IIT KHARAGPUR

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CERTIFICATION COURSES

Ethics in Engineering Practice

Lecture No (21,22) :Responsibility to the Environment

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Outline of the module

- The changing perspectives on Environment
- Engineering, Ecology and Economics
- The invisible hand and the Tragedy of the Commons
- Role of engineers in Sustainable development
- Codes of Ethics for engineers
- Environmental Leadership
- A vision for environmental Leadership for Asia
- Environmental Laws
- Preventing disasters and Changing the way for costing
- Social Activism

The changing perspectives on Environment

The new ways of thinking about the environment have increased the complexity of defining the responsibility of engineers and other applied scientists towards the environment.

Before 1970, the environment simply denoted *'the surroundings and the assemblage of the things nearby'*

Today it is a complex mix of combination of factors that are external to organisms and influence their living in any capacity. Additionally the challenges like human growth population, global warming, depletion of natural resources and over use of resources is making it further complex.

Continued

The modern day tone of environment has mainly originated from the emergence of the branch of ecology which was considered as altogether a new scientific discipline depicting 'the study of the relationship between organisms and their environment'.

The emergence of ecology has also given rise to the many new areas of engineering practice like chemical engineering and civil engineering etc.

Rachel Carson, a marine biologist , stands credited for bringing a change in the way environment is perceived today. The work done by her 1962, through her book '*Silent spring*' changed the consciousness of both public and policy makers about the effect of pesticides on environment.

Engineering, Ecology and Economics

Ecosystem - An ecosystem is a group of organisms that interact with each other and with their physical environment in ways that affect the population of those organisms.

Why ecosystem and Engineering?

Simply because the technology In case it messes up with the environment, it can affect the health of many breeds that a re co-existing in the environment.

Thus a need arises for the environmental ethics which denotes , the study of moral issues concerning the environment and moral perspectives, beliefs, and attitudes concerning those issues

The invisible hand and the tragedy of the commons

These two metaphors have majorly dominated thinking about the environment: **the invisible hand and the tragedy of the commons.**

Both these highlight the unintended influence of the marketplace on the environment, but one is optimistic and the other is cautionary about those impacts.

The ‘invisible hand’: Adam Smith, 1776, “The Wealth of Nations”

Smith conceived of an invisible (and divine) hand governing the marketplace in a seemingly paradoxical manner

– Business persons think of only their self-interest or benefits

– “It is not from the benevolence of the butcher, the brewer, or the baker, that we expect our dinner, but from their regard to their own interests”

–“Yet, although “he intends only his own gain,” he is “led by an invisible hand to promote an end which was no part of his intention. . . . By pursuing his own interest he frequently promotes that of the society more effectually than when he really intends to promote it. I have never known much good done by those who affected to trade for the public good.”

(Adam Smith, *An Inquiry into the Nature and Causes of the Wealth of Nations, vol. 1 (New York: Oxford University Press, 1976),*

The issue is :

Invisible hand metaphor does not adequately take into account damage to the environment

– Pollution caused to the environment
– Destruction of natural habitats residing together in the environment
– Depletion/damage of shared resources

Adam Smith could not have foreseen the cumulative impact of expanding populations, unregulated capitalism, and market "externalities"—that is, economic impacts not included in the cost of products. Regarding the environment, most of these are negative externalities—pollution, destruction of natural habitats, depletion of shared resources, and other unintended and often unappreciated damage to "common" resources.

From a larger perspective, think about the impact that various projects that are undertaken, say like building a bridge or a road by cutting trees or making a mall by removing a part of the forest.. How justified is it?

The tragedy of the commons - Garret Hardin, 1968

The thought is deeply rooted in Aristotle's observation that we tend to be thoughtless about things we do not own individually and which seem to be in unlimited supply.

William Foster Lloyd was a believer this phenomenon, which was later called as the tragedy of the commons by Garret Hardin, 1968

In simple words, it highlights the conflict between individual and collective rationality. When we get unlimited assess to resources, a bit of over use from our side (which others are also doing), in the long term makes a huge impact.

Continued

The same kind of aggressive, unmalicious but carelessness, exploitation arises of natural resources that are held in common like air, land, forests, lakes, oceans, endangered species, and indeed the entire biosphere is leading to a destructive impact.

The tragedy of the commons still remains a powerful image in thinking about environmental challenges in today's era of increasing population and decreasing natural resources.

Role of Engineers in Sustainable development

Today engineers are expected to play a immense role, when it comes to sustainability because of the large impact the work of engineers can have on society.

However, historically, engineers were not considered as responsible concerning the environment as they should have been. That's how the attitudes were predominant in society. There were hardly any laws that governed, what if anything went wrong or it affected the society tremendously in a negative way?

All engineers should reflect seriously on environmental values and how they can best integrate them into understanding and solving problems. This is because

-Projects, products, or processes designed by engineers can release toxic wastes that can have detrimental effect on environment. Like in case of pesticides .

-Some engineering developments flood farmlands, drain wetlands, and destroy forests.

-On the other hand engineers work on improvements to reduce/eliminate negative that impact environment.

Continued

As rightly put by Caroline Whitback in her book Ethics in engineering practice and research,

The professional responsibility of engineers and applied scientists for environmental protection, like their responsibility for ensuring public safety, requires attention to two sorts of risks:

“Hazards that have gone unrecognized, at least by some key decision makers, and that pose a grave or excessive threat to safety or the environment”; and

“Hazards that are a recognized feature of the situation but that cannot be completely eliminated and are mitigated only by increasing other risks and costs”.

This mainly emerges from the technical aspect of risk which talks about risk assessment before implementing any engineering project..

Code of Ethics for Engineers and Sustainable development

ASCE (American Society of Civil Engineers), 1997:

– Engineers shall hold paramount to the safety, health, and welfare of the public and shall strive to comply with the principles of sustainable development in the performance of their professional duties.

Section 1 (f) states that "Engineers should be committed to improving the environment to enhance the quality of life"

– Also have requirement to notify "proper authorities" when the principles of sustainable development are violated by employers, clients and other firms

The ASCE Code makes recommendations and explicitly states the requirements for engineers with respect to the environment stating what "engineers shall" (requirements) and what "engineers should" (recommendations)

Continued

IEEE Code of Ethics (Institute of Electrical and Electronics Engineers)

The IEEE Code of Ethics begins with point 1 as

"to hold paramount the safety, health, and welfare of the public, to strive to comply with ethical design and sustainable development practices, and to disclose promptly factors that might endanger the public or the environment"

The IEEE Code also commits its members to disclose the possible threats to the public in case any engineering practice is expected to cause any harm to the public in general.

Refer to the snapshot taken from the official website of IEEE

7.8 IEEE Code of Ethics

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

1. to hold paramount the safety, health, and welfare of the public, to strive to comply with ethical design and sustainable development practices, and to disclose promptly factors that might endanger the public or the environment;
2. to avoid real or perceived conflicts of interest whenever possible, and to disclose them to affected parties when they do exist;
3. to be honest and realistic in stating claims or estimates based on available data;
4. to reject bribery in all its forms;
5. to improve the understanding by individuals and society of the capabilities and societal implications of conventional and emerging technologies, including intelligent systems;
6. to maintain and improve our technical competence and to undertake technological tasks for others only if qualified by training or experience, or after full disclosure of pertinent limitations;
7. to seek, accept, and offer honest criticism of technical work, to acknowledge and correct errors, and to credit properly the contributions of others;
8. to treat fairly all persons and to not engage in acts of discrimination based on race, religion, gender, disability, age, national origin, sexual orientation, gender identity, or gender expression;
9. to avoid injuring others, their property, reputation, or employment by false or malicious action;
10. to assist colleagues and co-workers in their professional development and to support them in following this code of ethics.

Continued

ASME (American Society of Mechanical Engineers) Code of Ethics of Engineers

The Fundamental Principles
Engineers uphold and advance the integrity, honor, and dignity of the Engineering profession by:
using their knowledge and skill for the enhancement of human welfare;
being honest and impartial, and serving with fidelity the public, their employers and clients; and
striving to increase the competence and prestige of the engineering profession.

(Source ; http://web.mit.edu/course/2/2.95j/Codes-of-Ethics/ASME_Code_of_Ethics.html)

Continued

The Fundamental Canons

1. **Engineers shall hold paramount the safety, health and welfare of the public in the performance of their professional duties.**

2. Engineers shall perform services only in areas of their competence.

3. Engineers shall continue their professional development throughout their careers and shall provide opportunities for the professional development of those engineers under their supervision.

4. Engineers shall act in professional matters for each employer or client as faithful agents or trustees, and shall avoid conflicts of interest.

Continued

Engineers shall build their professional reputation on the merit of their services and shall not compete unfairly with others.

6. Engineers shall associate only with reputable persons or organizations.

7. Engineers shall issue public statements only in an objective and truthful manner.

(Source ; http://web.mit.edu/course/2/2.95j/Codes-of-Ethics/ASME_Code_of_Ethics.html)

Sustainable development and Engineers

United Nations World Commission on Environment and Development, *Our Common Future, 1987:*

*" d*efines sustainable development as "the development that meets the needs of the present without compromising the ability of future generations to meet their own needs"

ASCE (American Society of Civil Engineers) defines *sustainable development as "a process of change in* which the direction of investment, the orientation of technology, the allocation of resources, and the development and functioning of institutions [is directed] to meet present needs and aspirations without endangering the capacity of natural systems to absorb the effects of human activities, and without compromising the ability of future generations to meet their own needs and aspirations".

Continued

Engineers and applied scientists, because of their education and training, are in a special position to recognize both environmental hazards and safety hazards.

Their specialized knowledge and training are the basis for the growing consensus that engineers and applied scientists have a professional responsibility to bring environmental as well as safety hazards to light.

This has not only highlighted the role of engineers towards led sustainable development but also led to the emergence of concept of environmental leadership in general and more specifically in engineering organizations as well

Environmental Leadership

"Environmental leaders are those who look at environmental problems in light of their own experience and moral values, are committed to leveraging their area of expertise to realize sustainable development in their professional and private lives, and exercise leadership in fulfilling their social responsibilities" (United Nations Decade of Education for Sustainable Development) (UNDESD)

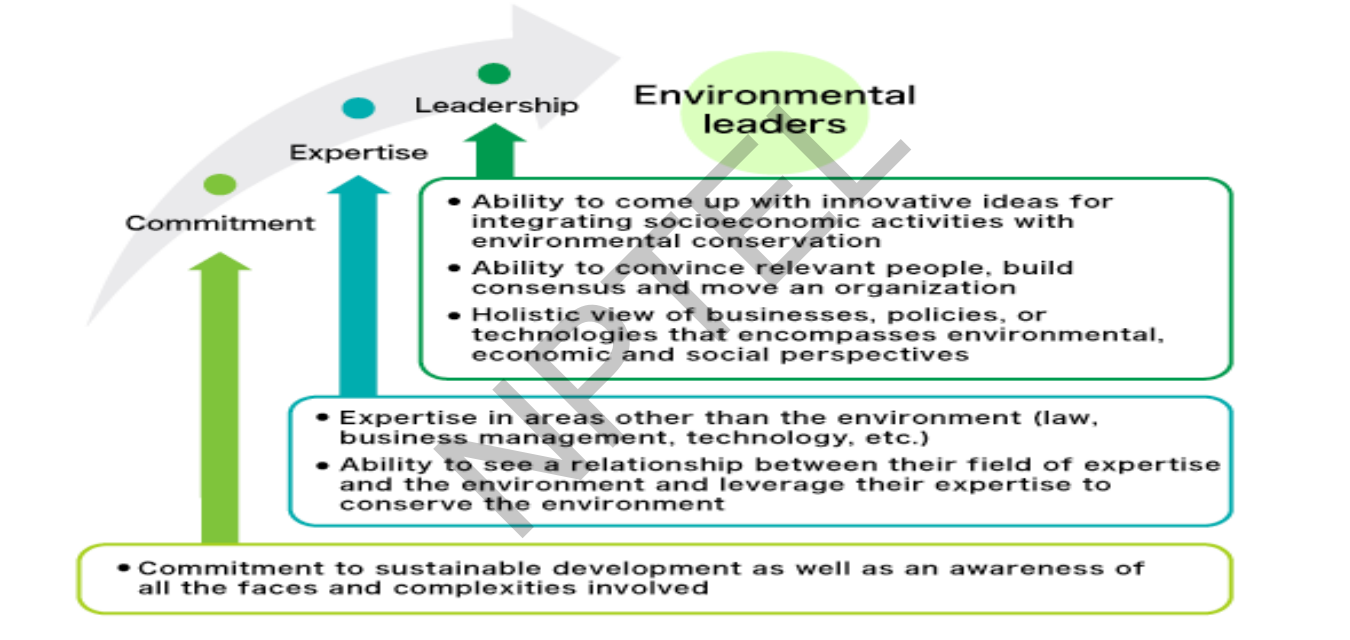
Two types of people are needed to attain sustainable development;

Environmentally-conscious citizens: people whose lifestyles have a minimal environmental impact
Environmental leaders: leaders who have the ability to make the socioeconomic system more harmonious with the environment through environmentally-friendly products, services, businesses, technologies, and policies

A vision for training such environmental leaders in Asia

https://edu.env.go.jp/asia/en/about/vision.html

Three requirements for promoting sustainability



https://edu.env.go.jp/asia/en/about/vision.html

Responsibility of engineers for assuring sustainability

- Cost-benefit and risk-benefit calculations are frequent component of environmental impact statements.
- Analysis of environment risks is often the official responsibility of engineering teams, they should make sure that goals of sustainable developmental are met.
- Engineers are expected to be honest while preparing reports of these evaluation projects. If the costs of implementation go much beyond than what our environment can afford, engineers should make sure that such projects are scrapped.
- Human wellbeing should be kept on utmost priority while undertaking engineering activities.
- Only those projects, products or machines should be given a go ahead, that cause no harm to environment or human well being.

Environmental Laws

Environmental Laws…

- National Environmental Policy Act, 1969
- Occupational Safety and Health Act, 1970
- Clean Air Act, 1970
- Clean Water Act, 1972
- Toxic Substances Control Act, 1976

Preventing of Natural disasters

Communities at the local and even state level have special responsibility to conserve natural resources and beauty for future generations.

They have special responsibility, as well, for preventing natural events—such as hurricanes, floods, fires, and earthquakes—from becoming disasters. There are four sets of measures communities can take to avert or mitigate disasters.

For instance, homes should not be built in floodplains, homes in prairie country should have tornado shelters, hillsides should be stabilized to prevent landslides, structures should be able to withstand earthquakes and heavy weather, roof coverings should be made from nonflammable materials, and roof overhangs should be fashioned so flying embers will not be trapped.

Changing the way, costing is done

There is a need to change the way, costing is done. It would not only increase the awareness but also make engineers more concerned while passing or undertaking any projects.

Classically, only direct costs of labor, raw materials and use of facilities are included.

But if true costs like;
– Effects of pollution
– Depletion of energy and raw materials
– Disposal
are also included this would help in achieving a more sustainable orientation.

Promoting Social activism

Social activism by concerned citizens has played a key role in raising public awareness. As examples, we cite Rachel Carson, Sherwood Rowland, and Engineers Without Borders.

In the United States the environmental movement had many roots, but its catalyst was Rachel Carson's 1962 book *Silent Spring. Carson made a compelling case that pesticides,* in particular dichlorodiphenyltrichloroethane (DDT), were killing creatures beyond their intended target, insects. DDT is a broad-spectrum and highly toxic insecticide that kills a variety of insects. It also persists in the environment by being soluble in fat, and hence storable in animal tissue, but not soluble in water, so that it is not flushed out of organisms. As a result, DDT enters into the food chain at all levels, with increasing concentrations in animals at the higher end of the chain.

Thank You!!

Ethics in Engineering Practice

Lecture No 23: Environmental Ethics and Spirituality

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Outline of the module

- Introduction to the topic
- Transcendentalism
- Deep Ecology
- Ecofeminism
- The Gaia Hypothesis
- The Judeo-Christian Tradition
- Asian religions
- Animistic Religions
- Modern Pantheism

Source: Engineering, Ethics and the Environment , Vesilind and Gunn, Cambridge University Press

Introduction

It is quite evident that classical ethical theories provide no solid ground for protecting our environment

For eg, building a dam as per Utilitarianism may be justified but if it costs a lot in terms of harming the habitat and the natural ecosystem it may not be justified.

The theorists who neglected the idea of classical theorists and were dominated by the real concern for individual organisms, places, eco-systems and future generations started the search for environmental ethics in spirituality

Transcendentalism

Earliest attempts to incorporate the ***spirituality of nature*** into a religion

Ralph Waldo Emerson (1803-1882) and Henry David Thoreau (1817-1862) rejected the idea of understanding nature thorough scientific rationality and proposed the concept of transcendentalism , which denotes moving beyond the scientific logics for understanding nature

Emerson advocated the idea of yielding oneself to nature for attaining spirituality

Continued

But how is this making sense for engineers?

This is related to engineering in some sense as transcendentalism led the foundation of the movements of conservation and preservation of natural resources which in a way restricts the actions of the engineers which might harm nature like cutting trees, using excessive water for industrial purposes etc.

Deep Ecology

This in a way was an extension of transcendentalism.

This movement was formalized with the writings of ***Norwegian philosopher Arne Naess,*** who proposed two fundamental values :

Self-realization
Biocentric equality

as the basis for the evolution of environmental ethics.

Continued

These values defy rational justification and rely more on connecting deeply with ecology.

Self realization relates to the recognition of oneself as member of greater universe, not just as single individual or a member of particular community.

As per Naess, this can only be achieved through reflection and contemplation.

Reflecting in terms of how it would affect us and contemplating the affect of an action on long term

Continued

Biocentric equality, follows self-realization and calls for understanding oneself a one with other creatures in the world.

We cannot regard ourselves as superior and should accept that all creatures have equal rights to flourish

We can eat and use other creatures only to the extent it is vital for our survival.

For a deep ecologist, collecting material wealth is considered unethical.

Continued

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For a deep ecologist, collecting material wealth is considered unethical.

Deep ecology and engineering ethics

Engineers should focus on developing sustainable societies for the greater good of society

Using of resources should be restricted to the extent it is considered very essential to meet vital needs

Engineers should respect the fact the other life whether human or non human has a value in itself and engineers as individuals have no right to reduce its richness for materialistic benefits.

Ecofeminism

Ecofeminism as a term emerged in 1980's

Its basic premise relates to constructing environmental ethic by incorporating the problem of patriarchy into our thinking about humans and nature

In simple words, **Ecofeminism**, which is also called as ecological feminism, that examines the connections between women and nature.

According to one of the proponents, Ecofeminism is "the potion that there are important connections – historical, symbolic or theoretical between domination of women and domination of non-human nature"

Continued

Patsy Hallen, an influential American philosopher, believes that because science is our chief means of understanding the environment, there is a need to make it more feminine.

It emphasizes the ethics of caring, as opposed to the male oriented ethics of justice.

It aims at nurturing the feelings of having care for Mother Earth .

Continued

It is an alternative approach to environmental morality – a simple caring for the living and non-living environment which in a way brings us a step closer to the environment

It should be noted that Ecofeminism is not gender specific, all people regardless of geneder can have a caring attitude towrads our enviornemnt.

The Gaia Approach

In Greek mythology, Gaia means nurturing the goddess earth

It is largely the idea of a contemporary biologist, James lovelock, who suggested that earth should be viewed as a single organism, Mother nature,which lives like any other organism

The Gaia hypothesis postulates the idea of preserving earth like a living organism

It restricts humans from destroying other creatures that co-exist with humans in the mother earth

The Judeo-Christian Tradition

Human beings are different from rest of the nature

We are the only creatures with a developed language

Humans have a domination over all other animals

Lynn Whites's 1967 essay, " The Historical roots of Our Ecological Crisis" best described the influence of Judeo-Christianity on human use of natural environment , which led to a severe ecological crises.

Continued

A medieval historian, White (1907-1987) also strongly believed that Judeo-Christianity traditions were largely responsible for exploitative attitude of humans on nature leading to the ecologic crises.

Because of the fact that it never restricted humans from destroying plants and killing animals

Asian Religions

Taoist and Confucianism traditions in China

Zen Buddhist in Japan

Both these religions consider whole world in its organic sense , with nothing existing in isolation and everything connected to each other.

Buddhism has main tenet principle as the principle of *'ahimsa', "do not destroy life"*

Continued

Buddhism teaches compassion for all of life including trees, forests and wildlife.

Such oneness does not hinders development.

Taoism encourages technological advancements as long as it is in harmony with nature.

In Japan, The Zen Buddhist movement also stresses oneness with nature.

Continued

But unfortunately in both China and Japan, the presence of environmentally enlightened religion does not seem to have prevented the massive destruction and disregard for environmental equality.

The other major religion in Asia is Hindu tradition. Hindus believe that god resides in all creatures and thus prohibit eating meat. The doctrine of ahimsa is also shared by Hindus which advocates not destroying life.

The central tenets of Hinduism require care and compassion for animals and nature but this does not seems to be the reflection in their practical Experience like Japan and China.

Animistic Religions

Most ancient religions, including Polynesian and Native American religions are animistic and recognize the existence of spirits with nature.

In such religions, spirits do not take human form and are simply within tree or the sky.

In many animistic religions killing of animals like deer or bear requires proper appeasement.

Cutting down a tree requires an explanation to that spirit (tree) for cutting it

Continued

Some modern environmentalists have looked upon animism with admiration and have believed that such wisdom doesn't exists anymore

Modern Pantheism

It is considered to be an updated version of both transcendentalism and animism.

Under modern pantheism, ecology is viewed as the scientific revelation of god.

According to Harold Wood, modern pantheism offers three approaches to achieving oneness with god – the way of knowledge, way of devotion and the way of works

Continued

Way of knowledge relates to studying nature deeply, and being observant with what nature possesses

Way of devotion relates to celebrating the parts of nature as a way of being and communion with nature

And the way of works denotes acting in the best interest of the ecosystem.

The Point of Discussion

The Possibilities:

Stop worrying about environmental ethics

Abandon any attempt to develop and environmental ethic and just adopt some ideas based on inner feelings

Adopt and environmental ethic that makes most of sense to us based on understanding of the world and our own evaluation of ethics

Thank You!!

Ethics in Engineering Practice

Lecture No 24: Engineering as Social experimentation

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Outline of the module

- Introduction to Experimentation
- Benefits of Experimentation
- Similarities between engineering and standard experiments
- Contrasting engineering and standard experiments
- Engineers as responsible experimenters
- Conscientiousness, Relevant information, Moral autonomy and Accountability

Source: Ethics in Engineering, Martin and Schinzinger, McGraw-Hill (Third Edition)

Introduction

Experimentation plays an important role in all projects that are a matter of concern. Engineering projects in totality can be viewed as experiments.

Even in engineering projects, preliminary tests or simulations are conducted out to make sure that the best prototype is prepared and taken further for making it a reality.

More specifically, from the time it is decided a project is to be pursued into reality , experimentation starts.

Continued

The experimental tests conducted serve as basis for more detailed designs.

Like for example, before a road construction begins, researchers in civil engineering labs might be asked to prepare different samples of the aggregates to see which is well suited in terms of the strength of the material used and proposed road load

Or Engineers at a beverage company might be asked to come up with special design of the bottles and conduct experiments to find out which one is the best for the grip

Benefits of Experimentation

(1) Coming up with the best version of the product by trying various iterations

(2) Utilizing experiments as a means to seek feedback and carrying out further improvements

(3) Technically, it may seem a perfect product but it might vary when executed behaviorally. Experiments help find out behavioral usage flaws For eg. The design of a water bottle may seem perfect with respect to its engineering specifications but might be a pain when holder for long by the person using it

Highlights of Engineering experiments

Like all projects, engineering projects are also carried out in partial ignorance. Uncertainties can be found in the abstract model used for design calculations or in the characteristics of the material purchased for execution of the projects etc

Sometimes, engineers have to bypass the exploration and laboratory testing for the sake of moving the projects ahead, and have to rely on their knowledge and wisdom to make things work out in the field

Like other experiments, outcomes in case of engineering projects as well are uncertain

Continued

Often in engineering, it may not be known what the possible outcomes are. Like even after a dam is built, it may not serve the purpose for which it was built , however the damage to the region might have already been done

Like failure of a nuclear test is not just a failure, it may have a far reaching impact of the area as well as the life surrounding it

The classic example is of Nano car – designed to fulfill the dream of millions of Indians to own up their own car – but the fire out bursts were unexpected and unpredictable

Continued

Engineering experiments are an ongoing process. They are even carried out after a product leaves the factory.

Constant monitoring can help a great deal in carrying out further improvements in designing of the products

To monitor is about making periodic improvements to identify the unintended side effects and it should not be restricted within the factory as ultimate purpose of a product is solved when it delivers value to the society at large, thus their feedback is essential.

Contrasting engineering experiments with other experiments

Experimental Control – In standard experiments one group receives the special experimental treatment , while the other called as control group does not receives any such treatment. Their comparison is done at a later stage to report results. This may not be possible in engineering experiments until and unless they are carried out in laboratories.

In engineering experiments, clients or consumers exercise control because it is they who choose to buy or use the product.

Continued

Calls for an ***Informed Consent –*** Testing drugs on humans cannot be done until and unless their consent is taken. Today society has come to realize the primacy of the subject's safety and free will to participate in medical experiments

It involves two things:

Knowledge
and
Voluntariness

Continued

Knowledge means giving complete information of the experiments to the subjects, nothing should be hidden from them, more specifically the side effects

This just does not merely extends to experiments.

Even when products are sold, it is the duty of the engineers to make the general public aware about the side affects of products, if there are any

They should be given full information about practical risks involved as well as the benefits of the products as well.

Continued

Voluntariness means that the subjects should agree to be part of the experiments on their free will , not out of coercion or force. In **total, an informed consent is one;**

When it is given voluntarily

It is based on the information that any rational person would want before he/she says yes to be a subject

The subject has given the consent when he she was not too young or mentally ill or under any intoxication

Continued

Knowledge gained:

Scientific experiments are most probably conducted to gain knowledge but this may not be the case for engineering experiments.

Engineers are Responsible Experimenters

As engineers are the main technical enablers or the facilitators to carry out the experiments, their expertise places them in a unique position , ***a position of responsibility to be precise.***

Apart from displaying technical competence, engineers are expected to;

Protect the safety of human subjects and respect their right of consent

Constant awareness and imaginative forecasting of possible side effects

Continued

Personal involvement at all stages

Taking accountability for the results

Conscientiousness

It calls for the engineers to exercise a full range of moral values and responsibilities in a given situation

Engineers might be working in situations of pressure under large bureaucracies and on salaries which in a way might restrict them from investing in seeing a larger image

It highlights the role of the engineers as guardians of public interests, whose duty is to guard the welfare and society of people who are affected by it.

Relevant information

Conscientiousness is considered blind without relevant factual information.

It is the job a engineer to first get all the relevant information and properly assess all the information for meeting the expected moral obligations.

It relates to getting full context of the one's work

Moral Autonomy

People are morally autonomous when their moral conduct and principles of action are their own. The attitude of management plays a decisive role in how much moral autonomy engineers feel they have.

It would surely be in the great interest of any organization if engineers are given a great deal of latitude in exercising their personal judgment on moral issues relevant to their jobs

It is comfortable illusion that working for an employer and performing acts to serve company's interests , relives one from being morally and personally responsible for (immoral) actions but nothing like this exists

Accountability

Responsible people accept moral responsibility of their actions

Engineers should be ready to submit their actions to moral scrutiny and be open to assessment from others.

Thank You!!

Ethics in Engineering Practice

Lecture No 25: Ethics in Changing Domain of Research

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Outline of the module

- Trust as ingredient for research collaborations
- Elements for trustworthy behavior
- Values in science and engineering research
- Breaking the Trust – Research misconduct
- Composition of research misconduct – fabrication, falsification and plagiarism
- Finding of Research misconduct requires what?
- Research misconduct vs. mistakes/errors

Outline of the module

- When does a Research misconduct qualifies as a fraud
- Falsification vs. Legitimate data selection
- Deterrents to ethical engineering research
- Self deception vs. observer bias
- Keys to Research integrity
- Factors that undermine research integrity
- Advantages of fostering responsible Research conduct
- Responsibilities of an author of a Research article

Source: Ethics in Engineering practice, Caroline Whitback, Cambridge University Press

Introduction

The most important ingredient for **Research** and **Research** collaborations for engineers is;

trust

Trust is described as the combination of ;

Confidence
and
Reliance

Continued

Confidence means being sure that the other party is not going to do anything to harm you or affect you in a way which is not acceptable or in an undesired manner

Reliance means you can seek support from the other party or you are hopeful of getting sincere help from them in times of need

If we have no alternative, we may continue to rely on people we have no confidence eon but this in long term needs to a downward spiral

Elements to responsible or trustworthy behavior in professionals

Competence and Concern

Competence depicts the expertise to achieve good outcomes in domain of expertise

Concern denotes a case where other party also does things for their as well as your good

Key values in science and engineering

A. Simplicity

B. Consistency

C. Ability to yield accurate predictability

Breaking the Trust

Research misconduct – fabrication, falsification and plagiarism in proposing, performing or reviewing or in reporting research results

Deterrents to trust in engineering research are;

Fabrication

Falsification

Plagiarism

Continued

Fabrication: ***making up data or results or reporting them***

Falsification: ***manipulating*** **Research** ***materials, equipments or processes or changing or omitting data or results***

Plagiarism: ***appropriation of another persons ideas, processes or results or words without giving proper credit***

A finding of Research misconduct requires

- **Significant departure from accepted practices of relevant Research community**

- **It should be committed intentionally**

- **Allegation must be proven with evidence**

If any of the above conditions is not satisfied, it does not qualify for a research misconduct.

Other issues

Cooking of data: Selecting only those data points which fit the hypothesis

Replication : Repeating an experiment without giving due credit. It is only justified if proper reasons are produced for conducting the same experiment in different settings

Research Misconduct vs. Mistakes/Errors

The point of differentiation lies in:

Research misconduct is always intention, mistakes and errors may not be committed intentionally

Only actions that seriously threaten **Research** integrity can qualify as a **Research** misconduct

Research ***integrity relates to ensuring integrity of results, dealing fairly with others in terms of giving them their due credit, acknowledging others contribution***

What Research misconduct does not includes

Honest errors

Difference of opinion

When does a research misconduct qualifies as fraud

- *When a false representation is made*
- *The perpetrator knows that misrepresentation is false and recklessly disregards it to be true or false*
- *It is done with the intention to deceive others*

Continued

Instances of research misconduct commonly stem from "cutting corners" which means confirming to results that the perpetrator wants the others to believe to be true

Falsification vs. Legitimate data selection

What is data selection?

It is the differential treatment of data

-If done as per a legitimate criteria, data selection is an indispensable part of science

-It is acceptable to drop a part of data if statistical methods that are being employed warrant discarding some data for smooth running of the software

Continued

What is not acceptable?

Changing data to fit one's expectations

Changing value of data to get certain results

If data selection is done with out proper justification

Continued

The crucial justification depends upon the characteristics of the data, how much cleaning or sorting is required to make that data fit

Sometimes statistical software's themselves crunch the data

Key points to remember while evaluating a report

Intuition vs. reasoning

The basis of your argument should be reasoning not the intuition

Intuition : ability to recognize what is going on in a situation on your gut feeling

Reasoning : ability to recognize what is happening in a situation on the basis of evidence

Continued

Avoiding observer bias

Failing to notice what we do not want or expect to see

It can completely change the way how you report findings

Deterrents to Ethical Engineering research

Recklessness:

Taking serious risks that ethically speaking should not be taken by one while conducting research. It is like disregarding major ethical values and standards of honesty and integrity

Cutting corners:

intentionally taking shortcuts to produce or show desired results or knowing violating good research practices

Self-Deception vs. observer bias

Self deception: failure to spell out even to one's own self what one is doing – even in circumstances under which one can normally tell

Observer bias: relates to seeing what one wants to see or does not wants to see

The point of discussion is which one is more deadly for good research?

Key to Research Integrity

Data falsification

Data fabrication

Plagiarism

Data today comes in many forms, it is no longer just observations.

It also comes in the form of recordings in laboratory notebook, photographs as well as micrographs.

Continued

Safeguarding that data and producing actual results is as much a matter of being truthful as it is about using the accurate methods for producing right results.

The large collaborations which are happening these days can create new occasions of error, confusion and misrepresentation but all this should be avoided.

Factors that undermine Research integrity

Many surveys show that a majority of engineering students have admitted to falsifying results, lets have a look at factors that lead to research integrity;

a. Cutbacks in research funding

b. Shortage of jobs – less opportunities – forces researchers to cut corners

c. Pressure to perform from research supervisors

Continued

d. Lack of faculty supervisors or low guide scholar ratio

e. Prospect of major financial gains through falsifications of required results

f. Need for articles for promotion

g. Pressure from collaborators

Emerging emphasis on fostering responsible conduct

The correlation between misconduct charges and poor research environment suggests that better responses to subtler problems of research conduct can reduce the incidence of misconduct charges.

What can be done to foster reasonable conduct in research:

a. Strict supervision
b. Curbing guide-scholar ratio

Continued

d. Awards to honest scholars

e. Strict punishment regimes

f. Fostering trust in relationships

g. Avoiding time bounds and purely **Research** based promotions

Responsibilities of an Author of a research article

1. Refrain from plagiarizing
2. Use journal space wisely
3. Reveal any hazards in conduct of experiments, if any
4. Report all sources of information properly
5. Reveal any financial or other sources of conflict

Continued

6. Providing details about resercah so that others can replicate it with valid justifications

7. Citing previous publications properly

8. Refraining from doing personal attacks by criticizing others work

9. Creating a clear distinction concerning those who quality as co-authors or those who just need acknowledgement

Continued

10. Avoiding duplicate publication, sending the same work in two or more journals at one time

Conflict of Interest

A conflict of interest occurs when the party

Is in a position of trust that requires the exercise of judgment on behalf of others

Has interests or obligation or responsibilities of the sort that might interfere with the exercise of such judgment

Having those interests is neither obvious nor usual for others in the position of trust

Continued

And Financial conflict of interest occur when the agents interests are financial

Usually committees are formed in institutions to resolve conflict of interest situations

Thank You!!