PROFESSIONAL ETHICS

Engr. Madeha Mushtaq

Engineering as Social Experimentation

Experimentation

- To undertake a great work and especially a work of novel type means, carrying out an experiment.
- Experimentation:
  - A test under controlled conditions that is made to demonstrate a known truth,
  - to examine the validity of a hypothesis, or
  - to determine the efficacy of something previously untried.
- The process of conducting such a test is called as an experimentation.

What is Engineering?

- Engineering is the application of science and math concerned with the design, building, and use of new ideas, new innovations.
- Engineers figure out how things work and find practical uses for scientific discoveries.
- To solve real world problems that improve the world around us.

Engineering as Social Experimentation

- Many products of technology present potential dangers that engineering should be regarded as an inherently risky activity.
- Engineering should be viewed as an experimental process.
- It is an experiment on a social scale involving human subjects and can effect environment and nature.
- Experimentation is commonly recognized as playing an essential role in the design process.

Ethical issues during the design process

- Designing can be described as an activity in which engineers translate certain functions or aims into a working product or system.
- A ferry can be conceived of as the translation of the function 'transporting people from one side of the river to the other'.
- If you want to achieve transport between two riverbanks, you can choose among a series of possible technical solutions, such as a bridge, a tunnel, a ferry, or a cable-lift.

Engineering Design Process

- The design process is an iterative process that can be divided in different stages, like:
- *Problem analysis and formulation*. During the problem analysis stage, the designer or the design team conceptualizes the design problem.
- *Conceptual design*. In the conceptual design stage the aim is to generate concept designs. The focus is on an integral approach to the design problem.
- *Simulation*. The concept designs are checked in this stage to see whether they meet the design requirements.

Engineering Design Process

- *Decision*. In this stage, various concept designs are compared with each other and a choice is made for a design that has to be detailed. The results from the simulation stage are used for this comparison.
- *Detail design*. Once the choice has been made for a particular design, it has to be elaborated on and detailed.
- *Prototype development and testing*. After the design is detailed, often a prototype of the design is constructed and tested.

Similarities to Standard Experiments

Partial Ignorance

- Any project is carried out in partial ignorance.
- Engineers are asked to make things work without all the available scientific knowledge (including that about humans), safety facts, environment, health, social influences, etc.
- Good design relies on information gathered before and after a product leaves the factory.
  - Especially when the product is tested in its true “environment,” not fake ones used to simulate the real environment .(e.g., temperature cycling electronic products).

Uncertainty

- The final outcomes of engineering projects are generally uncertain like that of experiments.
- For example, a reservoir (Dam) construction may cause damage to the surroundings and affect the eco system, If it leaks or breaks, the purpose will not be served.
- A nuclear reactor Explosion may cause unexpected problems to the surrounding population leading to a great loss to the owners(Government).

Monitoring

- Monitoring is an essential part of experimentation.
- Monitoring is done by making periodic observations and tests by looking at for the successful performance and the side effects.
- The tests of the product's efficiency, safety, cost-effectiveness, environmental impact and its value that depends upon the utility to the society should also be monitored.
- It also extends to the stage of client use.

Learning from the past

- Engineers should learn not only from their own earlier design and operating results, but also from other engineers.
- Engineers repeat the past mistakes of others due to the following reasons.
  - Lack of established channels of communication.
  - Misplaced pride in not asking for information
  - Embarrassment at failure or fear of Law. (legal problems).
  - Negligence.

Learning from the past

- The following are some of the examples:
- The tragedy of ‘Titanic’ happened on April 15,1912.
- It was the largest ship the world had seen.
- It was also the most glamorous ships, first fully safe ship.
- Because of the insufficient number of life boats resulting in the death of 1522 out of 2227 (life boat capacity available was only 825).
- The same disaster took place in the steamship “the Arctic” some years before, because of the same problem.

Learning from the past

- In June 1966, a section of the Milford Haven Bridge in Wales collapsed during construction due to improper matching of horizontal impact forces in mind.
- A bridge of similar design, constructed by the same bridge- builder in Melbourne, Australia, also partially collapsed in the month of October, same year.
- During this incident 33 people were killed and many were injured.

A BALANCED OUTLOOK ON LAW [Role of Law in Engineering Ethics]

Role of Law In Engineering

- A balanced outlook on laws stresses the necessity of laws and regulations and their limitations in directing engineering practice.
- Laws are necessary because
- people are not fully responsible by themselves
- of the competitive nature of the free enterprise, which does not encourage moral initiatives
- they are needed to provide a minimum level of compliance.

Role of Law In Engineering

- **Code for Builders by Hammurabi:**
- Hummurabi the king of Babylon in 1758 framed a code for the builders.
- **The United States Steamboat Code: [1852 A.D]**
- In the early 19th century, a law was passed in USA to provide for inspection of the safety of boilers and engines in ships. It was amended many times and now the standards formulated by the American Society of Mechanical Engineers are followed.

Role of Law In Engineering

- Rules serve as powerful support and defense for those who wish to act ethically.
- Good laws, effectively enforced, clearly produce benefits.
- In areas of experimentation, rules must not attempt to cover all possible outcomes of an experiment, nor must they force the engineer to adopt a rigidly specified course of action.
- The regulations should be broad based guidelines but should hold the engineer accountable for his or her decisions.

The Problems of Law In Engineering

- The greatest problem of law in engineering is of ‘minimal compliance(Fulfillment)’.
- Engineers and employers can search for loop holes in the law.
- Engineers will tend to refer to standard readymade specifications rather than come up with innovative ideas.
- Minimal compliance led to the tragedy of the ‘Titanic’.

The Problems of Law In Engineering

- Continually updating laws and regulations may be counter-productive and will make law always lag behind technology.
- Highly powerful organizations, like the government can violate the laws when they think they can get away with it.
- Better solution could be to empower rulemaking and inspection agencies.
- The Food and Drug Administration (FDA), Federal Aviation Agency (FAA), and the Environmental Protection Agency (EPA) are examples of these in the United States.

Case studies for Engineering as Social Experimentation

Computer Testing

- “On a recent co-op job my company had just shipped its latest and greatest computer product. After a few months in the field it was found to vastly lack the processor power it needed to do what it claimed to do. The fix that followed had to have the shortest turn around time I had ever seen. The fix was top quality, but the damage had been done. A full scale test, or even simulation, would have predicted this problem before shipping.”
- What should the co-op do? Trust specifications of other’s subcomponents?

Meeting Specification

- “At my co-op position I was placed in a design team to create an audio system. The project was a classic example of marketing wanting the product so bad that time lines were regarded higher than the quality of the product. The audio system's first prototypes arrived with many problems, some of which could not be resolved until after the product was released. It basically came down to the decision of letting the consumers find all the problems, and then hoping that the management would provide the team with more time and funding to fix the problems, to try to keep the customers happy.”
- What to do?

Class Task
“Environment”

- “In wastewater treatment plants, control systems are tested in the field. The control systems are designed according to specifications and ISA/IEEE rules, but the testing of how the systems will operate under real life situations is done after installing them. Two questions arise:
- First, can the plant design withstand additional rain, population increases, weather problems, etc.?
- Second, can the control system adequately analyze these new factors and operate the plant successfully? If anything fails, the great danger is the release of raw sewage/sludge and bacteria onto land and into the water supply.”
- What can the engineer do? Will competence solve the problem?

References

- Mike Martin and Ronald Schinzinger, “Introduction To Engineering Ethics”, McGraw Hill, New York, 2010
- Miscellaneous Journals and Internet Resources.