UNIT 5

ENGINEERS AS MANAGERS, CONSULTANTS, AND LEADERS

ENGINEERS AS MANAGERS

- Engineers undergo the most intensive technical training of any professionals.
- Why does this transition occur?
- One hand, many companies prefer engineers as managers because their technical understanding is essential to managing technological corporations, and it is easier to teach engineers the business side of corporate work than to teach non-engineers engineering.

- **On the other hand, engineers find management inviting because of an array of corporative incentives.**
- **These incentives include higher salaries, greater authority and widened area of responsibility, and increased prestige and recognition.**

Managers as Professionals

- Making the transition from primary technical work to management involves many adjustments.
- It requires expanded knowledge about finances and scheduling, strengthened skills in coordinating and motivating other people, and the ability to make risk-taking decisions involving a wider range of factors than purely technical considerations.

- **What about ethics?**
- **Engineers have ethical responsibilities outlined in their professional code of ethics, but can managers be professionals in a comparable sense.**
- **The primary ethical responsibility of managers is to produce a valuable product (or service) while maintaining respect for persons, including customers, employees, and the general public.**

- **The moral roles of engineers and managers are complementary and symbiotic, rather than opposed.**
- **As managers, engineers remain professionals whose primary moral responsibility is to provide safe and useful products that are profitable.**
- **Two responsibilities of engineer-managers: promoting an ethical climate and resolving conflicts.**

Promoting an Ethical Climate

- **An ethical climate is a working environment conducive to morally responsible conduct.**
- **Within corporations, it is produced by a combination of formal organization and policies, informal traditions and practices, and personal attitudes and commitments.**
- **Engineers make a vital contribution to such a climate, but managers have even greater responsibility.**

- The ethical climates of organizations differ greatly.
- At one extreme are corporations that are largely indifferent to ethics.
- At another extreme are companies that place a high priority on concern for worthwhile products and ethical procedures.

- **Texas Instruments (TI) is one of the examples of a large corporation that developed a successful ethics program during the 1980s.**
- **How did the company appear to its clients and the government?**
- **What are the defining features of an ethical corporate climate?**

- **First, ethical values in their full complexity are widely acknowledged and appreciated by managers and employees alike.**
- **Second, the sincere use of ethical language is recognized as a legitimate part of corporate dialogue.**
- **Third, top management must set a moral tone, both in words, in policies, and by personal example.**
- **Fourth, Equality important is educating managers on conflict resolution.**

Managing Conflict

- **Managers have the authority and the responsibility to resolve or prevent damaging conflicts that threaten corporate efficiency.**
- **Their ultimate weapon is force: I am in charge see it my way or I will fire you.**
- **One study ranked the seven most common conflicts confronted by engineering project managers, in order of priority of overall intensity as follows:**

- **(1) Conflicts over schedules**
- **(2) Conflicts over projects and departments**
- **(3) Conflicts over personnel**
- **(4) Conflicts over technical issues**
- **(5) Conflicts over administrative procedures**
- **(6) Personality conflicts**
- **(7) Conflicts over costs**

The following four widely applicable principles for conflict resolution:

- **People: Separate the people from the problem**
- **Interests: Focus on interests, not positions**
- **Options: Generate a variety of possibilities before deciding what to do.**
- **Criteria: Insist that the result be based on some objective standard**

CONSULTING ENGINEERS

- Consulting engineers work in private practice.
- They are compensated by fees for the services they render, not by salaries received from employers.
- Here we will raise questions in four areas advertising, competitive bidding, contingency fees, and provisions for resolution for disputes.
- How in safety matters consulting engineers may have greater responsibility than salaried engineers?

Advertising

- Consulting engineers are directly responsible for advertising their services.
- Prior to a 1976 Supreme Court decision, competitive advertising in engineering was considered a moral issue and was banned by professional codes of ethics.
- Deceptive advertising normally occurs when products or services are made to look better than they actually are.

This can be done in many ways, including:

- **(1) by outright lies**
- **(2) by half truths**
- **(3) through exaggeration**
- **(4) by making false innuendos, suggestions, or implications**
- **(5) through obfuscation created by ambiguity vagueness or incoherence**
- **(6) through subliminal manipulation of the unconscious.**
- **Another way is to impress with performance data that is meaningless because it has no reference standards.**

Competitive Bidding

- **The job of the consulting engineer is generally to develop creative designs for solving novel problems.**
- **Often there is no way to make precise bids.**
- **In 1978 the Supreme Court ruled that professional societies were unfairly restraining free trade by banning competitive bidding.**
- **Though, the ruling still left several loopholes.**

Contingency Fees

- Consulting engineers essentially make their own arrangement about payment for their work.
- Naturally this calls for exercising a sense of honesty and fairness.
- But what is involved specifically?
- A contingency fee or commission is dependent on some special condition beyond the normal performance of satisfactory work.

Safety and Client Needs

- The greater amount of job freedom enjoyed by consulting engineers as opposed to salaried engineers leads to wider areas of responsible decision making concerning safety.
- Job safety is the primary responsibility of the contractor who has direct control over the construction.

- But how far do the consultants responsibilities extend?
- Is a letter to the construction supervisor sufficient?
- Or is the consultant morally required to follow through by checking to see that the problem is corrected?

Provision for Resolution of Disputes

- **Large and complex engineering projects involve many participants at different levels of responsibility within the organizations representing the owner, the consulting engineer, and the construction firm.**
- **Overlapping responsibilities, fragmented control, indecision delays and an inability to resolve disputes quickly and amicable characterize many projects.**

- Engineering practice today does not regularly provide for clear cut arbitration or conflict resolution.
- This responsibility arises from the engineers close contacts with both the owner and the eventual constructor of a project and from the social experimentation nature of engineering.

ENGINEERS AS EXPERT WITNESS AND ADVISERS

- **Engineers sometimes serve as consultants who provide expert testimony in adversarial or potentially adversarial contexts.**
- **The focus may be on the past, as in explaining the causes of accidents, malfunctions, and other events involving technology.**

- **Or the focus may be on the future, as in public planning, policy making that involves technology, and the potential value of patents.**
- **Usually engineers are hired by one adversary in the dispute, and that raises special ethical concerns about their proper roles.**

Expert Witness in the Courts

- **Their primary responsibility is to be objective in discovering the truth and communicating it honesty.**
- **Why is this responsibility?**
- **The appropriate role of expert witness is not determined in the abstract, but instead depends on the shared understanding created within society.**

- In particular, the role must be understood in terms of the aims of a legal system, consistent with professional standards.
- What is the aim of our legal systems?
- We like to think of the aim as discovering the truth about events that disputing parties perceive differently.

- What role, then, do the courts give to expert witnesses?
- Ideally, expert witnesses would be paid by the courts, rather than opposing attorneys, in order to counter potential biases.
- In practice, the high costs require that the parties to disputes pay for consultants.

- The legal system distinguishes between eye witnesses and expert witnesses.
- Eye witnesses testify in matters of perceived facts, whereas expert witnesses are permitted wider latitude in testifying on facts in their areas of expertise.
- The role of expert witnesses is to identify the truth about the causes of accidents, not to directly serve attorneys clients.

Abuses

- A small minority of engineers do become hired guns, who violate the standards of honesty and due care in conducting investigations.
- The most common abuses involve more subtle biases resulting from money, ego and sympathy.
- Financial Biases
- Ego Biases
- Sympathy Biases

Advisers in Planning and Policy-making

- Technology is always involved in decisions about public policy making (forming general strategies of society) and public planning (forming projects that affect communities).

- **In policy making, public officials and the general public need objective studies about the costs and benefits of alternative systems of transportation, housing, energy use, land use and national defense.**
- **In planning, they need expert advice about the feasibility, risks and benefits of particular technological projects that affect local communities.**
- **For that reason, numerous laws and government policies have been adopted that require objective studies before public funds are committed to projects.**

Normative Models of Advisers

- Engineers who serve as planning advisers and policy analysts have responsibilities both to their clients and to the general public.
- These responsibilities as always, can conflict.
- We can distinguish three normative (value laden) models for how to balance these responsibilities.

- Hired guns
- This model makes the obligation to clients paramount, if not exclusive.
- Studies conform to client's wishes, whatever they may be.
- Facts favorable to the client are dramatically highlighted and unfavorable facts downplayed.
- The responsibilities to the public are regarded as the minimal ones of avoiding lies, fraud, and direct harm.

- **Value Neutral Analysts**
- **This model insists that engineers should be completely impartial.**
- **Not only should they conscientiously avoid any taint of bias and favoritism, but they should avoid any form of advocacy.**
- **Their role is to identify all options and analyze the factual implication of each option.**

- **Value Guided Advocates**
- **According to this model, engineering consultants may adopt partisan views in controversial issues, but they remain honest and independent in their professional judgment.**
- ***Loyalty* is serving the interest of clients.**

MORAL LEADERSHIP

- **As managers, business entrepreneurs, corporate consultants, academics, and government officials, engineers provide many forms of leadership.**

Morally Creative Leaders

- **Leadership is an achievement word: It indicates success in moving a group towards goals.**

- **When a leader’s goals are not only permissible but also morally valuable.**
- **More leaders are individuals who direct, motivate, organize, creatively manage, or in other ways move groups toward morally valuable goals.**
- **Leaders may be in positions of authority within a corporation, or they may not be.**
- **Leadership can be shown by individuals participating at all levels of organizations.**

- Leadership should not be confused with headship that is, with being the head of a group.
- Moral leaders are *morally creative.*
- Moral creativity consists in identifying the most important values that apply in a particular situation, bringing them into focus through effective communication within groups, and forming workable commitments to implementing them.

Participation in Professional Societies

- Professional societies do more than promote continuing education for their members.
- They also serve to unify a profession, and to speak and act on behalf of it.
- Professional societies provide a forum for communicating, organizing, and mobilizing change within and by large groups.
- That change has a moral dimension.

Leadership in Communities

- Do engineers have special responsibilities as citizens that go beyond those of non engineers?
- For example, should they provide greater leadership than others in social debates about industrial pollution, automobile safety, and disposal of nuclear waste?

- **For example, there is the matter of advertising:**
- **While an engineer who is employed by a company will bring recognition and honor to the company through volunteer activities, any such efforts on the part of a self employed engineer could be interpreted as self serving attempts to gain publicity and perhaps even to secure valuable inside information.**

Ideals of Voluntary Service

- **Engineers might best help the needy though group efforts.**

CONCLUDING REMARKS, INTEGRITY AND INGENUITY

- Engineers cannot escape the political, economic, and social milieu of the society in which they work.
- It is obvious that a complex engineering system requires time to be properly designed and executed.
- The engineering process that leads from the conception of a product to its final use.

- **An engineering project displays “integrity” when its various activities are carried out in the interrelated, integrated fashion.**
- **Finally integrated appears as the chief attribute in our definition of character-the character of the engineer.**

- **Beyond keeping open the lines of communication, engineers must have an inkling of what might go wrong, helped by the imagination that is implied in the roots the word engineering viz., ingenuity.**
- **Generally a philosophically based ethics strategy is more effective for the “experimentally” based, open-ended functions.**

Citicorp Skyscraper

- Architect Hugh Stubbins and structural engineer Bill LeMessurier faced a big design problem when they worked on the plans for the Citicorp Center, New York's fifth highest skyscraper.

UNIT IV

RIGHTS OF ENGINEERS GLOBAL ISSUES

- **ISSUES / PROFESSIONAL RIGHTS**
- **WHISTLE – BLOWING**
- **THE BART CASE**
- **EMPLOYEE RIGHTS**
- **DISCRIMINATION**
- **MULTINATIONAL CORPORATIONS**
- **ENVIRONMENTAL ETHICS**
- **COMPUTER ETHICS**
- **WEAPONS DEVELOPMENT**

ISSUES / PROFESSIONAL RIGHTS

- Basic Right of Professional Conscience
- Institutional Recognition of Rights
- Specific Rights: Recognition and Conscientious Refusal
- Foundation of Professional Rights

ISSUES

- **Do Engineers have a moral right to refuse to carry out what they consider to be unethical activity?**
- **How far are employers obligated to respect this right?**
- **And do the answers to these questions depend in part on whether one works for private corporations or, for the government?**

PROFESSIONAL RIGHTS

- Engineers have several types of moral rights: categories of human, employee, contractual, and professional rights.
- Engineers have special rights, including institutional rights that arise from specific agreements in the employment contract.
- Engineers have special rights that arise from their professional role and the obligations it involves.

Basic Right of Professional Conscience

- There is one basic and generic professional right of engineers: the moral right to exercise responsible professional judgment in pursuing professional responsibilities.
- Pursuing those responsibilities involves exercising both technical judgment and reasoned moral convictions.
- For brevity, this basic right can be referred to as the right of professional conscience.

Institutional Recognition of Rights

- Having a moral right is one thing.
- Having it respected by others and given recognition within a corporation is quite another.
- When engineers appeal to the basic right of professional conscience they may be arguing for its institutional recognition by employers.

- **Specific Rights: Recognition and Conscientious Refusal**
- **Engineers have a general right / obligation to protect the safety and well being of the public.**
- **Both the importance and difficulty of applying professional rights in specific circumstance can be illustrated by the right of conscientious refusal and the right to professional recognition.**

Foundation of Professional Rights

- There are two general ways:
- One is to proceed piecemeal by reiterating the justifications given for the specific professional duties.
- The second way is to justify the right of professional conscience, which involves grounding it more directly in the ethical theories.

WHISTLE – BLOWING

- Definition
- Three Cases
- Moral Guidelines
- Protecting Whistle – Blowers
- Commonsense Procedures
- The right to Whistle – Blow
- Beyond Whistle – Blowing

WHISTLE – BLOWING

- **When is whistle-blowing morally permissible?**
- **Is it ever morally obligatory?**
- **To what extent do engineers have a right to whistle-blow?**
- **When is whistle-blowing an act of disloyalty to an organization?**
- **What procedures ought to be followed in blowing the whistle?**

Definition

- In a wide sense, whistle-blowing is alerting relevant persons to come moral or legal corruption.
- In a narrower sense, whistle-blowing is making public accusations about misconduct by one's organization.
- There are four main features of whistle-blowing: (1) Act of Disclosure (2) Topic (3) Agent (4) Recipient

Types

- External whistle-blowing
- Internal whistle-blowing
- Open whistle-blowing
- Anonymous whistle-blowing

Three Cases

- Ernest Fitzgerald and the C-5A
- Carl Houston and Welding in Nuclear Plants
- George B. Geary and U.S. Steel

Moral Guidelines

- **When are engineers morally permitted, and when are they morally obligated, to do so?**
- **Richard T. De George suggested that it is morally permissible for engineers to engage in external whistle-blowing concerning safety when three conditions are met:**

- If the harm that will be done by the product to the public is serious and considerable
- If they make their concerns known to their superiors and
- If getting no satisfaction from their immediate superiors

Protecting Whistle – Blowers

- **What happens to whistle-blowers?**
- **Most whistle-blowers have suffered unhappy and often tragic fates.**
- **Government employees have own important protections.**
- **Various federal laws related to environmental protection and safety and the Civil Service Reform Act of 1978 protect them.**

Commonsense Procedures

- Except for emergencies, always try working first through normal organizational channels.
- Keep supervisors informed of your actions.
- Be accurate in your observations and keep formal records documenting relevant events.
- Consult colleagues for advice-avoid isolation.
- Before going outside the organization, consult the ethics committee of your professional society.
- Consult a lawyer concerning potential legal liabilities.

The right to Whistle – Blow

- Whistle-blowers who proceed responsibly and take special care to document their views are fulfilling their obligations to protect and serve the public.
- To this extent they have a professional moral right to whistle-blow.

Beyond Whistle – Blowing

- Whistle-blowing is a moral necessity.
- But generally it holds little promise as best possible method for remedying problems.
- The obvious way to remove the need for internal whistle-blowing is to allow greater freedom and openness of communication within the organization.

THE BART CASE

- Background
- Responsibility and Experimentation
- Controversy
- Aftermath
- Comments

- The Bay Area Rapid Transit system (BART) is a suburban rail system that links San Francisco with the cities across its bay.
- It was constructed during the late 1960s and early 1970s, and its construction led to a now classic case of whistle-blowing.
- The case is important because it remains controversial, because it involved a precedent-setting intervention by an engineering professional society.

Background

- BART is a recent example of that trend.
- The BART system was built with tax funds, and its construction was characterized by tremendous cost overruns and numerous delays.

Responsibility and Experimentation

- Engineering project was an interesting experiment.
- The three engineers were felt that too much of experimentation was going on without safeguards.
- Safety features were given insufficient attention and quality control was poor, they thought.

Controversy

- **The controversial events that followed as the engineers sought to pursue their concerns are described and interpreted from the opposing view points of the engineers and management.**

Aftermath

- At Helix's request the engineers later agreed to reveal themselves by going before the full board of directors in order to seek a remedy for the safety problems.

Comments

- The study questions below ask about the extent to which the three engineers and BART's management acted responsibility.
- Here the author wish to comment on two attitudes held by the topic on responsibility and deserving mention because of the frequency with which similar arguments are heard.

EMPLOYEE RIGHTS

- Employee Bill of Rights
- Choice of Outside Activities
- Privacy
- Drug Testing
- Due process

EMPLOYEE RIGHTS

- Employee rights are any rights, moral or legal, that involves the status of being an employee.
- They include some professional rights that apply to the employer-employee relationship: for example, the right to disobey unethical directives and to express dissent about company policies without employer retaliation.

Employee Bill of Rights

- In freedom inside the organization, refers to employee rights.
- The bill of rights in the constitution was written to apply to government, not to business.

Choice of Outside Activities

- **All employees have the right to pursue non-work activities of their own choice without coercion or retribution from employers.**

Privacy

- **Employees are required to answer questions about their criminal records while taking a polygraph test.**
- **Job applicants at the sales division of an electronics firm are required to take personality tests that include personal questions about alcohol use and sexual conduct.**

- A supervisor unlocks and searches the desk of an engineer who is away on vacation without the permission of that engineer.
- A sociologist has been hired as a consultant to a large construction firm which has been having personnel conflicts in one division.
- A large manufacturer of expensive pocket computers has suffered substantial losses from employee theft.
- A rubber products firm has successfully resisted various attempts by a union to organize its workers.

Drug Testing

- Drugs and drug abuse pervade our society, wreaking enormous damage that carries over into the workplace.
- Tests for drug use are invasive in that they require taking blood or urine samples under close observation.

Due process

- **The right to due process extends to fair procedures in firing, demotion, and disciplinary actions.**
- **Implementing the right to due process involves two general procedures:**
- **First, written explanations are owed to employees who are discharged, demoted, transferred to less enriching work.**
- **Second, an appeals procedure should be established that is available to all employees who believe their rights have been violated.**

DISCRIMINATION

- **Examples**
- **Definitions**
- **Antidiscrimination Laws**
- **Moral Justification of Nondiscrimination Laws**
- **Preferential Treatment**
- **Sexual Harassment**

DISCRIMINATION

- Discrimination is especially pernicious within the work environment.
- When there are conflicts, engineers must carefully examine the ethical bases of their and their colleagues' actions.

Examples

- Promotions of Chemical plant manager
- Scale of pay for Women engineers
- A farm equipment manufacturer

Definitions

- It means preference on the ground of sex, race, skin colour, age, and or religious out look etc. whether or not such preference is viewed as justified.
- It means morally unjustified treatment of people on arbitrary or irrelevant grounds.

Antidiscrimination Laws

- The principle of equality
- The Equal Employment Opportunity Act of 1972 amended and strengthened the Civil Rights Act by giving greater powers of enforcement to the Equal Employment Opportunity Commission.
- Age discrimination was prohibited by the Age Discrimination in Employment Act of 1967, amended in 1974.

Moral Justification of Nondiscrimination Laws

- Are they morally justified? Should the government be allowed to use law to force private corporations to treat people equally?
- The liberation position answers no to these questions.
- According to this view, all fair-employment legislation is unjust.

Preferential Treatment

- Hiring a woman or a member of a minority over an equally qualified white male is only one form of preferential treatment.
- The weak form / strong form
- Both form raise questions about what moral equality requires, but of course the strong version is more controversial.

Sexual Harassment

- Sexual harassment is a invidious form of a sex discrimination, involving as it does not only the abuse of gender roles and work-related power relationships – and authority relationship in universities – but the abuse of sexual intimacy itself.

MULTINATIONAL CORPORATIONS

- Three Senses of ‘Relative’ Values
- ‘When in Rome’
- International Rights
- Promoting Morally Just Measures
- Technology Transfer and Appropriate Technology
- Bhopal

Three Senses of ‘Relative’ Values

- **Ethical Relativism:** Actions are morally right within a particular society when they are approved by law, custom, or other conventions of that society.
- **Descriptive Relativism:** Value beliefs and attitudes differ from culture to culture.
- **Moral Relativism:** Moral judgment should be made in relation to factors that may vary from case to case.

‘When in Rome’

- Which standards should guide engineers’ conduct when working in foreign countries?
- Ethical relativism supports the maximum,
- ‘When in Rome do as the Romans do.”

International Rights

- The right to freedom of physical movement
- The right to ownership of property
- The right to freedom from torture
- The right to nondiscriminatory treatment
- The right to physical security
- The right to freedom of speech and association
- The right to monomial education
- The right to political participation

Promoting Morally Just Measures

- The overall impact of the business dealings must tend to promote morally just institutions in the society, not increase unjust institutions.
- At the same time, corporations should respect the laws and culture of the host country providing they do not violate basic moral rights.

Technology Transfer and Appropriate Technology

- Technology Transfer is the process of moving technology to a novel setting and implementing it there.
- A novel setting is any situation containing at least one new variable relevant to the success or failure of a given technology.
- It in a generic sense it refers to **identification, transfer, and implementation** of the most suitable technology for a new set of conditions.

Bhopal

- It is clear that greater sensitivity to social factors was needed in transferring chemical technology to India.

ENVIRONMENTAL ETHICS

- Case Studies
- The Commons and a Livable Environment
- Guilty until Proven Innocent?
- Internalizing Costs of Environmental Degradation
- Technology Assessment
- Philosophical View of Nature

Case Studies

- Acid Rain
- PCBs and Kanemi's Rice Oil
- Asbestos in the Air; Asbestos in drinking water
- Land Subsidence
- Too little water for the everglades

The Commons and a Livable Environment

- In this century, increasing population and decreasing natural resources have prompted similar thinking about our relationship with nature.
- The same kind of competitive, but unthinking exploitation arises with all natural resources held in common: air, land, forests, lakes, and oceans.
- Democratic controls can take many forms include: passing laws, internalizing costs, and relying on technology assessment in approving projects.

Guilty until Proven Innocent?

- Ethical import questions: who is affecting whom – and where, when and how?
- Engineers have more confidence in their projects and will therefore chafe at such an interpretation.
- Accordingly, they must adopt a viewpoint of engineering as experimentation.

Internalizing Costs of Environmental Degradation

- The engineer must with the economist, the natural and physical scientists, the lawyer, and the politician in an effort to find acceptable mechanisms for pricing and releasing products so that the environment is protected through truly self-correcting procedures.

Technology Assessment

- Technology assessment prepared studies on the social and environmental effects of technology in areas such as cashless trading (via bank card), nuclear war, health care, or pollution.

Philosophical View of Nature

- Since the 1970s, and especially since 1979 when the new journal Environmental ethics was founded, philosophers have explored a wide range of moral perspectives concerning the environment.
- Is it human-centered or nature-centered?
- But philosophers viewed that the world's great religions nature.

COMPUTER ETHICS

- **Power Relationships**
- **Property**
- **Privacy**
- **Professional Issues**

Power Relationships

- Some of the issues in computer ethics concern shifts in power relationships resulting from the new capacities of computers. Below to list a few examples:
- Job elimination, Customer relations, Biased software, Stock trading, Unrealistic experimentation, Political power, Military weapons.

Property

- The most troublesome issues about property and computers fall under two headings.
- The first is the use of computers in embezzlement and other forms of stealing money of financial assets.
- The second set of issues concerns the theft of software and information.
- Here the issues are more complex.

Privacy

- Storage, retrieval, and transmission of information using computers as data processors have revolutionized communication.
- By making more data available to more people with more ease, computers make privacy more difficult to protect.
- Yet this very benefit poses moral threats to the right to privacy.

- **Inappropriate access**
- **Data bank errors**
- **Hackers**
- **Legal responses**

Professional Issues

- **Many of the issues in engineering ethics arise within the context of computer work.**
- **New variations or new difficulties may be involved, often owing to the high degree of job complexity and required technical proficiency introduced by computers.**

- Some of the examples are below:
- Computer failures
- Computer implementation
- Health conditions

WEAPONS DEVELOPMENT

- The Weapons Seesaw
- The Engineers Involvement in Weapons Work
- Defense Industry Problems
- Decommissioning Weapons and Lasting Effects

The Weapons Seesaw

- **The trade in arms and military know-how has a king tradition.**
- **There was an example from II world war, that is the up and down in weapons development.**
- **The world most successful arms are merchants and manufacturers in the weapons seesaw.**

The Engineers Involvement in Weapons Work

- How do the men and women who design weapons, manufacture them, and use them fee about their work?
- Some of the examples are: Bob's employer manufacturers antipersonnel bombs
- Mary a chemical engineer was producing most brutal and destructive weapon

- **Ron is a specialist in missile control and guidance**
- **Marco's foremost love in physical electronics producing death rays**
- **Joanne is an electronics engineer assigned in fighter planes sold in abroad**
- **All over the world talented people engage in weapons work.**

Defense Industry Problems

- Across the globe that confer special privileges on their defense industries without giving sufficient thought to the problems that can accompany large military buildups.
- Unethical business practices occur as in all massive projects, but the urgency of completing a weapons system
- The second problem involves "technology creep" – the development of new weapons.

Decommissioning Weapons and Lasting Effects

- Engineers and scientists dealing with materials dangerous enough to be considered useful as weapons must consider not only their direct use but also their accidental diversion and ultimate safe disposal.
- After all, structural engineers are not free to build huge structures without considering how to safety dismantle them eventually.

UNIT – III

RESPONSIBILITIES TO EMPLOYERS

RESPONSIBILITIES TO EMPLOYERS

- Collegiality and Loyalty
- Respect for Authority
- Collective Bargaining
- Confidentiality
- Conflicts of Interest
- Occupational Crime

COLLEGIALITY AND LOYALTY

- Collegiality and Loyalty are essential aspects of team work in engineering.
- Collegiality is an important virtue, when there is competition among engineers from different companies.
- The central elements of collegiality are respect, commitment, connectedness, and cooperation.

Collegiality

- Collegiality is an amorphous concept and refers to an environment characterized by professionalism, a general sense of well-being, and spirit of cooperation.

Techniques for achieving collegiality:

- Development recognition and articulation of shared values
- Establishing / restoring a sense of professionalism
- Vision
- Defining expectations
- Paying attention to structure
- Paying attention to gender and diversity issues

- Score-keeping
- Compensation
- Trust
- Practice and Leadership
- Selection process
- Helpfulness
- Balance of power
- Partner evaluations
- Problem partners
- Business development

Two Senses of Loyalty

- Loyalty to an employer can mean two things:
- **Agency-Loyalty** is acting to fulfill one's contractual duties to an employer.
- Agency-Loyalty is entirely a matter of actions, whatever its motives.
- **Identification-Loyalty,** by contrast has as much to do with attitudes, emotions, and a sense of personal identity as it does with actions.

Obligations of Loyalty

- **There are two obligations:**
- **First, employees must see some of their own important goals as met by and through a group in which they participate.**
- **Second, employees must be treated fairly, each receiving (roughly) his or her share of benefits and burdens.**

Misguided Loyalty

- Both loyalty can be shown toward corporations or toward smaller divisions within corporations.
- Conversely, an engineer might identify with the corporation but not with a particular team to which he is assigned.
- Sometimes, inappropriate or misguided loyalty to a project team or supervisor can harm corporations, as well as the general public.

Professionalism and Loyalty

- There are three points about the relationship between professional responsibility and loyalty to companies and employers.
- First, acting on professional commitments to the public can be a more effective way to serve a company than a mere willingness to follow company orders.

- **Second,** **it is clear that loyalty to companies or their current owners should not be equated with merely obeying one's immediate supervisor.**
- **Third,** **suggested how an engineer might have professional obligations to both an employer and to the public.**

RESPECT FOR AUTHORITY

- Salaried engineers have obligations to respect their employers' legitimate authority.
- What is the nature of this authority?
- How far should it be recognized by salaried professionals as being morally justified?

Institutional Authority

- Institutional authority is acquired, exercised, and defined within institution.
- It may be defined as the institutional right given to a person to exercise power based on the resource of the institution.
- It is given to individuals in order to meet their institutional duties, that is, their assigned tasks within an organization.

- **Institutional rights and duties are for the most part two sides of the same coin, and they deal with precisely the same activities and functions.**
- **Project engineers have the institutional duty to ensure that the projects they supervise are successfully completed, and they are given the institutional rights.**

Institutional vs. Expert authority:

- Institutional authority should not be equated with expert authority.
- Expert authority is the possession of special knowledge, skill, or competence to perform some task or to give sound advice.
- In this sense, doctors are authorities on health and civil engineers are authorities on structures or transportation.

- One of the key competencies for management is leadership ability, which has its own kind of expert authority that has been called the "authority of Leadership": the expertise to effectively direct others.
- It is possible for engineers to have expert authority in matters in which they have little or no institutional authority to make decisions.

Authority vs. Power:

- Institutional authority must be distinguished from power.
- People who are especially effective may acquire great power or influence.
- Highly respected engineers of proven integrity may have power within an organization exceeding their explicit institutional rights.

Morally Justified Authority

- The preceding distinctions clear the way for making two observations:
- First, an employer may have the institutional authority to direct engineers to do something that is not morally justified.
- Second, engineers may have an institutional duty to obey a directive that is morally unjustified, but their moral duty, is not to obey.

Accepting Authority

- **Our present concern is to obtain a clear idea of what accepting authority under normal conditions should and should not involve.**
- **Administrative behaviour, Simon states "A subordinate is said to accept authority whenever he permits his behaviour to be guided by the decision of a superior, without independently examining the merits of that decision".**

Paramount Obligations

- Recent codes of ethics state that an engineer's paramount obligation is to protect the public health, safety, and welfare, rather than the obligations of loyalty and faithful service to employers.
- Is this true? In my view is yes. As long as "paramount" is understood to mean "chief in importance or deserving primary emphasis".

- The basic moral task of salaried engineers is to be aware of their obligations to obey employers on the one hand and to protect and serve the public and clients on the other hand.
- Most of the time there is no conflict between the two.
- But when, occasionally, genuine conflict arises, it must be resolved by the exercise of an autonomous moral judgment.

COLLECTIVE BARGAINING

- Is it possible for engineers to be professionals, dedicated to the highest ethical standards of professional conduct, and loyal to their companies while simultaneously being members and supporters of a union?

- **In Engineers and their Professions, John Kemper writes: Professionalism holds that the interests of society and of the client are paramount.**
- **Unions are collective bargaining agents that sometimes place the economic interests of the members ahead of those of the client or employer.**

Historical Note

- Most contemporary engineering unions had their origin during the 1940s.
- These groups remained independent of the large national unions like the AFL – American Federation of Labor, and the CIO – Congress of Industrial Organization.

- At their peak during the late 1950s, engineering unions had only 10% of the total number of engineers as members.
- As of 1985 about 25,000 engineers, scientists, and technicians belonged to unions.

- **Decline due to:** Job insecurity, unhappiness with salaries and lessened professional recognition
- **Let us now turn to the two arguments in support of this stand as advanced by the NSPE:** The first we will call the **"faithful agent argument"** and the second the **"public service argument"**.

Faithful Agent Argument

- **The argument given was concise, "the engineers have a higher standard than self-interest: they have the necessary ethical duty to act for their employer as a faithful agent or trustee."**
- **Under discussion involves several features, any one of which might seem inconsistent with loyalty to employers:**

- **(1) it goes against the desires or interests of the employer**
- **(2) it uses coercion or force against the employer, and**
- **(3) it involves collective and organized opposition.**
- **Some incidents suggest two generalizations.**

- First, employee duty to employers does not entail unlimited sacrifice of economic self-interest.
- Second, as the NSPE code itself states, the duty to employers is limited by the more paramount duty to protect public health, safety, and welfare.

- **The NSPE recommends the use of a sounding board, composed of a mix of employees and managerial engineers, to settle disputes with employers through reasonable dialogue.**

Public Service Argument

- By definition union seek to promote the special interest of their members, not the interest of the general public.
- Strikes are the ultimate source of power for unions.
- Professional societies can be seen as vehicles to establish principles of fair employment.

Union Critics:

- They are the main source of inflation, which can devastate the economy of a country.
- Unions encourage adversarial, rather than cooperative, decision making.
- Unions promote mediocrity and discourage initiative by emphasizing job security and by making job promotion and retention rest on seniority.
- Unions encourage unrest and strained relations between workers and management.

Union Supporters:

- Unions have been the primary factor in creating healthy salaries and the high standard of living enjoyed by today's workers.
- Unions give employees a greater sense of participation in company decision making.
- Unions are a healthy balance to the power of employers to fire at will.
- Unions yield stability by providing an effective grievance procedure for employee complaints.

CONFIDENTIALITY

- **Keeping confidences is one of the most central and widely acknowledged duties of any professional.**
- **What is meant by the term "confidential information" and how can we identify what data should be kept confidential?**

- **Confidential information is information deemed desirable to keep secret.**
- **“Keep secret” is a relational expression.**
- **It always makes sense to ask,” Secret with respect to whom?”**
- **Engineers and other employees are usually expected to withhold information labeled “confidential” from unauthorized people both inside and outside the organization.**

- What are the criteria for identifying what information is “labeled” confidential at the workplace?
- One criterion is suggested in the code of ethics of the ABET:
- “Engineers shall treat information coming to them in the course of their assignments as confidential”.

- **Related Terms:** Privileged information is an expression often used as a synonym for “confidential information.”
- Proprietary information is information that a company owns or is the proprietor of.
- A rough synonym for “proprietary information” is “trade secrets.”
- Patents differ from trade secrets.

Justification and Limits

- **What moral basis does the confidentiality obligation rest, with its wide scope and obvious importance?**
- **Why are employers allowed to determine what information is to be treated as confidential?**
- **And what are the moral limits or restrictions on the confidentiality obligations of employees?**

The obligation of confidentiality can be justified at two levels.

- **The first level is to appeal to three ordinary moral considerations: respect for autonomy, respect for promises, and regard for public well-being.**
- **The second level of justification of the confidentiality obligation is to appeal directly to the major ethical theories: Rights ethicists, duty ethicists, and rule-utilitarianism**

Changing Jobs

- The obligation to protect confidential information does not cease when employees change jobs.
- Many engineers value professional advancement more than long-term ties with any one company and so change jobs frequently.
- Engineers in research and development are especially likely to have high rates of turnover.

Management Policies

- **What might be done to recognize the legitimate personal interests and rights of engineers and other employees while also recognizing the rights of the employers in this area?**
- **And how can obligations to maintain confidences of former employers are properly balanced against obligations to faithfully serve the interests of new employers?**

- **In this complicated area, some general management policies are being explored.**
- **One approach is to use employment contracts that place special restrictions on future employment.**
- **Other tactics aside from employment contract provisions have been attempted by various companies.**

CONFLICTS OF INTEREST

- **Professional conflicts of interest are situations where professionals have an interest which if pursued might keep them from meeting their obligations to their employers or clients.**
- **Sometimes it is as a consultant for a competitor's company, other times it is a more personal interest.**

Impairment of Judgment and Service

- Conflicts of interest threaten good judgment in faithfully serving an employer and client.
- Thus, to refine the definition of conflicts of interest by saying that they typically arise when two conditions are met:

- **(1) the professional is in relationship or role that requires exercising good judgment on behalf of the interests of an employer and client, and**
- **(2) the professional has some additional or side interest that could threaten good judgment in serving the interests of the employer or client**

Gifts and Bribes

- Companies give gift to selected employees of government agencies or partners' in trade.
- Many such gifts are unobjectionable, some are intended as bribes, and still others create conflicts of interest, strictly speaking, involve bribes.
- What are the differences?

- A bribe is a substantial amount of money or goods offered beyond a stated business contract with the aim of winning an advantage in gaining or keeping the contract.
- Bribes are made in secret.
- Bribes are illegal or immoral.

Interests in Other Companies

- Some conflicts of interest consist in having an interest in a competitor's or a subcontractor's business.
- One blatant example is actually working for the competitor or subcontractor as an employee or consultant.
- Another example is partial ownership or substantial stockholdings in the competitor's business.

- Does holding a few shares of stock in a company one has occasional dealings with constitute a conflict of interest?
- Usually not, but as the number of shares of stock increases the issue becomes blurry.
- Again, is there a conflict of interest if one’s spouse works for a subcontractor to one’s company?
- Usually not.

Insider Information

- An especially sensitive conflict of interest consists in using “inside” information to gain an advantage or set up a business opportunity for oneself, one’s family, or one’s friends.
- The information might concern one’s own company or another company with which one does business.

Moral Status

Why conflicts of interest are prohibited?

- The professional obligation to employers is very important in that it overrides in the vast majority of cases any appeal to self-interest on the job
- The professional obligation to employers is easily threatened by self-interest in a way that warrants especially strong safeguards to ensure that it is fulfilled by employees.

OCCUPATIONAL CRIME

- Occupational crimes are illegal acts made possible through one's lawful employment.
- It is the secretive violation of laws regulating work activities.
- When committed by office workers or professionals, occupational crime is called "white-collar crime."

- **Industrial Espionage**
- **Price Fixing**
- **Endangering Lives**
- **The cases are offered as further exploration of the central themes: professionalism, loyalty, conflicts of interest, and confidentiality.**

- **Employers who expose their employees to safety hazards usually escape criminal penalties.**
- **It is motivated by personal greed, corporate ambition, misguided company loyalty, and many other motives.**

UNIT II

The Engineers Responsibility for Safety

- **The responsibility of engineers for safety derives from clients' and the public's right.**
- **Only with adequate knowledge can persons become willing participants in an engineering project or experiment, decide not to participate, or decide to oppose it.**

I. Safety and Risk

- ✓The concept of Safety
- ✓Risks
- ✓Acceptability of Risk
- ✓Lessons for the Engineer

- **Absolute safety,** in the sense of a degree of safety that satisfies all individuals or groups under all conditions, **is neither attainable nor affordable.**
- **Example:** a power in the hand of child/adult
- Sick due to air pollution in old/healthy adult

The concept of Safety

- "safety" would be thoroughly subjective by defining it in terms of whatever risks a person judges to be acceptable.
- William W. Lowrance: "A thing is safe if its risks are judged to be acceptable".

- **First,** a case where we seriously underestimate the risks of something – eg. Toaster
- **Second,** the case where we grossly overestimate the risks of something – eg. Fluoride in drinking water
- **Third,** there is the situation in which a group makes no judgment – they simply do not think about it.

Risks

- What is meant risk?
- A risk is the potential that something unwanted and harmful may occur.
- Good engineering practice has always been concerned with safety.

- **Often referred "new risks" in the sense that**
- **(1) they are now identifiable**
- **(2) the public's perception of them has changed.**
- **Meanwhile, natural hazards continue to threaten human populations.**

Acceptability of Risk

- Lawrence's definition – safety as acceptable risk
- Rowe's definition – a risk is acceptable when those affected are no longer
- Voluntarism and control: motorcycle drive in amusement, live near chemical plant

- **Effect of information on risk assessments:** seat belt in a car
- **Job related risks:**
- **Magnitude and Proximity:** a future risk is easily dismissed by various rationalization including: (1) the attitude of “out of sight and out of mind” (2) the assumptions that predictions for the future (3) the belief

Lessons for the Engineer

- Engineers face two problems with public conceptions of safety.
- On the one hand there is the overly optimistic attitude that things that are familiar, that have not hurt as before, and over which we have some control present no real risks.

- **On the other hand is the dread people feel when an accident kills or maims in large numbers, or harms those we know, even though statistically speaking such accidents might occur infrequently.**

II. Assessment of Safety and Risk

- Knowledge of Risk
- Uncertainties in Design
- Testing for Safety
- When Testing is inappropriate

- **Absolute safety is not attainable, and any improvement in safety relates to an engineered product is often accompanied by an increase in the cost of that product.**
- **Cost associated with warranty expenses, lost of customer goodwill, and even loss of customers.**
- **High safety (low risk) leads to high primary cost**

Knowledge of Risk

- **Experience and historical data would provide good information about the safety of products.**
- **Much has been collected and published: gaps remain, however, because**
- **(1) there are some industries where information is not freely shared, and**

- **(2) there are always new applications of old technology that render the available information less useful.**
- **Too many companies believe that releasing technical information might hurt their competitive position.**

Uncertainties in Design

- Risk is designed into a product.
- It arises because of the many uncertainties faced by the design engineer, the manufacturing engineer, and even the sales and applications engineer.

- **Uncertainties about the purpose of a design**
- **Uncertainties about the applications of a product**
- **Uncertainties about the material quality**
- **Uncertainties about the standards**
- **Engineers by introducing a comfortable " Factor of Safety".**

Testing for Safety

- Successful prototype testing
- Routine quality assurance tests
- Engineers made occasional spot checks

When Testing is Inappropriate

- A common approach is scenario analysis
- Another approach, as failure modes and effects analysis
- In contrast to this: the fault-tree analysis
- The reverse of the fault-tree analysis is the event-tree analysis

III. Risk-Benefit Analyses and Reducing Risk

- Personal risk
- Public risk and public acceptance
- Accounting publicly for benefits and risks
- Incentives to reduce risk
- Some examples of improved safety
- Liability

- **Many large projects, especially public works, are justified on the basis of a risk-benefit analysis.**
- **The questions answered by such a study are the following:**
- **Is the product worth the risk concerned with its use?**
- **What are the benefits?**

- Do they outweigh the risks?
- But who establishes these values and how?
- It should be noted that risk-benefit analysis, like cost-benefit analysis, is concerned with the advisability of undertaking a project.

Personal Risk

- **Given sufficient information, an individual is able to decide whether is it risk / safety?**
- **The difficulty in assessing the personal risks, is it voluntary / involuntary?**

- **The problem of quantification alone raises innumerable problems in assessing personal safety and risk.**
- **How is one to assess the dollar value of an individual's life?**

Public Risk and Public Acceptance

- Risks and benefits to the public at large are more easily determined
- because individual differences tend to even out as large numbers of people are considered.
- NHTSA (National Highway Traffic Safety Administration), incidentally, emphasized that "placing a value on a human life"

Accounting publicly for benefits and risks

- The conclusions of risk assessment and cost-benefit studies are increasingly being challenged by special-interest groups.
- Engineers are reluctant to face the rough-and tumble of the political and legal arenas, they are often called upon as expert witnesses.

- Engineers are usually asked for numbers when assessing safety and risk: they should regard statistics
- One of the difficulties with risk-benefit and cost-benefit analyses is the matter of who does the assessing.
- But difficulties in public accounting for risks and benefits are not related only to methods of quantification.

Incentives to Reduce Risk

- The engineers is faced:
- the tasks of designing and manufacturing safe products
- giving a fair accounting of benefits and risks
- meeting production schedules and
- helping his or her companies maintain profits all at the same time

- Of these objectives, product safety should command top priority.
- Engineers should recognize that reducing risk is not an impossible risk, even under financial and time constraints.
- Ex: Assumptions – operator error
- Reality – accidents are caused by dangerous conditions

Some examples of improved safety

- The magnetic door catch introduced on refrigerators
- The dead-man handle used by the engineer
- Old-fashioned semaphores in rail roads
- The motor-reversing system
- A car safety belt

Liability

- Engineers and students of engineering need to be aware of strict liability.
- As Richard Moll writes: "The fact that proof of negligence is not essential to impose liability is a frightening prospect for most manufacturers."
- Engineering practice should be preventive or defensive in approach. Therefore knowledge of liability is well advised.

IV. Three Mile island, Chernobyl and Safe Exits

- Three Mile Island
- Prior warnings
- Chernobyl
- Three Mile Island, Chernobyl, and a Forerunner
- Safe Exit

- An engineered system are called upon to carry out more complex tasks, it becomes more difficult to control them.
- Designers hope to ensure greater safety during emergencies by taking human operators and mechanizing their functions.
- Operator errors were the main cause of the nuclear reactor accidents at Three Mile Island and Chernobyl.

- **Beyond these errors a major deficiency surfaced at both installations:**
- **Inadequate provisions for evacuation of near by populations.**
- **This lack of “safe exit” is found in too many of our amazingly complex systems.**

Three Mile Island

- **Three Mile Island unit 2 (TMI-2) Nuclear Power Plants in Pennsylvania.**
- **On March 28, 1979 was one of the most serious accident (TMI-2) in the history of the U.S nuclear industry.**
- **It was the combination of human error, insufficient training, bad operating procedures, and unforeseen equipment failure.**

Prior Warnings

- At the time of an accident alarm is disregarded by the operators.
- Apart from the technical lessons learned at the TMI laboratory, the experience has offered lessons in the need for disaster planning and open-mindedness.

- Open-mindedness refers, to not allowing a preoccupation with rules to prevent close examination of safety problems that may not be covered by rules.
- It also refers to a willingness on the part of management to take seriously the safety concerns expressed by engineers within or outside the organization.

Chernobyl

- The nuclear power plant complex at Chernobyl, near Kiev (Ukraine, then of the U.S.S.R), is the world's second largest power plant park, with an output of 6000 megawatts.
- On April 25, 1986, a terrible reactor fire occurred.

- **Due to subsequent radiation leaks lot of deaths as a result.**
- **This was the world's worst civilian atomic disaster.**
- **Authorities claim that their energy sector is not fully computerized, and is fairly low tech.**

Three Mile Island, Chernobyl, and a Forerunner

- There are similarities and dissimilarities between the events, but the lessons to be learned do not differ much.
- The physical layout of systems may be different from plant to plant and country to country, but managers and operators are very never different in their behavior.

- **Discussions about dangers to the public at the time of the events became “mass medicated” events,**
- **while engineers, physicists, physicians, health officials and regulators were unable to issue authoritative status reports and offer professionally sound advice.**

- Financially the nuclear power industry is facing a bleak picture in the United States.
- Supporters and opponents were given public funds to broadcast programs in support of their positions.

Safe Exit

- The best one can do is to assure that
- when a product fails it will fail safely,
- that the product can be abandoned safely, or
- that the user can safely escape the product
- Let us refer to these three conditions as safe exit.

- **Who take the responsibility for providing safe exit?**
- **Who will recognize the need for a safe exit?**
- **It is our position that providing for a safe exit is an integral part of the experimental procedure – in other words, of sound engineering.**

V. Bhopal Gas Tragedy

- The Bhopal Gas Tragedy is a catastrophe that has no parallel in industrial history.
- In the early morning hours of December 3, 1984, a rolling wind carried a poisonous grey cloud past the walk of the Union Carbide C Plant in Bhopal, Madhya Pradesh, India.

- An estimated 8000 or more people died, about 3, 00,000 more would suffer agonizing injuries from disastrous effects.
- Forty tons of toxic gases were released from Carbides Bhopal plant and spread throughout the city.
- People whose hopes and dreams were ironically bound up with the technology

UNIT II

ENGINEERING AS SOCIAL EXPERIMENTATION

I. Engineering as Experimentation

- Similarities to Standard Experiments
- Learning from the past
- Contracts with Standard Experiments
- Knowledge Gained

- In 1912 the Titanic was proclaimed as the greatest engineering achievement,
- with capacity of 3547 passengers and crew.
- Titanic was confidently believed to be virtually unsinkable.
- Experimentation is commonly recognized to play an essential role in the design process.

Similarities to Standard Experiments

- **Several features** of virtually every kind of engineering practice combine to make it appropriate to view engineering projects as experiments.
- First, any project is carried out in partial ignorance.

- **Second, the final outcomes of engineering projects, are generally uncertain.**
- **Third, effective engineering relies upon knowledge gained about products both before and after they leave the factory – knowledge needed for improving current products and creating better ones.**

Learning from the Past

- It might be expected that engineers would learn not only from their own earlier design and operating results, but also from those of other engineers. A few examples are:
- The Titanic disaster (1912), Milford Haven Bridge wall collapse (1966), ship colliding with bridge in Venezuela (1964)

Contracts with Standard Experiments

- **Experimental control:** In a standard experiment this involves the selection of members for two different groups.
- The members of one group receive the special, experimental treatment.
- Members of the other group, called the control group, do not receive that special treatment.

- **Informed consent: Informed consent is understood as including two main elements: Knowledge and voluntariness.**
- **First, subjects should be given not only the information, but all the information needed to make a reasonable decision.**
- **Second, subjects must enter into the experiment without being subjected to force, fraud, or deception.**

Knowledge Gained

- Scientific experiments are conducted to gain new knowledge, while "engineering projects are experiments that are not necessarily designed to produce very much knowledge according to a valuable interpretation.

II. Engineers as Responsible Experimenters

- Conscientiousness
- Relevant Information
- Moral Autonomy
- Accountability

- From the perspective of engineering as social experimentation, what are the general features of morally responsible engineers?
- At least four elements are pertinent: a conscientious commitment to live by moral values, a comprehensive perspective, autonomy, and accountability.

Conscientiousness

- People act responsibly to the extent that they conscientiously commit themselves in live according to moral values.
- It will be noted that conscientiousness implies consciousness, because intent is not sufficient.

- **Open eyes, open ears, and an open mind are required to recognize a given situation, its implications, and who is involved or affected.**

Relevant Information

- **Conscientiousness is blind without relevant factual information.**
- **Hence showing moral concern involves a commitment to obtain and properly assess all available information pertinent to meeting one's moral obligations.**

- **This means, as a first step, fully grasping the context of one’s work, which makes it count as an activity having a moral import.**

Moral Autonomy

- **People are morally autonomous when their moral conduct and principles of action are their own, in a special sense deriving from Kant.**
- **Engineers are compelled to look to their professional societies and other outside organizations for moral support.**

- **Professional societies, originally organized as learned societies dedicated to the exchange of technical information, lack comparable power to protect their members.**
- **Only now is the need for moral and legal support of members in the exercise of their professional obligations being recognized by those societies.**

Accountability

- **Responsible people accept moral responsibility for their actions.**
- **The divorce between casual influence and moral accountability is common in business and the professions, and engineering is no exception.**
- **Such a psychological schism (split) is encouraged by several prominent features of contemporary engineering practice.**

- First, large scale engineering projects involve fragmentation of work.
- Second, corresponding to the fragmentation of work is a vast diffusion of accountability
- Third, there is frequently pressure to move on to a new project.
- Fourth, the malpractice afflicting the medical profession is carrying over into engineering.

III. The Challenger Case

- Several years before the destruction of challenger, NASA (National Aeronautics and Space Administration) historian Alex Ronald wrote a critical piece about the space shuttle program.
- The Columbia and its sister ships, Challenger, Discovery, and Endeavor, are delta-wing craft with a huge payload bay.

Safety Issues

- Safety measure was rejected as too expensive because of an accompanying reduction in payload.
- Working with such constraints, why was safe operation not stressed more?
- The shuttle program was a truly experimental and research undertaking.

- **It is clear that the astronauts were not informed the particular problems (field joints) to the experienced engineers.**
- **One engineer was quoted as saying, "A small amount of professional safety effort and upper management support can cause a quantum safety improvement with little expense".**

IV. Codes of Ethics

- Roles of Codes
- Codes and the Experimental Nature of Engineering
- Limitations on Codes

Role of Codes

Codes of ethics for engineers have helped with impressing safety concerns on management.

(a) Inspiration and guidance

- Code provides a positive stimulus for ethical conduct
- Helpful guidance concerning the main obligations of engineers

- **Faith of engineer, published by the Accreditation Board for Engineering and Technology (ABET), which succeeded the Engineering Council for Professional Development (ECPD).**

(b) Support

- Codes give positive support to those seeking to act ethically.
- Codes can potentially serve as legal support for engineers.

(c) Deterrence and Discipline

- Codes can serve as the formal basis for investigating unethical conduct.
- Such an investigation generally requires paralegal proceedings designed to get at the truth about a given charge without violating the personal rights of those being investigated.

(d) Education and Mutual Understanding

- Codes can be used in the classroom and elsewhere to prompt discussion and reflection on moral issues
- To encourage a shared understanding among professionals, the public, and government organizations
- Concerning the moral responsibilities of engineers.

(e) Contributing to the Profession's Public Image

- Codes can present a positive image to the public of an ethically committed profession.
- It can help engineers more effectively serve the public.
- It can also win greater powers of self-regulation for the profession itself.
- It reduces to a kind of window dressing.

(f) Protecting the Status Quo

- **Codes establish ethical conventions, which can help promote an agreed upon minimum level of ethical conduct.**

(g) Promoting Business Interests

- **Codes can place unwarranted “restraints of commerce” on business dealings to benefit those within the profession.**

Codes and the Experimental Nature of Engineering

- **The perspective of engineering as social experimentation provides some help in deciding which functions should be primary in engineering codes.**

- **The best engineers to express their views freely – especially about safety – to those affected by engineering projects.**
- **The guidance, inspirational, and educational functions of engineering codes are important, as is their role in promoting mutual understanding among those affected by them.**

- The disciplinary function of engineering codes is in our view of secondary importance.
- Probably the worse abuse of engineering codes in the past has been to restrict honest moral effort on the part of individual engineers in the name of preserving the profession's public image and protecting the status quo.

Limitations on Codes

- Codes are restricted to general and vague wording.
- It is easy for different entries in codes to come into conflict with each other.
- The NSPE (National Society of Professional Engineers) code states: "Engineers shall hold paramount the safety, health, and welfare of the public in the performance of their professional duties".

- Codes are cannot serve as the final moral authority for professional conduct.
- Codes results from their proliferation.
- Core concepts of code limitations: (i) the public interest (ii) qualities of truth, honesty, and fairness, and (iii) professional performance

V. A Balanced Outlook on Law

- A regulated Society
- The trend toward Greater Detail
- Industrial Standards
- Problems with the Law in Engineering
- The Proper Role of Law in Engineering

- **Illustrations:**
- **(1) The 1969 Santa Barbara offshore spill of 235,000 gallons of crude oil blackened 30 miles of spectacular beaches, damaged wildlife, and hurt the local tourist trade.**
- **(2) A group of Southern Californians staged a burning of gasoline credit cards issued by the offending oil company.**

A regulated Society

- In order to live, work, and play together in harmony as a society.
- Engineers should play an active role in establishing or changing enforceable rules of engineering.
- Example: (1) 1758 B.C: Babylon's Building Code (2) A.D. 1852: The United States Steamboat Code

The trend toward Greater Detail

- (i) Law take care of building failures after the structure had failed.
- (ii) Law makers cannot be expected always to keep up with technological development.
- (iii) Laws changed upon each innovation.

- **The rule making and inspection agencies:**
- **Food and Drug Administration (FDA)**
- **Federal Aviation Agency (FAA)**
- **Environmental Protection Agency (EPA)**

Industrial Standards

- Standards facilitate the interchange of components
- Standards consist of explicit specifications
- Standards are established by companies
- Standards help not only the manufacturers; they also benefit the client and the public.
- Standards can also be a hindrance at times.

Problems with the Law in Engineering

- The legal regulations apply to engineering and other professions are becoming more numerous and more specific all the time.
- Many of our engineering decisions on ethical issues to an interpretation of laws.

- **For example: One of the greatest moral problems in engineering is that of minimal compliance.**
- **This can find its expression when companies or individuals search for loopholes in the law that will allow them to barely keep to its letter even while violating its spirit.**

- Or, hard-pressed engineers find it convenient to refer to standards with ready made specifications as **“handbook mentality”** and repetition of mistakes.
- On the other hand, remedying the situation by continuously updating laws or regulations.

The Proper Role of Law in Engineering

- Good laws, effectively enforced, clearly produce benefits.
- Law establish reasonable minimal standards of professional conduct and provide at least a self-interested motive for most people and corporations to comply.

- **Law serve as a powerful support and defense for those who wish to act ethically.**
- **By pertinent law, one can feel free to act as a responsible engineer.**
- **To view engineering as social experimentation can provide engineers with a proper perspective on laws and regulations.**
- **With these regard, law serving as a protector of the ethical engineer.**

MORAL REASONING AND ETHICAL THEORIES

1974 → DC 10 Jumbo Jet Crash at Paris

346 people were killed →

Engineers met a clash

↓

Employee with Public

- Ethical theories play a role in understanding the problems and moral dilemmas
- Moral reasons require us to respect other people as well as us, to care for others, good as well as our own.
- Moral reasons involve respecting persons by being fair

- **Professional Ideals and Virtues:**
- **Virtues – Behaviour showing high moral standard**
- **Ideals – A person or thing regarded as perfect**

Theories about Virtues

- **Aristotle: Virtue and the Golden Mean**
- **Good judgment** is necessary for successful rational activities that range from engineering to philosophical inquiry.
- **Moral virtues** are tendencies, acquired through habit formation, to reach a proper balance between extremes in conduct, emotion, desire, and attitude.

- **Aristotle thought of each virtue as governing a particular aspect of our lives.**
- **Courage governs confrontations with danger and risk**
- **Truthfulness governs truth-telling**
- **Generosity governs giving and**
- **Friendliness governs personal relationships**

- Macintyre: Virtues and Practices
- He applied virtue ethics to professional ethics
- He differentiate external goods and internal goods
- External goods like money and prestige, which can be achieved through many different kinds of activities

- **Internal good of medicine is the promotion of health**
- **Internal good of law is social justice**
- **Internal good of teaching is learning and self development**
- **In this way, moral aims concerning the good of persons are built into the very meaning of professions – and hence professionalism**

Professional Responsibility

- The most basic and comprehensive professional virtue is professional responsibility.
- Professional responsibility is an umbrella virtue: can be grouped into four categories:

1)Self-direction virtue 2)Public-spirited virtues 3)Team-work virtues 4)Proficiency virtues

- **Integrity**
- **Moral integrity is the unity of character on the basis of moral concern, and especially on the basis of honesty.**
- **The unity is consistency among our attitudes, emotions, and conduct in relation to justified moral values.**

- **Employees wrong statement:**
- **“Don’t blame me; I was just doing my job”**
- **“If I don’t do it, someone else will”**

- Integrity is a bridge between responsibility in private and professional life.
- Integrity makes possible the virtues of self-respect and pride in one’s work.
- Compromise can mean two things: negative sense and positive sense

- **Honesty has two approaches:**
- **Truthfulness and trustworthiness**
- **Honesty in acts: respect for the property of others**
- **Honesty in speech: being candid**
- **Honesty in beliefs: forming one's beliefs without self-deception**

Self – Respect

- Self-respect is valuing oneself in morally appropriate ways
- Related virtues of self-respect:
- A sense of honor (dignity) – emotions of self-respect
- Self-control – maintaining self-discipline
- Courage – disposition to confront dangers and difficult tasks
- Good judgment – lies at the core of all virtues

- **John Rawls**: self-respect takes two forms
- Recognition self-respect is properly valuing oneself and respects others in the same worth
- Appraisal self-respect is properly valuing ourselves according to how well we meet moral standards and our personal ideals.

Senses of Responsibility

- A virtue, they may also ascribe
- Obligations
- General moral capacities of people
- Liabilities and accountability for actions
- Blame worthiness or praise worthiness

THEORIES ABOUT RIGHT ACTION

- Illustration: Resignation of Spiro T.Agnew his vice president of USA on October 10, 1973
- The following lists showed the four main types of theories about morality.
- Virtue ethics
- Duty ethics

Utilitarianism

Right ethics

Basic Concepts:

- Virtues and vices
- Most good for the most people
- Duties to respect persons
- Human rights

Utilitarianism

- John Stuart Mill: (1806-1873) Act- Utilitarianism and Happiness
- Richard Brandt: Rule-Utilitarianism and Rational Desires

Duty Ethics

- Immanuel Kant (1724 – 1804): Respect for Persons
- A list of duties such as:
- be honest, keep promises, don't inflict suffering other people, be fair, and
- make reparation when have been unfair,
- show gratitude for kindness extended by others

There are duties to us:

- **seek to improve one’s own intelligence and character,**
- **develop one’s talents,**
- **don’t commit suicide**

- **Why are these our duties?**
- **According to Kant, there are three interwoven conditions:**
- **each expresses respect for persons,**
- **each is a universal principle, and**
- **each expresses an unqualified command for autonomous moral agents**

- **Rawls' Two Principles:**
- **Each person is entitled to the most extensive amount of liberty compatible with an equal amount for others, and**
- **Differences in social power and economic benefits are justified only when they are likely to benefit everyone, including members of the most disadvantaged groups.**

Right Ethics: Human right ethics

- John Locke(1962–1704): Liberty Rights
- to be a person having rights – human rights – to life, liberty, and the property generated
- Locke's won version of a human rights ethics was individualistic.
- Liberty rights or negative rights that place duties on other people not to interfere with one's life

- A.L.Melden (1910 – 1991): Liberty and Welfare Rights
- Human rights as intimately related to communities of people
- He defined as rights to community benefits needed for living a minimally decent human life – ‘positive’ welfare rights
- Not all moral rights are human rights

Testing Ethical Theories

- Which ethical theory is best?
- The theory must be clear, and formulated with concepts that are coherent and applicable.
- It must be internally consistent in that none of its tenets contradicts any other.

Self- Interest, Customs, and Religion

- Moral reasons and ideals form three distinct categories:
- Self- Interest
- Customs
- Religion

- **Self- Interest and Ethical Egoism**
- **A view that tries to reduce morality to the pursuit of self-interest, this view is called ethical egoism.**
- **According to Thomas Hobbes (1588 – 1679) and the novelist Ayn Rand (1905 – 1982): moral values are reduced to concern for oneself / one's long term interests.**

Customs and Ethical Relativism

- Ethical relativism says that actions are morally right when they are approved by law or custom.
- Why would anyone accept ethical relativism?
- First reason is that law provides a public way through disputes about right and wrong

- A second reason that ethical relativism seems attractive to some people
- A third reason that it is confused with moral rationalism.
- Virtually all Philosophers have accepted moral relationalism in everyday rules such as
- “Don’t lie”
- “keep promises”

Religion and Divine Command Ethic

(Moral commitment and religious belief)

- **They are related historically**
- **For many people there are important psychological connections between their moral and religious beliefs**
- **Religions sometimes set a higher moral standard than in conventional**

USES OF ETHICAL THEORIES

- Ethical theories have three important uses:
- in understanding moral dilemmas
- in justifying professional obligations and ideals
- in relating ordinary and professional morality

Resolving Moral Dilemmas

- aid in identifying the moral considerations or reasons
- provide a more precise sense of what kinds of information
- way to rank the relevant moral considerations in order of importance
- help us identify the full moral ramifications
- provide frameworks for moral reasoning
- providing frameworks for development of moral arguments

Justifying Moral Obligations

- **It can be used to justify the obligations of engineers and offers involved in technological development.**
- **Using safety related obligations, the application of utilitarianism, rights ethics, and duty ethics in providing a moral foundation for professional responsibilities.**

- **Level 1:** Claims about an action being right
- **Level 2:** Claims that a given person has special safety obligations
- **Level 3:** Principles specifying the special safety obligations of engineers
- **Level 4:** Foundational ethical principles

Relating Professional and Ordinary Morality

- Ethical theories that are useful in expressing everyday moral experience are also useful in justifying the obligations of professionals.
- Consider four other views concerning the origin and justification of the safety obligations of engineers.

- 1st view is that engineers acquire moral obligations concerning safety
- 2nd view is that engineers acquire special obligations by joining a professional society
- 3rd view is that engineers acquire safety obligations through the contractual agreements
- 4th view is that engineers, upon entering their careers

B.E. VIII
CIVIL & STRUCTURAL ENGINEERING
CSEC 805
ETHICS IN ENGINEERING

UNIT I

- INTRODUCTION TO ENGINEERING ETHICS
- NEED FOR ENGINEERING ETHICS
- PROFESSION AND PROFESSIONALISM
- MORAL REASONING AND ETHICAL THEORIES
- THEORIES ABOUT RIGHT ACTION
- USES OF ETHICAL THEORIES

WHAT IS ENGINEERING ETHICS?

- **Study of moral issues and decisions confronting individuals and organizations**

- **Study of related questions about the moral ideals, character, policies, and relationships of people and corporations**

Senses of Engineering Ethics

Ethics – Morals

- Ethics is an activity and area of inquiry
- Ethics refer to the set of specifically moral problems and issues related to engineering

- **Ethics is a purely factual matter about what engineers and others believe about moral problems in engineering**
- **Ethics refer to the study of morality**

Variety of Moral Issues

Two approaches to Engineering Ethics:

- **Everyday problems that can take on significant proportions in an engineers life or an entire engineering office – Micro Ethics**

- **Societal problems that are often shunted aside and are unexpectedly resurface on a regional or national scale – Macro Ethics**

Where and How do Moral Problems Arise in Engineering?

- An engineered Products/ Project go through various stages of conception
- Design and Manufacture, followed by testing, sales, and service

Examples:

- An Inspector discovered faulty construction equipment
- An electric utility company to operate a nuclear power plant
- A chemical plant dumped wastes in a landfill
- Electronic company ABC geared up for production

Three Types of Inquiry

- Normative Inquiry
- Conceptual Inquiry
- Factual Inquiry

Engineering Ethics and Philosophy

- Engineering ethics →

  Applied / Practical = Philosophical Ethics

- Medical ethics, Legal ethics & Business ethics

- Engineers are Salaried Employers - Engineering Decisions tied to Business Decisions

Historical Note

- The late 1970s the systematic attention been devoted by Engineers

After II World war:

- The Society for Social Responsibility in Science
- The Federation of American Scientist
- The bulletin of the American Scientist

- **The concept of engineering ethics is as an "interdisciplinary discipline" involving philosophy, engineering, social science, and law and management science.**

- Robert Baum's National Project on Philosophy and Engineering ethics

- Sponsored from 1978 – 1980

- National Science Federation (NSF)
- National Endowment for the Humanities (NEH)
- The Business and Professional Ethics Journal, Was created in 1981

NEED FOR ENGINEERING ETHICS

- The Moral / Immoral will adopt on an established set of beliefs.
- It is a means to increase the ability of concern engineers, managers, citizens and others.
- The study of engineering ethics helps develop skills in all stages.

Moral Dilemmas

Three sorts of complexity and murkiness

- **Problems of Vagueness**
- **Problems of Conflicting Reasons**
- **Problems of Disagreement**

Steps in Confronting Moral Dilemmas

- Identify the relevant moral factors and reasons
- Gather all available facts that are pertinent to the moral factors involved

- **Consider alternative courses of action as ways of resolving the dilemma, tracing the full implication of each.**
- **If possible rank the moral considerations in order of importance as they apply to the situations.**

- **Talk with colleagues, seeking their suggestions and alternative perspectives on the dilemma.**
- **Arrive at a carefully reasoned judgment by weighing all the relevant moral factors and reasons in light of the facts.**

Moral Autonomy

- **Autonomy** →

  Self determining or

  Independent

- **The unifying goal should be to increase moral autonomy**
- **Moral autonomy can be viewed as the skill and habit of thinking rationally about ethical issues on the basis of moral concern.**

Kohlberg’s Theory

Kohlberg’s Theory: 1927 – 1987

3 Levels of Moral Development:

- Pre-Conventional Level

– in which right conduct is regarded as whatever directly benefits oneself

– this is the level of development of all young children.

- **Conventional Level**
  - in which the norms of one's family, group, or society are accepted as the final standard of morality
  - the most adults never mature much beyond the stage.

- **Post-Conventional Level**

– is attained when an individual comes to regard at a set of principles concerning rights to self interest or social conventions.

- Moral responsibilities emerges from a foundation of early moral training by one's Parents and Culture

Gilligan's Theory

- Gilligan's Theory – Women based study
- Gilligan refers to this context – on maintaining personal relationships as the ethics of care, and contrasts it with an ethics of rules and rights.
- Example: Heinz's Dilemma

- Gilligan's recasting the levels:
- The Pre-conventional level – is roughly the same as Kohlberg's level – what is good for oneself?
- The Conventional level – here there is the opposite preoccupation with not hurting others and with a willingness to sacrifice one's own interests in order to help or nurture others.

- **The Post-conventional level** – the individual becomes able to strike a reasoned balance between caring about other people and pursuing one's self interest while exercising one's rights.

- **Moral Autonomy**

– as much to do with caring for other people within a community based as personal relationships: Gilligan says

- as it does with being sensitive to general principles and human rights: Kohlberg says

Consensus and Controversy

- Agreement and Disagreement ------- Tolerance requires
- In both the class room and work place there is a need for authority: teachers having authority over students, and managers having authority over engineers.

PROFESSION AND PROFESSIONALISM

- Herbert Hoover – President of United States
- American Institute of Mining Engineers – Engineers President
- Federated American Engineering Societies – Former Positions
- It is a great profession

Profession

- The word profession is used as a synonym for "job" or "occupation" and to be a professional at some activity means merely to earn one's living through it.

Profession in new sense:

- Knowledge
- Membership
- Organization
- Public Good

- **Professionalism as Independence:**
  - Robert L. Whitelaw's view, only consulting engineers qualify as professionals
  - loyal service to employers as the heart of professionalism in engineering
  - filtering their everyday work through a sieve of ethical sensitivity

- Accreditation Board for Engineering and Technology (ABET) and Engineer's Council for Professional Development (ECPD) states – engineers shall hold paramount the safety, health and welfare of the public in the performance of their professional duties.

Multiple Motives

- UG Curriculum is very difficult than the majority of academics
- Sense of activity Orientation
- Samuel Florman – The Existential Pleasures in Engineering
- In the act of personally changing the world

- The joy of creative effort
- The scientist’s job in understanding the laws and riddles of the universe
- Relates to size in the world
- Relates to regularly being in the presence of machines