Learning Objectives

- To understand What is Social Experimentation ?
- To understand the responsibility of an Engineer as a social experimenter
- Role of Code of Ethics
- Importance of Law
- The Challenger Case Study

After a review of some of the major concepts of professional ethics, let us now focus on the roles and responsibilities of engineers and the engineering profession. In this chapter, we look at engineering as a 'social experimentation' and engineers as social experimenters. Their responsibility in different areas of engineering as social experimentation, product design and maintenance are discussed in brief.

ENGINEERING AS SOCIAL EXPERIMENTATION

Medicine is accepted readily as social experimentation because of its explicit preoccupation with human beings. In the case of engineering the argument goes thus: engineers experiment with things and processes and not with human beings; then how can it be regarded as social experimentation? The answer lies in the fact that there is always a strong human interface in the use of the process and results of these experiments and the beneficiaries are invariably humans.

Social experimentation is a research process. Engineering involves applied research and development. Experimentation ethics is the discipline that is concerned with the analysis of moral principles applicable in the conduct of research especially in relation to human subjects. It seeks to protect the rights and welfare of human subjects involved in the process. Research can do good; but also may cause harm. Research that causes harm is morally wrong. If avoiding harm is of primary importance, then many a research project with potential for doing good would be considered unethical since in the initial stages, some cause harm, but once proved successful will do good for the society. Therefore, the ratio of benefit to harm is the more reasonable criterion for justifying any experimentation. This principle of harm and benefit is called ***beneficence***.

Another relevant principle is ***autonomy***, which recognizes the rights of a person to information, self-determination and to liberty. A researcher has to provide all relevant information and then take the informed consent of a subject before asking him/her to participate in his/her project research.

Researcher should not subject a mentally ill or disabled person to experimentation without the due process.

For ethically sound. experimentation, an engineer should:

(1) Minimize the risk to subjects

(2) Make sure that risks are reasonable relative to anticipated benefits

(3) Obtain, prior consent from subject or their legal representatives

(4) Document the informed consent .

(5) Maintain, the privacy and confidentiality of the subjects and experiments

(6) Monitor the data throughout the experiment to ensure the safety.

(7) Provide safe exit to subjects.

Murphy's law states that if anything can go wrong, it will sooner or later. All technological products carry some potential danger, and therefore in engineering processes, there is always an element of risk, however small. In each and every stage of technology, process or product development, experiments are conducted. There are uncertainties at every stage. Engineers do not have the luxury of waiting until all the relevant facts are in before commencing work. At some point of time theoretical exploration and laboratory testing must be bypassed for the sake of moving the project ahead and gain time. The talent and ability to accomplish tasks with the available knowledge is crucial in an engineer. The final outcome of an experiment could be uncertain but monitoring throughout the experiment is essential. It is not sufficient for engineers to rely on handbooks alone. Engineering, like any other experimentation, demands constant monitoring, alertness and vigil on the part of the experimenters at every stage of a project.

Engineering as a social experimentation is not just a metaphorical notion. Any experiment in engineering has to consider its impact on the environment. Simulation studies are done but there are always risks associated with any experiment. Failures and mishaps are encountered in experimentation. Only after considerable research and experimentation, a product is ready to be put to use.

RESPONSIBILITIES OF ENGINEERS AS EXPERIMENTERS

Now let us look at the responsibilities of engineers as experimenters. Engineers are technical enablers or facilitators; they are far from being sole experimenters. Their responsibilities are shared with colleagues, management, public and others. They use their expertise to monitor an experimental project to identify risk, inform clients and public and to take appropriate corrective decisions. In the following paragraphs we discuss the general characteristics of a morally responsible engineer.

Conscientiousness

First and foremost is conscientiousness or being conscientious. It means commitment to live according to certain moral values. Conscientiousness implies consciousness. An Engineer has to be sensitive to a range of moral values and responsibilities that are relevant in a given situation; he should have the willingness to develop the skills and expend the effort needed to reach the best balance possible among various considerations. 'Open eyes, open ears and an open mind' are required to evaluate a given situation, its implications and determine who are involved or affected. He should not violate any rights, not breach any confidentiality, or tamper with data. He has to constantly play the role of a guardian of public interest.

Accountability

Accountability means being responsible, liable, answerable or obligated. It may be individual or collective. It assumes that there is a duty that one has to discharge. One can generally be held account-

Social experimentation is a research process.

able for the failure to do one's duty. Responsible people are expected to accept moral responsibility for their actions. In extreme cases, they may resign from their post.

Moral Autonomy

This concept is discussed in the previous chapter. The word autonomy comes from the Greek words 'autos' meaning self and 'nomos' meaning law. It denotes the absence of external constraint plus a positive power of self-determination. One should always act so as to treat persons as end in themselves, and never as means to ends. As an experimenter, an engineer is exercising his identity as a professional. Engineers may have to look for moral support from their professional societies.

Being Informed

Engineer has to show the commitment to obtain and properly assess all the information pertinent to meeting one's moral obligations. Conscientiousness is blind without relevant factual information. This has to be done on a continuing basis and confidentiality maintained. The cost-benefit analysis of information collection is to be estimated by the Engineer.

Awareness of Code of Ethics

As a social experimenter, an Engineer has to be aware of the codes of ethics of his profession. They help the engineer with a checklist and provide inspiration in the form of positive stimulus and guidance for decision-making. Since they are brief, they offer mostly general guidance. Engineering societies like, IEEE, ASCE, ABET, ASME have general codes of ethics for their members and many technologically advanced companies like Texas Instruments, TISCO, IBM etc .have developed company-specific codes. These tend to concentrate on the moral issues encountered in dealing with vendors, customers, governments etc. Texas Instruments publishes an ethics diary and provides on line consultation on ethical issues. Their ethics site has 'Quick Tests' answering queries on ethics such as (*Their site extols their employees "If you're not sure, ask. Keep asking until you get an answer*")

Is the action legal?

Does it comply with our values?

If you do it, will you feel bad?

How will it look in the newspaper?

From the perspective of engineering profession, the emphasis of codes should be on supporting responsible conduct, offering general guidance and promotion of mutual understanding rather than punishment. Preserving *status quo* and promoting business interests in violation of free competition should be avoided .It should be kept in mind that codes are but a small part of engineering ethics. Codes are not sacred writ and should always be open to critical examination. Codes should be applied with caution, keeping in view their limitations. (*Last chapter of the book deals with code of ethics in greater detail.*)

To create awareness and the implementation of the code of ethics, the engineering associations have to hold regular meetings, communicate the codes to all members , check for possible violations enforce codes by rewards and punishment and review, update and report.

Importance of Law

In the first chapter we looked at the relationship between law and ethics. Here we will focus on law with respect to social experimentation.

Let us examine the role of law in the engineering ethics. Here we will focus only with respect to social experimentation. The law allows for the social experimentation, but it has to place emphasis on moral responsibility of engineers – an emphasis that goes beyond merely following laws and is especially vital for those working for the future technologies and its development. Laws lag behind the technological development . They look at the issue of compliance and regulation that can slow

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