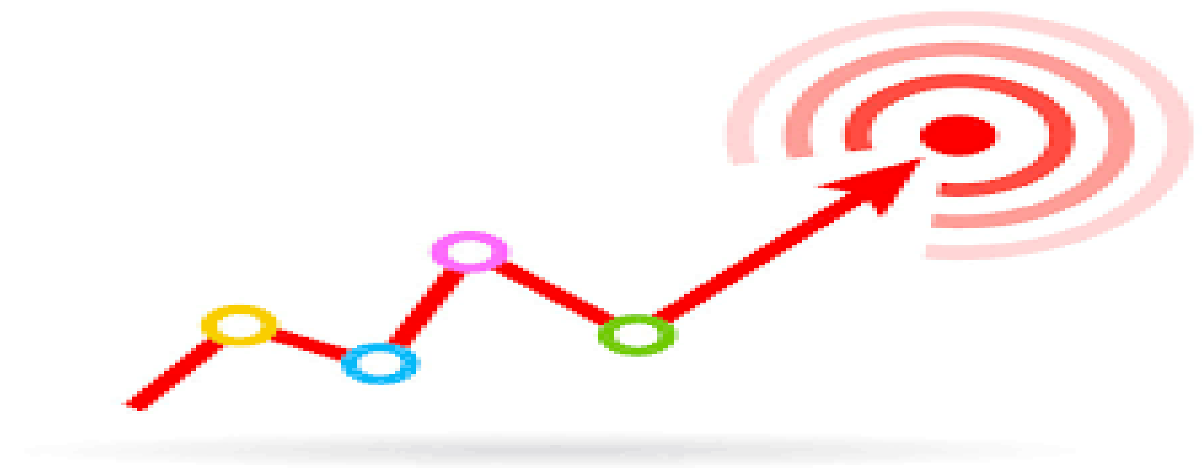
Objectives

•Determine what ethical issues arise in engineering practice with regard to the environment

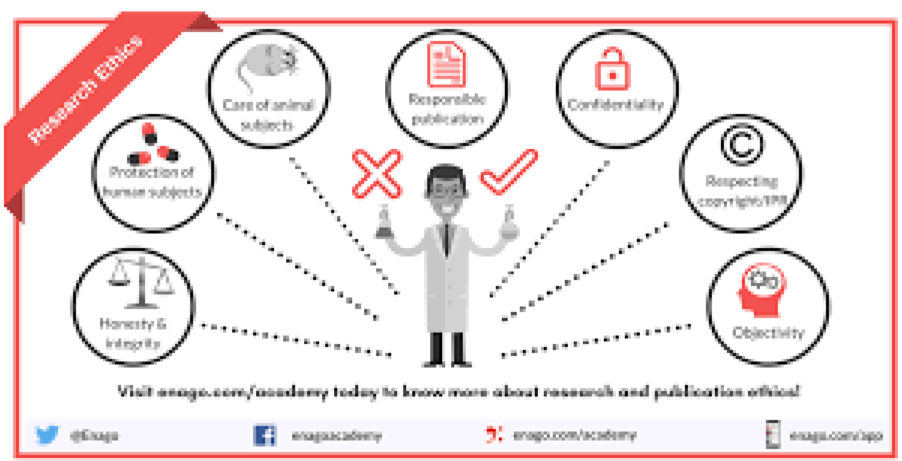
• Decide how engineering practice is impacted by computer technology

•Learn about ethical issues that arise in the course of research.



There are many unique ethical issues that arise in engineering practice that may not be encountered in other professions.

- ❑ Environmental Ethics
- ❑ Computer Ethics
- ❑ Ethics and Research



Environmental Ethics

One of the most important political issues of the late 20th and early 21st centuries has been environmental protection and the rise of the environmental movement.

This movement has sought to control the introduction of toxic and unnatural substances into the environment, to protect the integrity of the biosphere, and to ensure a healthy environment for humans.

Engineers have a responsibility to protect the environment :

- To find solutions to the problems caused by modern technology.
- Use their knowledge and skills to help protect the environment.

This duty is even spelled out in many of the engineering codes of ethics.

Engineer’s responsibility for the environment is denoted concepts such as “**sustainable design**” or “**green engineering**.”

These concepts incorporate ideas to ensure that our designs do not harm the environment.

By applying the principles of sustainable design, engineers will help to maintain the integrity of the environment and ensure that our quality of life is sustained.

Characteristics of Sustainable Design:

1. Ensures that a product has minimal environmental impact during its use.

2. The product can be manufactured and disposed of without harming the natural world.

WHY
WE HAVE TO Protect
THE ENVIRONMENT?????????

THE MORAL UNDERSTANDING OF THE ENVIRONMENT:
QUESTIONS HARD TO ANSWER

The way to explore environment’s moral status is by trying to answer some questions regarding the place of humans in environment:

Q : Do we belong to nature, or does nature belong to us?

Q : If animals can suffer and feel pain just like humans, should they have moral standing??

Q : If animals have moral standing, how far does this moral standing then extend to other life forms, such as trees???

The Moral Understanding of the Environment: A Comparison

The Western Ethical Tradition

1. Only human beings have moral understanding.
2. Animals and plants are important only in respect to their usefulness to humans

The Environmental Movement

Humans are just one component of the environment and that all components have equal standing.

Regardless of the goal (i.e., either protecting human health or protecting the overall health of the biosphere for its own sake), there are multiple approaches that can be taken to resolving environmental problems.

Interestingly, these approaches mirror the general approaches to ethical problem solving.

There are multiple approaches that can be taken to resolving environmental problems:

Cost-Oblivious Approach	Cost Benefit Analysis
• The cost not important but making environment clean as possible	• This derived from utilitarianism , that means analysis of problem according to the benefits of reducing pollution and improvement of human-health . And costs required to solve the problem

COST-OBLIVIOUS APPROACH

Which means that the cost is not important, instead we need to focus on making the environment as clean as possible.

Problems:

1- Difficult to uphold and enforce, especially in a modern, urbanized society.
2- The definition "as clean as" is hard to agree on.

COST-BENEFIT APPROACH

Derived from utilitarianism. Which means achieving an economically beneficial balance of pollution with health or environmental considerations.

Problems:

1- The cost may be important, but humans' lives are costless.
2- It is difficult to accurately assess costs and benefits.
3- Doesn’t necessarily consider who shoulders the costs and who gets the benefits.

What are the Responsibilities of the Engineers to the Environment ?

It is up the engineer to decide the best solution using :

1. Professional ethics:

Professional codes of ethics that tell us to hold the safety of people and the environment to be of paramount importance.

2. Personal ethics:

Our personal ethics can also be used to determine the best course when we are confronted with an environmental problem.

Most of us have very strong beliefs about the need to protect the environment.

An engineer should not be compelled by his employer to work on a project that he finds ethically troubling, including projects with severe environmental impacts.

An engineer should not make decisions in areas in which he isn’t competent.

Engineer should seek the counsel of others such as biologists, public health experts and physicians, To understand the possible environmental consequences of a project.

And finally, engineers must follow the applicable federal state & have a responsibility to ensure that their work is conducted in the most environmentally safe manner possible.

Computer Ethics

Privacy
Hacking
Copyright infringement

Computers have rapidly become a ubiquitous tool in engineering and business. There are ways in which computers have brought benefits to society. Unfortunately, there are also numerous ways in which computers have been misused, leading to serious ethical issues.

The engineer’s roles as designer, manager, and user of computers bring with them a responsibility to help foster the ethical use of computers.

Computers as a Tool for Unethical Behavior

Many uses of the computers are merely extensions to computers of other types of unethical acts. For example, computers can be used to more efficiently steal money from a bank.

Unfortunately, the technology to detect and prevent this type of crime greatly lags behind the computer technology available to commit it.

Those seeking to limit computer crime are always playing a catch-up game.

Privacy

Similar computer ethics issues arise with regard to privacy.

We mean by privacy: is the basic right of an individual to control access to and use of information about himself.

Why is privacy an ethical issue?

Invasions of privacy can be harmful to an individual in two ways:

1. The leaking of private information can lead to an Individual’s being harassed or blackmailed.

2. Personal information can also be considered personal property. As such, any unauthorized use of this information is theft.

How do computers increase the problems with privacy protection?

Computerization makes the retrieval of files much easier for those with legitimate needs and reduces the space required to store the files, it also makes the unauthorized use of this information by others easier.

The old system of records

Computerization

Hacking

Ethical issues also arise when computers are used for **hacking**

Hacking comes in many forms: gaining unauthorized access to a database, implanting false information in a database or altering existing information, and disseminating viruses over the Internet.

Accessing private information **violates** the privacy rights of individuals or corporations, even if the hacker keeps this information to himself

Copyright Infringement

Copyright infringement is also a concern in computer ethics. Computers and the Internet have made it easy to share music, movies, software, and other copyrighted materials.

Although computers make copyright violation easy to do and hard to detect, it is still illegal and unethical. If creators can no longer profit from their work—if their work is freely distributed without their consent—then the incentive to create will diminish, and this type of creative activity that enriches everyone's lives will diminish as well.

Computers as an engineering tool

Computers are an essential tool for all engineers. Most often, we use computers for:

•**Writing** documents using a word-processing software package.
•**Using** spreadsheets to make financial calculations.
•**Using** databases to keep records of our work.
•**Keeping** track of appointments with scheduling software.
•**Using** commercially available software to develop plans for how our projects will proceed.

The use of these types of software is not unique to engineering indeed, they are useful in various areas of business.

The use of these types of software is not unique to engineering. Indeed, they are useful in various areas of business unique to engineering are two uses of computers:

- Design tools
- Components integrated into engineered systems.

Computer Design Tools

Numerous software packages are available for the design of engineered devices and structures. These all serve to allow an engineer to work more efficiently and to help take away some of the tedious aspects of an engineer's work. However, the use of this type of software also leads to ethical issues.

Who is responsible when a flaw in software used to design a bridge leads to the failure of the bridge?

Is it the fault of the engineer who designed the bridge?

Is it the fault of the company that designed and sold the defective software?

Who is at fault when a software package is used for a problem that it isn't really suited for?

What happens when existing software is used on a new and innovative engineering design that software hasn't yet been developed for?

What are the answers to these questions?

These questions all have the same answer: Software can never be a substitute for good engineering judgment.

Clearly, the engineer who uses software in the design process **is still responsible** for the designs that were generated and the testing that was done using a computer.

TIPS The Engineer should Follow When Designing:

- Engineers must be careful to make sure that the software is appropriate to the problem being worked on and should be knowledgeable about the limitations and applicability of a software package.

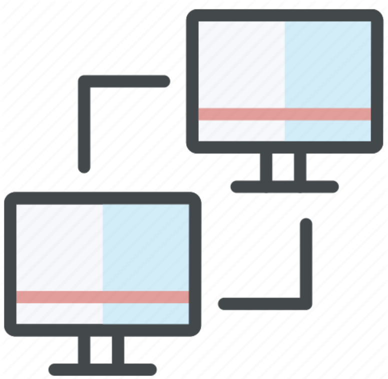
- Engineers must also keep up to date on any flaws that have been discovered in the software and ensure that the most recent version of the software is being used.

- Finally, it is important to verify the results of a computer generated design or analysis.

Integration of Computers into Engineered Systems

1. Computers have also become a component of many engineered systems. For example, modern automobiles contain multiple computers, dedicated to specific tasks.
2. Computers control the emissions and braking systems on automobiles and allow modern vehicles to operate more efficiently and safely.

However, the ability to control aspects of system performance using software removes humans from the control loop.



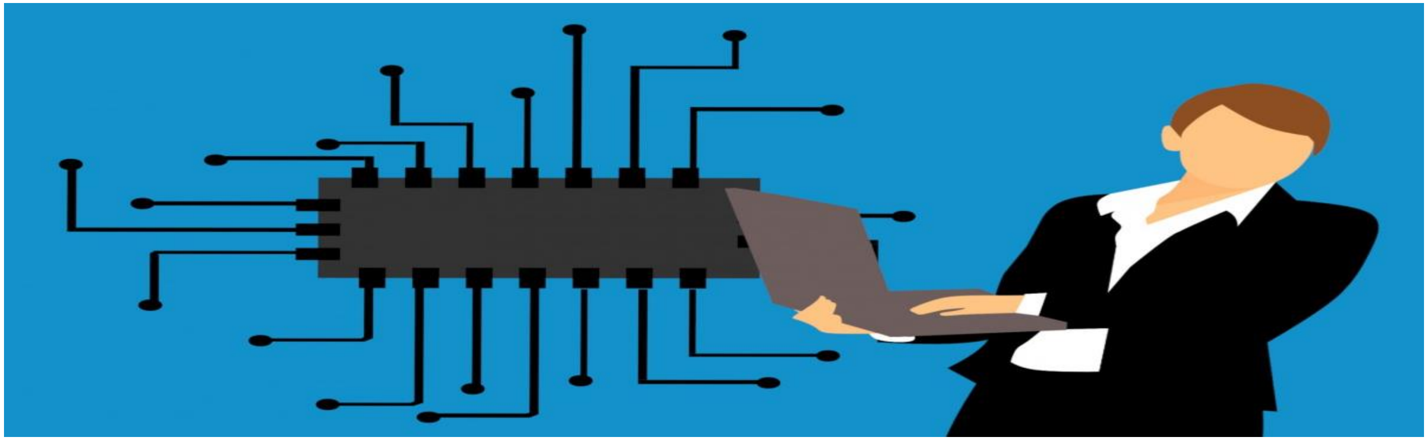
It is essential when designing systems with embedded computers and software that:

1. Engineers ensure that software is adequately tested.

2. Humans can intervene when necessary.

3. Safety systems have enough hardware redundancy without relying solely on software to ensure the safe operation of the system.

Autonomous Computers



Other ethical concerns arise because of the increasingly autonomous nature of computers

What do we mean by Autonomy?

Autonomy refers to the ability of a computer to make decisions without the intervention of humans.

The negative implications of this autonomy: Some of the negative implications of this autonomy are chillingly spelled out in 2001: A Space Odyssey , by Arthur C. Clarke, in which an autonomous computer responsible for running a spaceship headed for Jupiter begins to turn against the humans it was designed to work for.

Applications of Autonomy

1. Certainly, there are applications for which autonomy is valuable. For example, manufacturing processes that require monitoring and control at frequent intervals can greatly benefit from autonomous computers. In this case, the autonomy of the computer has very little impact beyond the interests of the manufacturer.

1. Other autonomous computer applications are not so benign. For example, by the 1980s, computers were widely used to automate trading on the major U.S. stock exchanges. Some brokerages and institutional investors utilized computers that were programmed to sell stocks automatically under certain conditions, among them when prices drop sharply.

This type of programming creates an unstable situation. As prices drop, computers automatically start selling stocks, further depressing the prices, causing other computers to sell and so on until there is a major market crash.

The 1987 crash was widely attributed to automated computer trading. Federal regulations have since been implemented to help prevent a recurrence of this problem. Many weapons systems rely heavily on computer sensors and computer controls. Due to the speed with which events can happen on a modern battlefield, it would seem valuable to have weapons that can operate autonomously.

However, weapons systems operating without human intervention can suffer from the instability problems described with regard to the financial markets.

For example, a malfunctioning sensor might lead a computer to think that an enemy has increased its military activity in a certain area. This would lead to an increased readiness on our part, followed by increased activity by the enemy, etc. This unstable situation could lead to a conflict and loss of life when really there was nothing happening [Rauschenbakh, 1988].

It is clear from this example that although autonomous computers can greatly increase productivity and efficiency in many areas, ultimately there must be some human control in order to prevent disasters.

Computer code of ethics

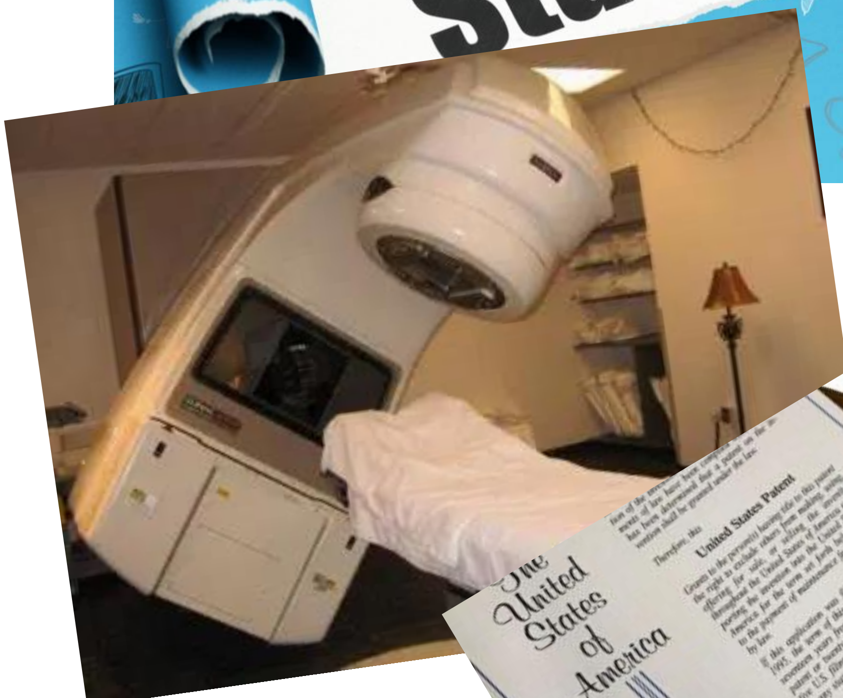
Computers as engineering tool, when used improperly as designed tools and as components integrated into engineered systems. For example, can't be a substitute for good engineering judgment always.

Consequently, many organizations have developed codes of ethics for computer use.

They are guidelines for the ethical use of computing resources but should not be used as a substitute for sound moral reasoning and judgment.

Have you ever asked yourself why a programmer gets angry when he discovers he has forgotten to write semicolon (;)? Or **get upset and shock when reading error: unexpected token? Did you ask yourself why the computer is interested in these details empty space, semicolon, brackets and incubators?**

In fact, the program is a precise and precise command chain, and any malfunction in a link (a programmatic command) leads to a breakdown of the chain (the program).



Read the following CASES from the textbook :

1- Accidental overdoses in medical radiation therapy systems: the therac-25

2- Avanti corp.* VS. Cadence design systems

Ethics and Research

There are two major ethical issues related to research:

1. Honesty in approaching the research problem

2- Honesty in reporting the results.

This relates to a state of mind essential to successfully performing research. This state of mind includes avoiding preconceived notions about what the results will be, being open to changing the hypothesis when such action is warranted by the evidence, and generally ensuring that an objective frame of mind is maintained.

Results must also be accurately reported. Once an experiment or test has been performed, the results of the experiment must not be overstated, but rather an accurate assessment and interpretation of the data must be given.

The environment that most researchers work in fosters temptations and rewards for overstating research results. Academic researchers must publish significant research results in order to get tenure at their universities.

Even for researchers in industrial environments or faculty who are already tenured, the quest for fame or the desire to be the first with new results can be overwhelming and can lead to falsification of data. Often, the pressure to get a new product to market leads the test engineer to –fudge- data to qualify the product. It is important to note the distinction between intentional deception and results or interpretations that are simply incorrect.

It is also important to ensure that proper credit is given to everyone who participated in a research project. It is tempting to think that fraud and deception in research are rare and only perpetrated by lower level scientists, but this perception is decidedly untrue.

There are many examples of well-known and even Nobel prize-winning scientists who have had lapses of ethical judgment with respect to their research.

For example: Robert Millikan - pictured- was a physicist from the University of Chicago who won the 1923 Nobel Prize in physics for experiments that measured the electrical charge of the electron.

Analyzing Ethical Problems in Research

How can ethical issues relating to research best be analyzed?

The easiest means to determine the best ethical course in performing research and experiment is to consult the codes of ethics of the engineering professional societies.

All of the codes include language requiring engineers to be honest in reporting the results of work and assigning credit for work done. For example, the code of the **American Institute of Chemical Engineers states that**:
“members shall ... treat fairly all colleagues and co-workers, recognize the contributions of others and issue statements and present information only in an objective and truthful manner”

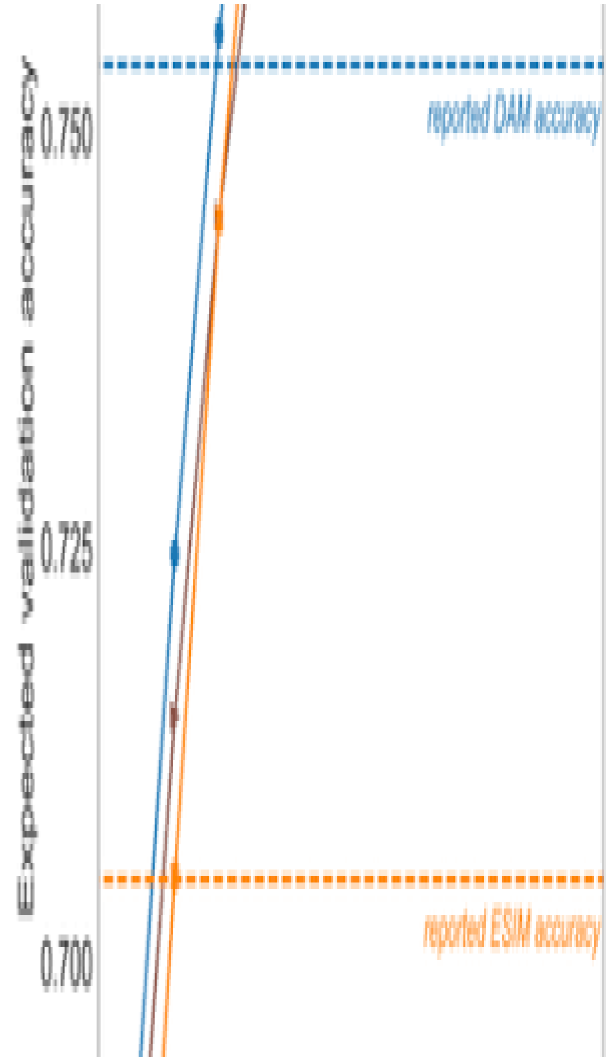
These statements apply equally well to all professional activities of an engineer, including research, experiment, and testing.

Several ethical theories can be used to analyze issues involving research. **Utilitarianism** or **rights and duty ethics** can be applied to research, but it is perhaps easiest to examine research issues using **virtue ethics**.

One of the **virtues** is honesty. Honesty facilitates trust and good relations between individuals, whereas dishonesty leads to doubts and misgivings about others.

Making false claims about the results of experiments is certainly a form of dishonesty. We should seek to enhance virtues such as honesty within ourselves and others, so virtue ethics clearly tells us that the inaccurate reporting of experimental results is unethical.

Likewise, not giving credit to everyone who has participated in a project is dishonest, and virtue ethics indicates that this practice is unacceptable.

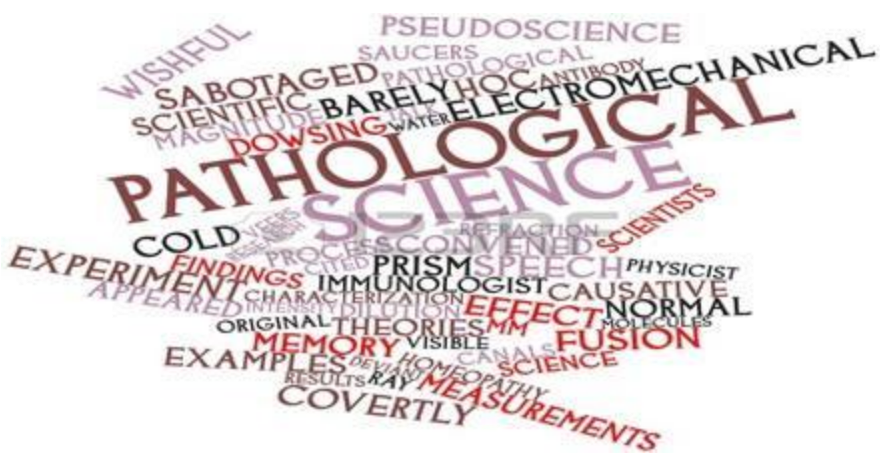


Pathological Science

Self-deception is one of the biggest impediments to the successful completion of a research or experimental project. Self-deception in research is a frequent occurrence in many areas of science and has led to some notorious cases throughout history.

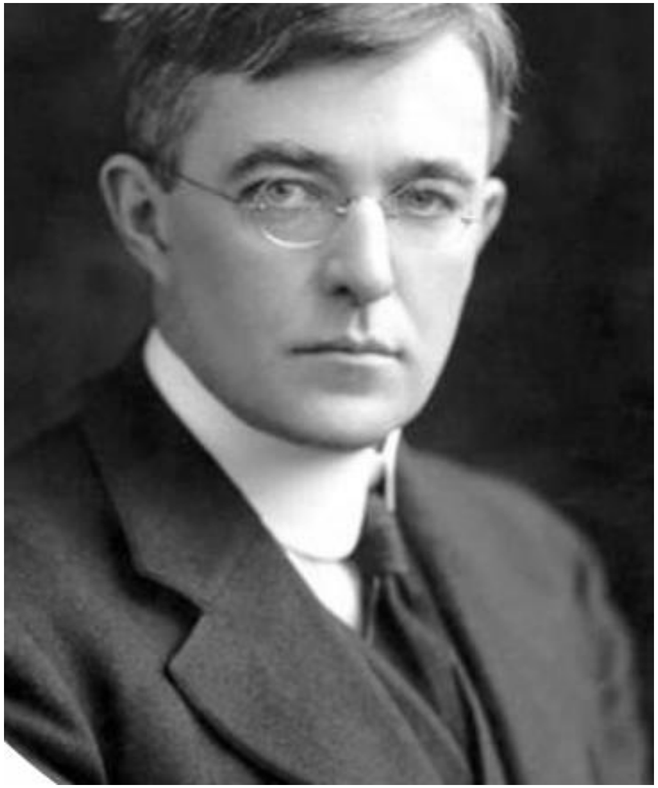
Definition of pathological science

Pathological Science: is an area of research where people are tricked into false results ... by subjective effects, wishful thinking or threshold interactions.



Founder of Pathological Science

The term was first used by Irving Langmuir -Pictured-,a Nobel Prize-winning chemist and a well-known physicist working at General Electric Research Laboratories, during a 1953 colloquium at the Knolls Research Laboratory.

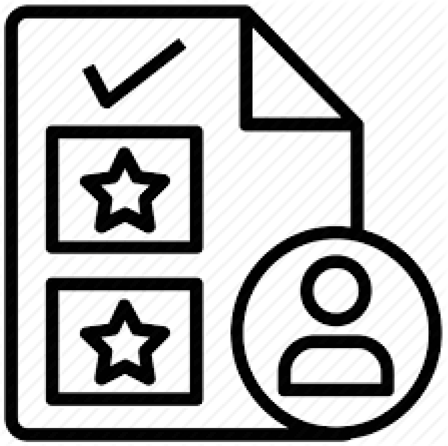


Langmuir said a pathological science is an area of research that simply will not go away. Long after it was given up on as **false** by the majority of scientists in the field, he called pathological science**: "the science of things that aren't so "**

Characteristics of Pathological Science

1. The maximum effect that is observed is produced by a causative agent of barely detectable intensity, and the magnitude of the effect is substantially independent of the intensity of the cause.

This characteristic implies that it doesn't matter how close the causative agent is or how intense it is; the effect is the same. This practice, of course, goes against all known forces and effects.



2. The effect is of a magnitude that remains close to the limit of detectability; or, many measurements are necessary because of the very low statistical scientifically, cant of the results.

The problem here is that when things are at the edge of statistical significance or of detectability, the tendency is to discard values that don't seem right. To measure anything at the edge of detectability requires a lot of data. With a lot of data to work with, the measurements can be massaged to fit the conclusion that is being sought. In fact, what often happens is that data are rejected on the basis of their incompatibility with the preconceived theory, rather than on their true significant.

3. Claims of great accuracy.

4. Fantastic theories contrary to experience.

5. Criticisms are met by ad hoc excuses thought up on the spur of the moment.

6. Ratio of supporters to critics rises up to somewhere near 50% and then falls gradually to oblivion.

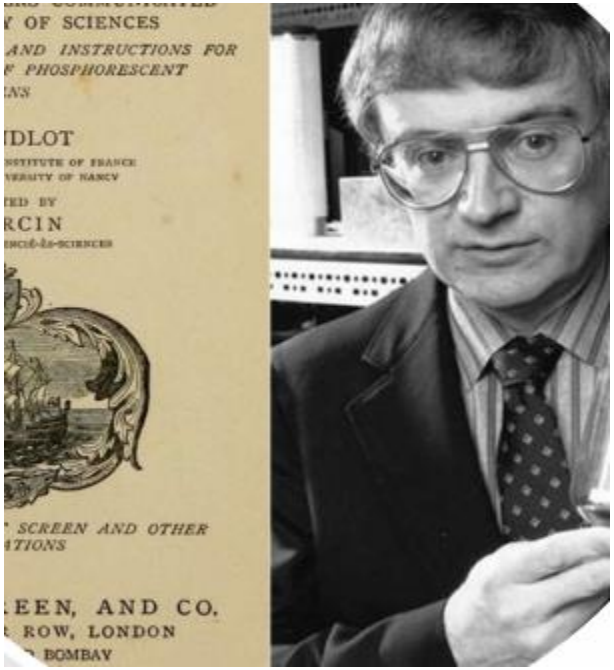
The term pathological science doesn't imply any intentional dishonesty, but only that the researcher comes to false conclusions based on a lack of understanding about how easy it is to trick yourself through wishful thinking and subjectivity.

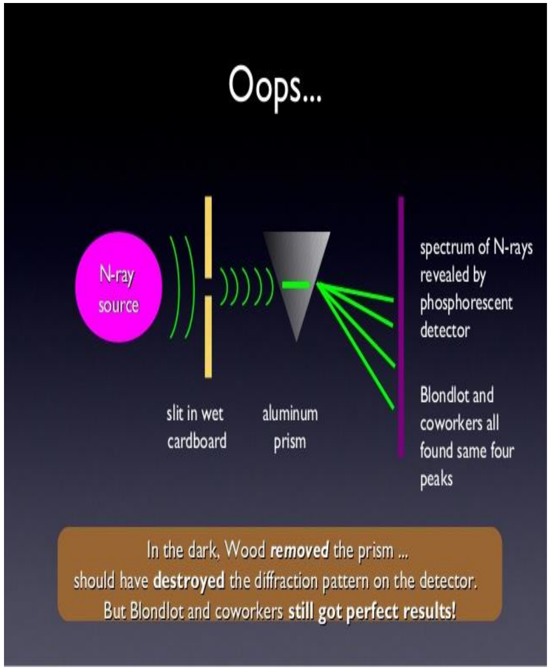
This shows that a great deal of objectivity and care in the pursuit of research or testing is required. Drawing conclusions on very subtle effects is very tricky, and these conclusions should be confirmed by as many colleagues as possible. Ultimately, the goal of research is not publicity and fame, but rather the discovery of new knowledge.


CASE STUDY
RESEARCHER
CIRCUMSTANCES
CASE
ANALYZING
KEY
DATA
CRITERIA
KNOWLEDGE

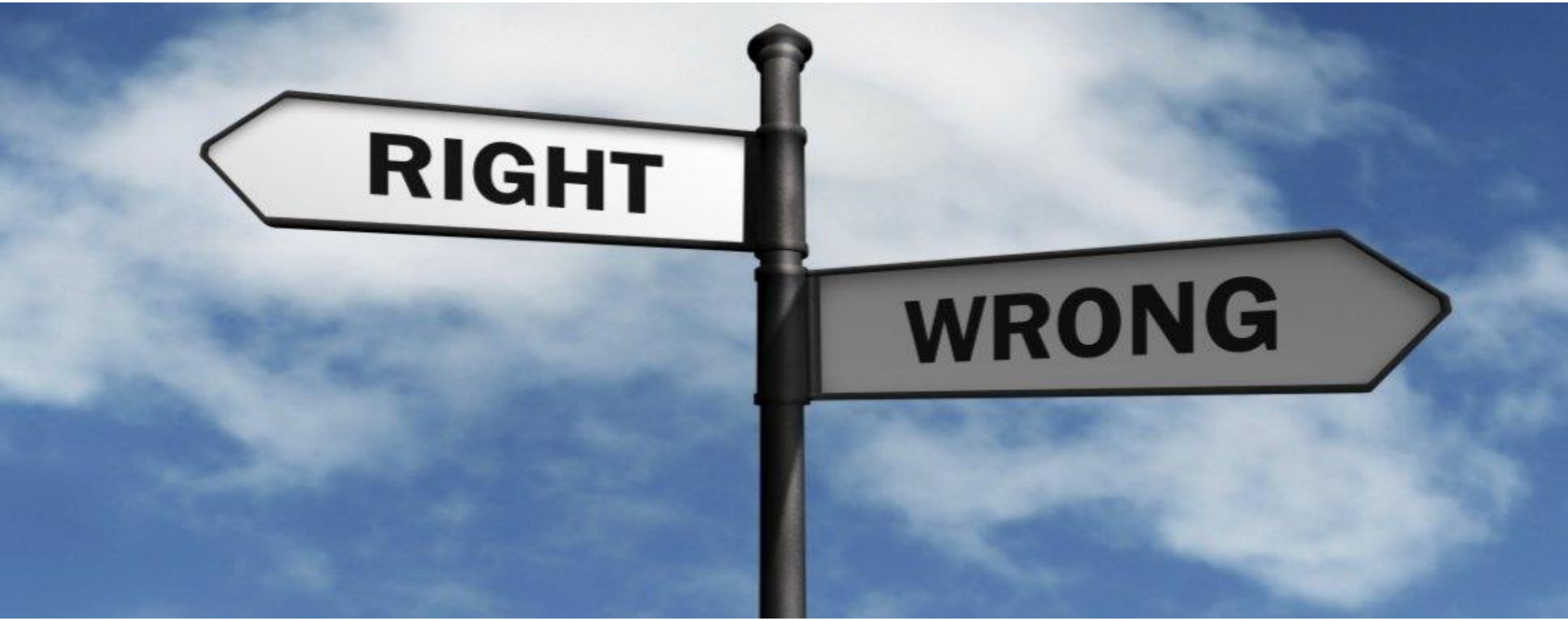
Read the other CASES from the textbook :

- **The City of Albuquerque vs. Isleta Pueblo Water Case**
- **The N-Ray Case**
- **The Case of Cold Fusion at Texas A&M University**
- **Ghostwriting of Research Articles**





Chapter 8
Doing The Right Thing



E. Esraa Hyarat
Hashemite University
Engineering Ethics (CHARLES B. FLEDDERMANN)

Objectives

- See how ethical problems can be avoided.
- Learn how engineers can cooperate with each other and with clients and government agencies to be sure that the ethically correct choice is made.

Introduction

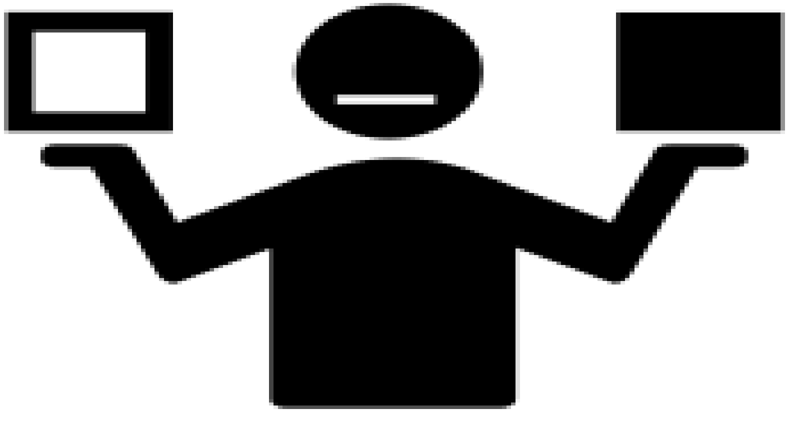
A lot of the cases presented in engineering ethics studies refer to disasters which happened due :

1- A pressure were put on engineers to make bad decisions.

2- Illegal or immoral activity was being covered up.

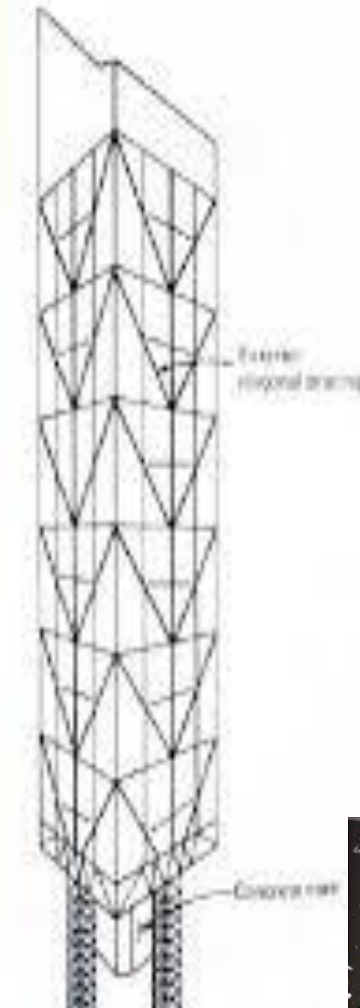
3- A mistake was made in a design .

The main difference between the cases in this chapter and the other chapters , is that the cases in this chapter **do not** cause disasters, but rather are examples of things should be done in the first place to avoid disasters .



Read the CASES from the textbook :

- The Citicorp Centre Case
- The Sealed Beam Headlight Case
- Automobile Crash Testing




GE 165


CHEVROLET
CAMARO
INSURANCE INSTITUTE
FOR HIGHWAY SAFETY

PROFESSIONAL SUCCESS

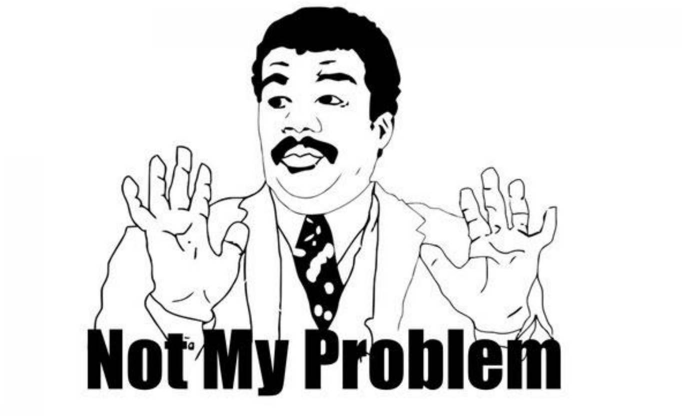
AVOIDING IMPEDIMENTS TO ETHICAL BEHAVIOR

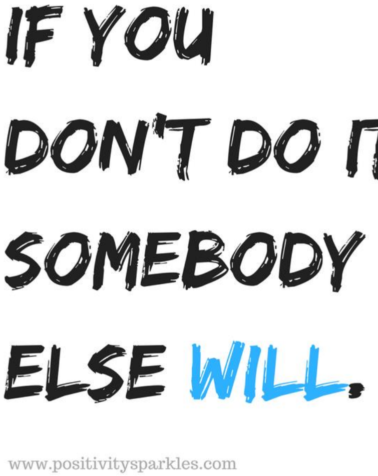
The ethically correct course of action is known.

We can examine some commonly cited reasons for not doing the right thing.

There are three common responses given for not choosing the right path

- It’s not my problem.
- If I don’t do it, someone else will.
- I can’t foresee everything that will happen.

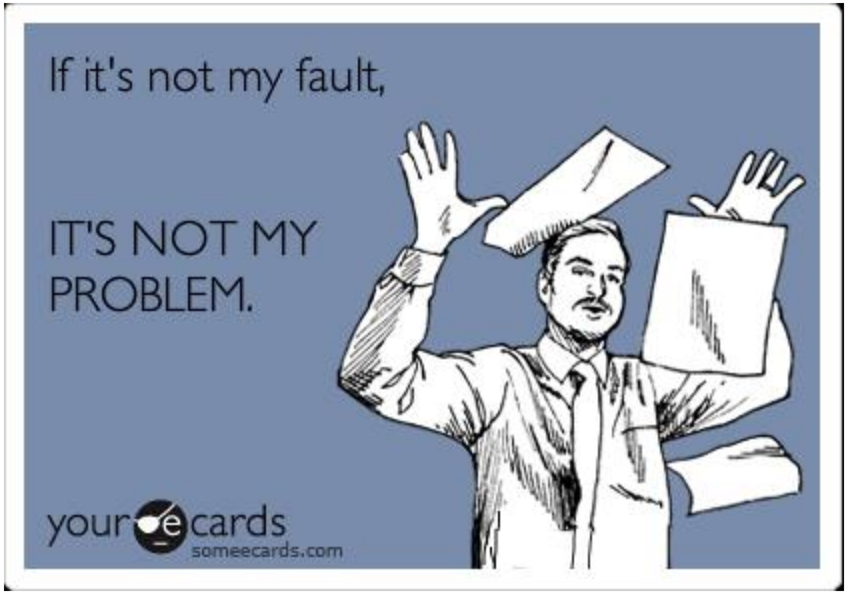




It’s Not My Problem

It’s very tempting to respond to problems this way, since it relieves us of the responsibility for a situation.

But is it true ?



For example, in the wake of accidents caused by an unsafe design, the costs of lawsuits and redesigns are borne by those who buy products from that company.

If a product causes injury, we all pay for it through increased health insurance premiums.
When cheating on government contracts occurs, this money must be made up by taxpayers. Either directly or indirectly, costing everyone. It truly is everyone's problem.

If I Don’t, Someone Else Will

Rarely are you the only engineer working on a particular technology. There are many others working on the same or similar ideas.

In the rush to be the first to the marketplace with a new idea or product, the thrill of the competition can get in the way of our ability to look objectively at what we are doing. But do you want to be the first to do something that turns out to be harmful or unethical?

Most of us would agree that being the first to gain notoriety for something that is wrong is not desirable.

I Can’t Foresee Everything That Will Happen

It is impossible to foresee every consequence of a new design or every potential use or misuse of your work. Engineering is an inherently creative process; making new devices or structures requires that engineers be creative in their work. Part of creativity in engineering is looking at both the potential uses and the potential misuses of our designs.

How do we do this?

<u>**First**</u>, we have to start by making foresight part of the design process.

We do that by attempting to design around potential problems that we identify. We can also work with regulators before a new technology is in place to ensure that the problems with the technology are understood and regulations are put in place to help ensure that the design is used in an ethical manner.

Second, ethics should not be an afterthought. Rather, ethical considerations should be an explicit part of the design process.

Finally, we also need to acknowledge that there are probably some things that should not be done.

What happens if the results of your work lead to unforeseen ethical problems?

Don't beat yourself up about it. If you did your job correctly, you attempted to foresee those problems. But of course you can't foresee everything. You can work after the fact to try to change things to be more acceptable.