Professional Ethics and Human Values

Second Edition

About the Author

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In recognition of his services in the field of engineering education, he was awarded the coveted Bharat Excellence Award and Gold Medal for Excellence in Education in New Delhi in 2006. He is listed as an International Expert in Industrial Engineering and Management in the *International Directory of Experts and Expertise*. He has been nominated for the post of Honorary Deputy Director General in India for the International Biographical Center.

Earlier, during the eighties, he was introduced to Dr. Julius Nyerere, the then President of Tanzania, as a Pioneer of Work Study in that country. He was one among the few non-political foreigners to be interviewed by the government newspaper of Tanzania.

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He has traveled widely, having visited over 30 countries, and is a philanthropist.

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Preface to the Second Edition

At the outset, I wish to thank the publishers and readers for necessitating the release of this book, in conformance to JNTU Kakinada syllabus. I wish to acknowledge my gratefulness to the individuals, professional journal editors, and the press for providing proactive reviews which have been incorporated as much as possible. Some of the reviewer comments are mentioned below:

Extracts from Reviews of the Book

I have read your book *Professional Ethics and Human Values*. It is a well-brought out book, which discusses the subject in a very comprehensive way and in a manner which would attract the students and teachers. I know teaching a subject like ethics and human values sometimes becomes philosophical and loses the core structure. You have done full justice to the subject. I hope this book would be followed at all educational institutes and would also be referred by industrial and research organizations. It would be a good idea to request some of the English and vernacular dailies to publish a review of this book.

Dr. Baldev Raj, Distinguished Scientist and Director
IGCAR, Kalpakkam

Professional Ethics and Human Values, authored by Prof. D R Kiran, published by McGraw Hill Education (India), has covered in depth the various ingredients of professional ethics and human values, which are essential. We see comprehensive integration of integrity, honor, dignity, safety, and health to brighten human life by values like love, purity, compassion, truthfulness, tolerance, sprit of service, coherence, utility of service, etc. We would like to place on record our sincere appreciations and congratulations to Prof. D R Kiran for this worthy textbook and wish that apart from the students, the general public would find it useful for self-development and for continuous improvement which is an ongoing and never-ending process.

Plant Engineering Journal of Indian Institution of Plant Engineering

Professional Ethics and Human Values has 24 chapters with an overview of ethics being nicely depicted. The role of the Indian Lok Sabha Committee on Ethics is highlighted. The author traces back the history and development of ethics. Hindu mythology and the Ten Commandments are vividly brought out by the author. All engineers should read this book to get a good idea on professional ethics and human values, and appreciate what is expected of them while starting a career in an organization.

Industrial Engineering Journal of Indian Institute of Industrial Engineering

There are many books by foreign as well as Indian authors on this subject. While foreign books emphasize on western ethos, many of the Indian books draw heavily on the foreign books. The students in their early years of study are unable to follow the foreign authors' styles and many of the Indian books also do not help them much. In this scenario, the book *Professional Ethics and Human Values* by Prof. Kiran is a welcome addition. Even though references are made to foreign books, the author has given many case studies relating to the Indian scenario and has quoted extensively from the Indian ethos. We congratulate the author for this wonderful book and wish that he brings out, with his rich experience, many more technical books.

Energy and Fuel Users' Journal of ENFUSE

About the Book

While Part I of the syllabus is general appreciation of human values, the second part of the syllabus is more specific to the engineering profession. A highlight of this edition is the rearrangement of the chapters to suit the JNTU Kakinada syllabus. Some of the syllabus topics like work ethics and service learning are included in Chapter 1 titled *Introduction*. Most additional topics are explained in Chapter 5 itself, with suitable cross references to the chapters where they are dealt more in detail.

Some of the highlights of the book are

- In-depth topical coverage of history and development of the concept of ethics; virtues like honesty and responsibility; Codes of ethics from several professional associations around the globe; Risk factors; Safety audit; Case study in Kumbakonam school fire accident; Critical and uncritical loyalty; International crimes; Whistleblowing vs currying favor; Social obligations of corporations and social audit; Green design; New forms of computer crimes and mobile phone crimes; Latest case studies

- Rich pool of pedagogy includes
  - 24 chapters
  - 300 Review Questions
  - 80 Fill in the Blanks

Finally, I solicit further comments and suggestions from all the readers, which would be gratefully acknowledged and incorporated wherever possible. I assure to continue to do my best to improve this book in the subsequent editions, in my quest for quality and to spread the fundamentally important awareness and skills in ethics to the business leaders, students, and future generations.

D R Kiran

Publisher's Note

Do you have any further request or a suggestion? We are always open to new ideas (the best ones come from you!). You may send your comments to *tmh.corefeedback@gmail.com*

Piracy-related issues may also be reported!

Preface to the First Edition

Ethics is a body of principles and standards on human conduct that governs the behavior of individuals and organizations. It is the awareness and the training imparted from the childhood stage to know what is right and what is wrong in day-to-day activities, and how one's actions affect others in the society.

Several accidents have taken place in engineering history, whose root cause in most cases, are more due to human errors than technical or equipment failures. The human errors include negligence and lack of ethical commitment on the part of the designer, the producer, or the operator of the engineering systems. This has called for the need to educate engineers on ethics at the college level itself.

Under this scenario, the Ethics Resource Centre has been established in USA in 1977 with the expressed objective of promoting ethical thought among corporate employees, and several books have been written on this concept. Simultaneously, many western universities have taken up the task of educating prospective engineers in the ethical dimensions and introduced the subject *Professional Ethics* or *Engineering Ethics* at the undergraduate level.

Among the several books on ethics, *Ethics in Engineering* by Mike Martin et al. is a good treatise. However, the topics were found to be written in continuous text style, making it difficult for students to comprehend the subject. Most Indian books are fully based on this single book, looking more like precise writing on the referred book including case studies with little or no Indian context.

In view of these factors, I had desired to write a book on this vital subject that I have been teaching, and this is the result of my effort. I have made extensive reference to Internet websites, religious scriptures, and several reference books on the subject. While, in general, the pattern of the Anna University syllabus is followed, other topics studied in other universities are also included as listed below.

Every chapter starts with a brief synopsis of the contents as well as the keywords used in the chapter. At the end of every chapter, a question bank is added with short-answer questions as well as detailed-answer questions. Another feature is the inclusion of objective questions for each chapter to make the question bank more interesting. Illustrations and case studies based on newspaper reports during the past one year are provided.

D R Kiran

UNIT I

HUMAN VALUES

LIST OF CHAPTERS

1

Introduction

- What is Ethics?
- Personal vs. Professional Ethics
- Professional Ethics vs. Personal Ethics vs. Common Morality
- Characteristics of Common Beliefs and Morality
- Professional Ethics and Engineering Ethics
- Importance of Ethics
- Senses of Engineering Ethics
- Ethics Office in Corporate Sector
- Indian Lok Sabha Committee on Ethics
- Applied Ethics
- Micro Ethics and Macro Ethics
- Significance of Ethics
- Why Study Ethics as a Higher Education Program?
- Why Ethics for Engineers?
- Some Recent Developments Towards Ethics in Education
- Other Training Requirements for Young Engineers
- Service Learning
- Teaching Teachers on Ethics

After explaining the meaning, definitions, the significance and senses of applications of ethics, this chapter discusses the need for teaching ethics to engineering students, besides training them in other character and personality improvement parameters as a part of the curriculum.

Keywords: *Professional ethics, personal ethics, common morality, Ethics Resource Centre, Corporate ethics, applied ethics, micro ethics, macro ethics and senses of ethics, Indian Lok Sabha Committee on ethics, quality philosophy, soft skills, self-confidence, service learning, community services, social awareness, academic and social objectives, ethics in education, seminars on ethics.*

1.1 WHAT IS ETHICS?

Ethics is a set of principles or standards of human conduct that govern the behavior of individuals or organizations. By these ethical standards, a person or a group of persons or an organization regulate their behavior to distinguish between what is right and what is wrong as perceived by others.

Philosophically speaking, ethics is concerned with what is morally right and morally wrong in a given field of human activity.

The *Cambridge Encyclopedia* defines ethics as that branch of philosophy dealing with the concepts and principles of morality and including such theoretical questions as the source and foundation of morality, the status and justification of moral rules, the relationship between moral and other human objectives, and the nature of the responsibility.

In short, we can propound the following definitions for ethics.

- Ethics can be defined as the discipline dealing with the moral duties and an obligation explaining what is good or not good for others and us.
- Ethics is the study of moral decisions that are to be made by us in the course of performance of our duties.
- Ethics is the study of characteristics of morals and deals with the moral choices that are made in relationship with others.
- Ethics is concerned with truth and justice considering a variety of aspects like the expectations of the society, fair competition, public relations, social responsibilities, and corporate behavior.

1.2 PERSONAL VS. PROFESSIONAL ETHICS

Fleddermann distinguishes personal and professional ethics in the following ways:

- *Personal ethics* deals with how we treat others in our day-to-day lives. Many of these principles are applicable to ethical situations that occur in business and engineering.
- However, *professional ethics* often involves choices at an organizational level than at the personal level. It involves relations between two organizations, between the corporation and the government, or with the society or between groups of individuals.

1.3 PROFESSIONAL ETHICS VS. PERSONAL ETHICS VS. COMMON MORALITY

Charles Harris gives another definition for professional and personal ethics and compares the above with common morality as follows:

- *Professional ethics* is a set of standards adapted by professionals in so far as they see themselves acting as professionals.
- *Personal ethics* is the set of standards of one's own commitment and interpretation of moral and immoral acts, usually based on the early training received at home.
- *Common morality* is the set of standards shown by a certain community or society.

Example

- If an engineer refuses to design a military hardware because he is against war, this is personal ethics rather than professional ethics or common morality.
- But if he feels that certain design factors of a component are against the interest of the customer and if he insists on giving the needed technical information to his client, he is acting on personal and common morality, though not with professional morality.
- On the other hand, if the engineer refuses to develop a process that results in excessive pollution of the environment, he is following professional ethics, personal ethics, and common morality.

1.4 CHARACTERISTICS OF COMMON BELIEFS AND MORALITY

1. Vulnerability Being susceptible for pain suffering, unhappiness, etc.

2. Autonomy We, at least to some degree, can think for ourselves and make our own decisions regarding moral actions.

3. Interdependency We depend on others in getting what we want and for performance of our day-to-day duties.

4. Shared Expectations and Goals We are also socially conscious and want to work together as teams and enhance our reputation among others.

Common moral traits like fairmindedness, self-respect, respect for others, etc. can be found in most human beings.

1.5 PROFESSIONAL ETHICS AND ENGINEERING ETHICS

The concepts and practices of ethics is applicable in any job function a professional is engaged in, whether he/she is an engineer, or a doctor or a lawyer or a consultant. Hence, while this book is titled *Professional Ethics*, it mostly deals with ethics relevant to the engineer as a profession or, in short, *Engineering Ethics.* Thus, though we refer the topic as *Professional Ethics* in several parts of this book, it invariably refers to *Engineering Ethics* so long as it refers to the engineer.

As suggested here, the other forms of ethics can be

- Medical ethics
- Business ethics
- Accounting ethics
- Legal ethics
- Consultancy ethics
- Corporate ethics, etc.

1.6 IMPORTANCE OF ETHICS

Several notorious instances, accidents, or scams, or other impacts caused because of simple negligence of duties due to lack of appreciation of responsibilities have attracted a great deal of attention that led engineers to gain an increased sense of their professional ethos and responsibilities.

Examples

- Overconfidence and lack of sufficient safe exits (*Titanic* disaster)
- Impatience (explosion of *Challenger Space Shuttle*)
- Poor maintenance (Bhopal gas tragedy)
- Inadequate safety factor in valve design (Three Mile Island Nuclear Power Station)
- Ignoring obvious safety hazards (Chernobyl Nuclear Power Plant explosion)
- Disregard to basic safety equipment and safe exit (Delhi Theatre fire accident)
- Ignoring potential landslides (Mathsyagandha Express accident on Konkan Railway in June 2004)
- Encroachment on free fire exit (Kumbakonam School fire accident)
- Letting unskilled and untrained labour handle highly explosive material under poor supervision (Sivakasi fire accidents)

These and several other major accidents have been analyzed and they indeed pointed to small omissions or negligence on the part of the personnel or the organizations involved. It has also been reasoned out that these persons had not given thought to all possible accidents and had an attitude that accidents are God's doings and the loss of life was negligible compared to the cost of providing higher safety factors for ensuring 100% safety of the equipment manufactured or operated by them. These incidences and attitudes have raised a lot of debates and created public awareness on the need for following and maintaining ethics in the engineering profession.

So…

- Several data were collected and studies were made
- Several theories were proposed
- Several books were written

…… … all in the recent times.

These studies and theories are aimed at explaining the principles, guidelines variances, and need of engineering ethics in simple words, so that all the practicing engineers as well as budding engineers and students appreciate and adapt these principles in their day-to-day career and whenever they face ethical dilemmas.

Thus, in a nutshell, we can say that the primary goal of studying ethics is to stimulate critical and responsible reflections on the ethical issues surrounding engineering practices.

1.7 SENSES OF ENGINEERING ETHICS

As we have seen from the definitions, the term *ethics* embraces several moral tenets of what we should do and what not to do under specific situations. Obviously, these explanations are distinct though related and it all depends on which sense we express the concept of ethics or, more specifically, professional ethics. We can broadly classify these senses of expression or usage of the term into four:

1. Senses of the Field of the Activity and Understanding Through Enquiry

This means that ethics is an activity where we seek to learn and understand the moral values by inquiring and analyzing into certain practices. These moral values, when understood, would guide us in resolving moral issues in and justifying the moral judgments we make. *Engineering Ethics*, in this sense, refers to the activity aimed at understanding moral values that guide us in performing our engineering practices and justifying the moral judgments we make as engineers.

2. Distinction of Moral Issues from Nonmoral Issues

Here, the term *ethics* makes a contrast between moral issues and nonmoral issues of say political, legal or artistic in nature, which are at a different level and concept than from those of engineering profession. A clear distinction is sought to differentiate between illegal activities, immoral activities, unethical activities, and wrongful activities. Engineering ethics, in this sense, refers to a set of moral issues faced by the engineer during the day-to-day practice of his/her profession.

3. Codes of Conduct

In some cases, ethics may refer to certain established codes of practices, beliefs, etc., displayed to maintain morality. When we say ethics of *Panchatantra*, or ethics of Ramana Maharshi, we mean the ethics or moral values illustrated or preached by them. Similarly, we can say Greek ethics, Martin Luther ethics, Gandhian ethics, and so on.

4. A Synonym for 'Morally Correct'

This is like saying someone is acting ethically or unethically. In this usage, engineering ethics refers to how a professional adheres to the codes with reference to his/her responsibilities, obligations, rights, and ideals, which may vary significantly from person to person. Such variances too are sometimes specified in the codes of practices.

1.8 ETHICS OFFICE IN CORPORATE SECTOR

As a sequence to the development of ethical thoughts in the modern era, as described in the next chapter, an Ethic Resource Center has been established in USA in 1977 to promote ethical thought throughout USA. A major step done in this direction has been to promote setting up of an exclusive Ethics Department in every medium and large organization. The specified purpose of this department is to

1. Ensure that the employees develop the ability and freedom to express their concerns about issues like safety (or in other words, whistleblowing)
2. Foster an ethical atmosphere and culture in the organization, thereby increase employee morale
3. Develop analytical thinking of the employees so that they can take right ethical decisions

4. Provide case studies and illustrations, which help employees to appreciate the right ethical decisions for specific issues and develop the right thinking when the problems crop up

ERC has also reported the existence of the following national-level ethic centers.

- The Gulf Centre for Excellence in Ethics (GCEE), Abu Dhabi, UAE
- The South African Ethics Institute, (Ethics), South Africa
- Transperencia for Columbia, Columbia
- The Centre for Business Ethics (CBE), St. Petersburg, Russia
- The Turkish Ethical Value Foundation (TEDMER), Turkey
- The Korean Business Ethics Institute (KBEI), Korea

1.9 INDIAN LOK SABHA COMMITTEE ON ETHICS

The Indian Government set up an ethics panel in the Lok Sabha as per the newspaper report that appeared on 30 April 2005, summarized as below:

> *The Indian Government has set up a 15-member Lok Sabha Committee on Ethics headed by Mr Chandra Sekhar, former Prime Minister of India. It will oversee the moral and ethical conduct of members, examine the complaints of unethical conduct and frame rules specifying acts which constitute unethical conduct. In examining complaints, it will follow the same procedure adapted for inquiry and determination by the Committee on Privileges as also for rules relating to consideration by reports, a Lok Sabha Bulletin said.*

1.10 APPLIED ETHICS

The study of ethics basically falls into two categories:

1. *Ethics* involving systematic enquiry into moral norms or standards of behavior and understanding their underlying values and justification.
2. *Applied ethics* dealing with the application of ethical principles in the moral-decision dilemmas. This also includes analysis of case studies and drawing of alternative ethical behavior in specific situations.

1.11 MICRO ETHICS AND MACRO ETHICS

There can be two approaches to engineering ethics:

1. The first one is emphasize the typical day-to-day problems in engineering practices like deciding upon the factor of safety. This is called *micro ethics*.
2. The second approach emphasizes on the social problems like the intentional or deliberate deviations often due to grafting or corruption. These ethical problems generally are dormant and are not addressed till they resurface unexpectedly in a highly magnified form and become a regional or national or even an international issue. This is called *macro ethics*.

1.12 SIGNIFICANCE OF ETHICS

- Ethics correspond to basic human needs. These basic ethical needs compel the organizations and corporations to be ethically oriented.
- Ethics create credibility and image for the corporations with the public.
- Ethics improve the employee morale and improve the credibility of the management with the employees.
- Ethics help better decision making.
- Ethics improve the overall profits of the company.
- Ethics protect the society and environment more than the law.

1.13 WHY STUDY ETHICS AS A HIGHER EDUCATION PROGRAM?

Educational institutions, especially professional institutions, can play a significant role in providing a sound foundation for professional ethics and values to students. Understanding the concepts of ethics and having an awareness of the professional codes of ethics and their role in nation building could largely help in developing a mindset tuned to precepts of ethics among students. This awareness and mindset will ensure that on graduation they carry a high sense of social responsibility and commitment to uphold the degree and honor of the profession. In the past one or two decades, many universities abroad, especially in the US, have set up centers for development of the concept and training methods in ethics and integrated them in the course curricula. *The Centre for the Study of Ethics in the Profession* at Illinois Institute of Technology (USA) is an illustration. In India, Anna University and other leading educational centers have pioneered in this direction. Nevertheless, a lot is still to be done for setting up of ethics centers in all the universities as well as corporations. To conclude, the following may be cited as some of the advantages of studying ethics in professional education.

1. Stimulating the Moral Imagination Imagination is needed to anticipate problems and to minimize the chances of being taken by surprise.

2. Recognizing Ethical Issues and distinguishing them from technical issues.

3. Developing Analytical Skills While engineers are trained in analytical skills for solving technical problems, they should be trained in analytical skills in identifying and solving ethical problems also.

4. Eliciting a Sense of Responsibility Though every engineer or every person appreciates that he/she should undertake certain responsibilities, training a person from the ethical point of view also would go a long way in his/her identifying and practicing these responsibilities.

5. Provide Codes of Ethics Ethical training would enable an engineer to appreciate and understand each of the canons indicated in codes of ethics drawn by professional bodies.

6. Provide Case Studies and Illustrations which help the employee to appreciate the right ethical decisions for specific issues and develop the right thinking when problems crop up. Discussions on case studies would enable an engineer to distinguish disagreements and ambiguities from realities.

7. Ensure that the employees develop the ability and freedom to express their concerns about issues like safety (or in other words, *whistleblowing*).

8. *Foster an ethical atmosphere* and culture in the organization, thereby increase employee morale

1.14 WHY ETHICS FOR ENGINEERS?

Engineering, as a profession, creates products and processes not only to satisfy the basic needs of humans but also to enhance the conveniences, comforts, power and aesthetics of everyday life. These products and processes are very much concerned with public life, more specifically of public health and safety. Engineers constantly involve themselves in the exercise of expert judgment and decision making in this creation. Unethical doings or actions are unbecoming of a professional. Engineers are professionals with high intellect and are supposed to have high ethical conduct.

Engineers are called experimenters, as everything they do would be done for the first time. The end products produced by them, like the construction of a bridge or development of new chemical process, have a direct impact on the safety and health of the society. Hence, engineers should be taught the ethical aspects of a product or process development at the college level to create awareness in them. This would also improve their outlook on their role in the protection of the interests of the society and the environment.

While making expert judgments, engineers constantly come across dilemmas in deciding which alternative to choose. One may consider the alternative he/she chooses as the best. But others, his/her colleagues or managers or customers, may not agree with that alternative being the best. This is because every alternative appears equally good or bad to different persons.

Once engineers start their career in an industry, they are faced with real ethical problems in their day-to-day work, and what all they studied during their BE, would certainly help them in tiding over ethical problems.

Hence, the concept of ethics as well as the understanding of guidelines would help engineers identify better alternatives that would be good for all. The engineers would thus be able to respond appropriately to ethical challenges during their career. Ethics would certainly show students a lot of things that go wrong in the workplace which have peoples' issues wrapped up in them.

1.15 SOME RECENT DEVELOPMENTS TOWARDS ETHICS IN EDUCATION

In 2000, a requirement that graduates from engineering schools of USA must demonstrate ethical awareness was included as a criterion for the accreditation of US schools of engineering. Since then, a few schools like A&M University of Texas in College station and the University of Virginia made ethics classes mandatory while some made it an elective. Some included ethics discussions into standard engineering courses, called *achieving ethics across the curriculum*. The aim for this is

- The students should acquire an ability to recognize and analyze the role that technology plays in important contemporary issues,
- They should apply these skills in solving engineering problems, and
- They should appreciate the perspectives differing from their own.

Some universities introduced a two-semester course with a thesis on examining ethical questions that may crop up when a system is first introduced or a project is under way, as discussed in Chapter 6 of this book. In India, Anna University was the first to introduce this subject as a mandatory course to all branches of engineering, though unfortunately it has recently been made an optional subject for engineering students. The following are some of the cases where study of ethics and related topics are introduced in the curricula at institutes of higher learning.

Organizational Behavior and Business Ethics have been made compulsory subjects in management studies in most universities and colleges of India. Some of these institutions are the following:

1. IIT Madras, Chennai, conducts a course on *Ethics*, conducts *Professional Development Workshops* and also has a forum called *Reflections*, where students discuss issues related to society,
2. Jawaharlal Nehru Technical University (JNTU) initially introduced it as two separate subjects for MBA. From 2013–14 onwards, it has been combined into a single subject for BE courses, hopefully as a compulsory subject for all branches.
3. The Indian School of Business, Hyderabad, has *Business Ethics* as a part of the curriculum and also has an elective paper on *Business Ethics* and another course on *Government, Business and Society*.
4. Cochin University of Science & Technology (CUSAT) offers compulsory orientation classes for first-semester students,
5. Amritha Institute of Management, Cochin, offers holistic ethics education,
6. Grace Academy of Management Sciences, Trissoor,
7. Institute of Hotel Management and Catering Technology, Tiruvananthapuram, introduced a compulsory paper on *Ethics Related to Hospitality*,
8. Symbiosis Institute of Health Science, Pune, has introduced a two-year MBA in Hospital and Health Care, with *Ethics in Health Care* as one of the subjects.

In fact, this author remembers having studied civics during his elementary school education in the mid-fifties in India as a core subject. This was compulsory for all elementary students. This subject taught the social and environmental responsibilities of every human being. It is, hence, understandably surprising why this subject has been discontinued from the elementary education in India today.

1.16 OTHER TRAINING REQUIREMENTS FOR YOUNG ENGINEERS

During one of the technical meetings of a professional association in 2002, the CEO of a popular group company had responded to the author's query, by pointing out that several fresh graduates who join the industry find it difficult to match their subject knowledge with the practical environment of the industry. Even class toppers sometimes fail in carrying out their duties after employment.

It is hence not out of place to suggest that young engineers need to be introduced to several other personality-improvement trainings as part of the technical curriculum as outlined below.

1. Training in Quality Philosophy

Today it is the buyers' market. Despite the high-technology manufacturing process adapted and a high level of quality control exercised, the success of a manufacturing organization depends on how the customer is satisfied with the products or services. This cannot be achieved just by learning or conforming to the product specifications. Everyone should appreciate that quality has to be maintained at each and every aspect of life. The quality philosophy and commitment should permeate into the minds of each and every one. This is more so with budding engineers, and their student life is the optimum period for getting trained.

Training the students in total quality management and making them appreciate quality philosophy is not only needed in their day-to-day working, irrespective of the field of work, but also in their day to day lives.

2. Emphasis on Comprehension

While teaching subjects like machine design that involve several mathematical calculations, it is not enough for the teacher just to explain the formulae or make the student work out the problems. He/She should explain the practical significance of each and every step and pay emphasis on explaining the practical application of each and every component. Similarly, in case of statistics, it is essential to make the student comprehend the practical significance of each and every parameter, before working out the problems.

3. Development of Soft Skills and Communication Abilities

It is a common fact that when a student attends an interview, he/she is tested more on how he/she responds than what he/she answers. In short, the following are some of the aspects of the students, called *soft skills*, as observed in order to judge his/her capacity to work in their organization.

- Communication skills and the fluency of expression, basically in English
- Methods of expressions and mannerism
- Behaviors in a group, especially in group discussions
- Ability to comprehend the questions and the quickness in response
- Skill in preparing the biodata which should be crisp and highlight only those points the organization or the interviewer would be interested in

For this reason, it is vital that colleges organize specialized short-term courses for the third and final-year students. A part of this training would be to conduct mock interviews.

4. Human Relations

Apart from technical subjects, it is essential to make students appreciate the importance of human relations since they have to work together with their colleagues, bosses, and subordinates in their day-to-day work in an industrial environment, especially in a dynamic situation. This is normally done by conducting guest lectures by HRD experts from industry.

5. Increasing Self-confidence and Team Spirit

Self-confidence is an attitude that allows individuals to have positive yet realistic views of themselves and their situations. They trust their own abilities, have a general control over their way of living and believe that within reason they would be able to do what they wish, plan, and expect. It strengthens their mental stability and will power for the successful achievement of any task and motivates them to move in the right direction.

6. Organizing Outdoor Games

These too are vital for the student, and once the transport is provided as above, several students would naturally be interested in excelling themselves in sports and bring name to the college.

7. Organizing Annual Student Seminars Involving Outside Students

Every department of the institution should organize at least one inter-collegiate paper presentation competition in the form of student seminars. These should fully be organized by the students, under guidance of the HOD and other staff members. Generally, all final-year students and a majority of others are inducted into the committees and it is the author's experience that even those students who are below average otherwise show up themselves as good organizers, and it is this experience that finally helps them to succeed in their life. Similarly, there shall be one or two national-level conferences organized per year by the college for the benefit of industries and faculties of other colleges. AICTE, ISTE, AU, etc., are funding these courses and seminars.

1.17 SERVICE LEARNING

Among the above, a significant character-development training is service learning. Instead of limiting the teaching activities to only the curricular subjects specified by the university, the institutions should strive in encouraging and training the students in several extra-curricular activities and service learning. Service learning is a teaching method that enriches learning by engaging students in meaningful service to their schools and communities in solving real-time problems. Service learning provides students with opportunities to understand the practical problems faced by the common public and the society. They lead the process with adults or professors as partners. In most educational institutions, it is included in the curriculum as Community Services or National Service Scheme (NSS). The students teach themselves to provide assistance and counseling to villagers and other less privileged public about education, agriculture, hygiene, welfare schemes, health, and more significantly, awareness about common issues like AIDS and family planning. With a good academic background, they apply critical thinking and problem-solving skills to solve these issues. One of the professors in charge of such socio-education camps has summarized this by saying

> "Every year we organize rural camps, where the students are taken to remote places and are made to stay there for a week or so, interacting with people and involving themselves in road construction and other activities. This helps them know the grave realities around them."

Benefits of the Service Learning Schemes

1. They serve as platforms for developing and cultivating self-confidence, self-respect, and social awareness among students.
2. They enhance positive mental attitude and inclination among students to take up social and rehabilitation activities for the benefit of the society.
3. They enhance their will power and proactive attitude to fight against social imbalance and injustice.
4. They develop the aptitude and creative power among students, helping them even in their further research-oriented studies.
5. They form the basis to mould the character and conduct of students for the fulfillment of their academic and social objectives.
6. They help the students to communicate with the underprivileged and their popularity among them helps their college also.

> *An illustration can be given of a private engineering college in the suburbs of Chennai which has become popular in the neighborhood in view of the NSS activities of the students in their village resulting in peaceful existence. On the other hand, another college, closer to Chennai, has no NSS activities, and the movement of their buses and other vehicles are generally subjected to resistance or ill will from the people of the neighboring village.*

1.18 TEACHING TEACHERS ON ETHICS

In view of the importance attributed to teaching of ethics as explained in the above paragraphs, the governments, the universities as well as professional institutions all over the world are funding national workshops on teaching this subject. In India, Anna University, the All India Council for Technical Education, and the Indian Society for Technical Education are some of the bodies providing funds to individual engineering colleges in conducting national-level seminars and workshops in Professional Ethics, like those organized by Sri Ram Engineering College, Velammal Engineering College etc., in Chennai.

As recent as July 2013 a one week Faculty Development Program on ‘Train the Teachers in Professional Ethics’ inviting speakers from all over India was conducted by the University School of Engineering & Technology of Guru Gobind Singh Indraprastha University, Delhi.

Question Bank

PART A

(Each question carries 2 marks which you are expected to answer in 3 minutes.)

1. What do you understand by ethics?
2. What are the objectives of ethics?
3. Give at least four explanatory definitions for engineering ethics.
4. Distinguish between personal and professional ethics.
5. Explain the scope of engineering ethics.
6. What is the need to focus on professional ethics?
7. Give some examples of human factors that led to major accidents.
8. Write short notes on Ethics Resource Centre.
9. Explain the scope of the department of ethics in the corporate sector.
10. What are the different senses of application of the term ethics?
11. What is Applied Ethics?
12. Distinguish between macro ethics and micro ethics.
13. Why should we train engineers in ethics?
14. List the characteristics of common beliefs and morality.
15. Distinguish between medical ethics and engineering ethics.
16. Give an illustration each for legal ethics, audit ethics, and medical ethics.
17. What is the scope of the Ethics Committee of the Indian Lok Sabha?

PART B

(These are mostly 8-mark questions to be answered in 12 minutes, presuming that the time allotted for a 100-mark question paper is 3 hours. Sometimes the same question may be asked as a 16-mark question to be answered in 25 minutes.)

1. Justify the reason for including the subject of ethics in the BE curriculum.
2. Indicate the several definitions and the scope of ethics in engineering education.
3. Discuss the three types of enquiries giving explanations and illustrations for each.
4. Discuss the need and benefits of service learning.

PART C

(Objective-type Questions)

1. Fill in the blanks:

(i) Ethics is the study of ______________ that are to be made by us in the course of performance of our duties.

(ii) ______________ is the set of standards shown by a certain community or society.

(iii) Interdependency means ______________

(iv) Development of ethics in the corporate sector is called ______________.

(v) ______________ is one of the purposes of studying ethics the BE level.

2.

(i) Engineer : Engineering ethics :: Doctor : ______________

(ii) Micro ethics : day to day issues :: ______________ : grafting or corruption.

3. State if the following statements are true or false:

(i) Applied ethics deals with the application of ethical principles in the moral-decision dilemmas.

(ii) Application of ethics in deciding the factor of safety is called macro ethics.

(iii) Engineering ethics is the distinction of moral issues from non-moral issues.

2

Human Values

- Definition of Human Values
- Definition of Virtues
- McIntyre's List of Virtues
- Moral Unity and Integrity
- Honesty
- Eight Ways of Misusing the Truth
- Other Forms of Lack of Integrity in Research and Development
- Civic Virtues
- Courage
- Valuing Time
- Empathy
- Self-Respect
- Self-Confidence
- Modesty
- Generosity
- Character
- The Ten Commandments of Character
- Responsibility
- Senses of Responsibility
- Legal vs. Moral Responsibilities
- Impediments to Appreciation of Responsibility
- Spirituality
- Spirituality vs. Religion, Supernatural, and Faith
- Religion and Ethics
- The Golden Rule in Religious Ethics

This chapter deals with several concepts and elements of human values and virtues identified by Aristotle, McIntyre, etc., and explains their inter-relationships.

Keywords: *Human values, virtues, unity, integrity, compromise, discretion, honesty, plagiarism, civic virtues, courage, valuing time, empathy, caring, self-respect, self-confidence, modesty, generosity, character, ten commandments of character, responsibility, accountability, microscopic vision, groupthink, mindset, mud-guarding.*

2.1 DEFINITION OF HUMAN VALUES

A profession is dedicated to the moral ideals as exhibited by the spirit of professionalism. These ideals are called *human values*, which are defined as the desirable features describing the character of a person. The *Oxford Dictionary* defines values as the standards of human behavior. This term is traditionally referred to in scriptures and textbooks as virtues and consequently the chapter uses the term *virtues* which may, for all practical purposes, refer in general to the term *Human Values*.

2.2 DEFINITION OF VIRTUES

The *Oxford Dictionary* defines virtue as a behavior that shows high moral standards. These are akin to the moral values and ethics, as described in the previous chapters. There are four basic types of virtues.

1. Self-direction Virtues that are needed for exercising moral autonomy and responsibility They include good moral judgment, courage, perseverance, fidelity to commitments, integrity, honesty, self-understanding, and humility.

2. Public-spirited Virtues that are focused on the good for the public effected by one's work and also on the good of the clients. They include justice, having no intention for harming others, intentionally or unintentionally, and a sense of accountability to the society.

3. Teamwork Virtues that are essential in enabling engineers to work successfully with others, like loyalty to the employers, cooperativeness, collegiality, loyalty, leadership qualities, and effective communication.

4. Proficiency Virtues possessing the mastery of one's craft and skills, like competency, diligence, and creativity.

2.3 McINTYRE'S LIST OF VIRTUES

McIntyre cites the following as virtues:

- Unity
- Integrity
- Honesty
- Self-respect
- Responsibility
- Accountability

2.4 MORAL UNITY AND INTEGRITY

- *Moral unity* is the consistency among our attitudes, emotions, and conduct. Integrity makes one feel responsible for all his/her actions, good or bad.
- *Moral integrity* is the unity of the character on the basis of moral values. It is the unity between the responsibility of an individual in his/her personal and professional life. Integrity promotes the attitude in an individual that he/she is responsible for all wrongdoings in his/her acts.
- *Compromise* is the attitude to settle things by mutual concession or reconciliation by mutual adjustments in attitude and conduct, when a difference of opinion exists. This is akin to tolerance cited in Chapter 6.
- *Discretion* is the sensitivity to the legitimate areas of privacy of the employer or client, especially with regard to confidential information.

2.5 HONESTY

Honesty is a fundamental virtue for all engineers who engage in relationships with their employers and clients. These relationships are based on trust that the engineers will perform effectively and truthfully the activities for which they are employed. Honesty takes the following three forms:

- *Honesty in acts*, like refraining from stealing, account manipulation, etc.
- *Honesty in speech* is telling the truth always like king Harishchandra, never involving in deceptive talks or hiding the truth with an intention to gain.
- *Honesty in beliefs*

Remember the story of the woodcutter and the river goddess? A woodcutter loses his axe into the river while cutting a tree growing over the river. He prays to the river goddess to retrieve his axe. The goddess first appears with a golden axe and enquires if it is his. The honest woodcutter says it is not his. Next, the goddess appears with a silver axe and he denies that also. The goddess then appears with his steel axe, and he says it is his. The river goddess is pleased with his honesty and presents him with all the three axes.

2.6 EIGHT WAYS OF MISUSING THE TRUTH

1. Lying
2. Deliberate deception
3. Withholding information
4. Failing to promote adequately the dissemination of information
5. Failure to seek out the truth
6. Revealing confidential or proprietary information secretly
7. Allowing one's judgment to be effected by corruption and bribery
8. Allowing oneself to be subjected to extortion

2.7 OTHER FORMS OF LACK OF INTEGRITY IN RESEARCH AND DEVELOPMENT

Trimming Data by smoothening irregularities for the purpose of showing them as accurate and precise. However, this is allowed to some extent by convention.

Cooking Data like deliberately omitting certain data that would lead to a different result than intended.

Forging Data by inventing some or all the data without exactly performing the experiment.

Plagiarism by use of intellectual properties of others without due reference to them or credit though drawing a line between legitimate and illegitimate use of intellectual properties is often difficult.

Multiple Authorship though legitimate in general, is sometimes used by some researchers by including too many names as authors, just to satisfy the need of some to show a large number of publications.

2.8 CIVIC VIRTUES

Civic virtue is the cultivation of habit of personal living, important for better society interaction and for the success of the community. The identification of the character traits that constitute civic virtue has been a major concern of political philosophy. This has been the main theme of the teachings of ancient philosophers like Socrates and Aristotle, who emphasized that *to live in accordance with nature is to live in accordance with virtue.* It is believed that civic virtue is not a genetic character but is acquired through programmed training methods right from the childhood of a person. This is the reason why *Civics* is taught in the elementary education scheme. Character building and molding is a significant aspect of civic education in shaping the personality and character of a student.

Apart from the above, the major component of a civic virtue in today's context is the acceptance of one's responsibility for the welfare and health of the society as well as the role played in environment protection, which have been dealt more in detail—the former in chapters 11 and 12, and the latter in Chapter 21.

2.9 COURAGE

The *Oxford Dictionary* defines courage as the conviction on the part of a person to act on one's belief despite danger or disapproval. It refers to the bold and uprighteous expression of views and actions without any fear and submission. Courage is generally associated with self-discipline that leads one to success. It strengthens the mental caliber and personal integrity for analyzing and solving critical problems without any fear or disappointment. It also encourages one to fight against evil or social injustice with a sense of moral devotion and commitment. The synonyms, or related terms, are boldness, bravery, daring, dauntlessness, fearlessness, prowess, gallant heroism, unafraid, undaunted, and valor.

2.10 VALUING TIME

Valuing time means optimal utilization of the time available for a fruitful purpose by judicial planning. This is also called time management, which is the critical aspect of enhancing productivity and achieving goals as per the desired time schedule.

2.11 EMPATHY

The word *empathy* comes from the Greek work *empathia*. Empathy can be defined as one's ability to recognize, perceive, and directly feel the emotions of others. As the states of mind, beliefs, and desires of others are intertwined with their emotions, one with empathy for another is often able to define more effectively another's modes of thoughts and moods. By empathy, one develops a clear understanding to appreciate the intentions of others in their own views and moral angles. It involves the patient listening of communications to promote a climate of interaction between individuals. This is very common among married couples who come to understand each other very well. This is also the major factor among close friends and colleagues working together in a common environment. This aspect is described more in detail in Chapter 13. The virtue of *caring* is also a result of feeling empathy and showing *generosity* on others

The following are some of other definitions provided by some authors for *empathy*:

- Empathy is the capacity to think and feel oneself into the inner life of another person. ***Heinz Kohut***
- Empathy is an effective response that stems from the apprehension or comprehension of another's emotional state or condition and that is similar to what the other person is feeling or would be expected to feel. ***Nancy Eisenberg***
- We recognize others as empathetic when we feel that they have accurately acted on or somehow acknowledged in stated or unstated fashion, our values or motivations, our knowledge and our skills or competence, but especially as they appear to recognize the significance of our actions in a manner that we can tolerate their being recognized. ***Wynn Schwartz.***
- To perceive the internal frame of reference of another with accuracy and with emotional components and meanings which pertain thereto as if one were the person, but without ever losing the 'as if' condition. Thus, it means to sense the hurt or the pleasure of another as he senses it and to perceive the causes thereof as he perceives them, but without ever losing the recognition that it is as if he was hurt or pleased and so forth. ***Carl Rogers***

2.12 SELF-RESPECT

Self-respect is the characteristic of a person to value himself in morally valid methods. While self-respect and self-esteem are generally used as synonyms, self-respect is a moral concept whereas self-esteem is a psychological concept, which signifies having a positive attitude towards oneself. Self-respect is slightly different from self-confidence, the former involving more of self-assessment while the latter emphasizing on the awareness of the self-possession of abilities. Self-respect can have two components, namely

- *Recognition* meaning showing equal respect to others as individuals and also respect their rights, as much as we want our rights to be respected

- *Appraisal* meaning evaluating oneself based on how the moral issues are faced

2.13 SELF-CONFIDENCE

Self-confidence is an attitude that allows individuals to have positive yet realistic views of themselves and their situations. They trust their own abilities, have a general control over their way of living and believe that within reason they would be able to do what they wish, plan, and expect. It strengthens their mental stability and will power for the successful achievement of any task and motivates them to move in the right direction.

The development of self-confidence in a person depends mostly upon the parental attitude, particularly in early childhood. If the parents keep encouraging the child's moves towards self-reliance and correct or guide the child when a mistake is done without scolding, the child would develop self-confidence and grow into a successful person. On the other hand, if the parents keep scolding him for each and every action, the child loses his self-confidence and grows into an introvert having apprehensions that whatever he/she does or says would only be criticized by others. The inner friend circles, the teachers, or other people close to a person too play a vital role in developing self-confidence. Nevertheless, lack of self-confidence is not necessarily related to lack of ability. A constant guidance from committed persons close to a child would help develop his self-confidence.

Factors for Development of Self-confidence

1. Childhood life and parental care as explained above
2. Purposeful objectives and targets well set after good foresight and planning
3. Consistent plans and commitment for the execution of a task
4. Not expecting too much of approval and consent from others
5. Bold character and a determined approach to solve problems
6. Proactive attitude to assess the reasons for mistakes and failures
7. Failure should be considered as a stepping stone for success
8. Flexible attitude and temperament in dealing with others
9. Modest without being a show-off to others
10. Well-structured communication and mutual exchange of views
11. Beneficial association with people of moral values
12. Not reacting to unhealthy comments from others but taking them in a positive and proactive attitude

13. Being committed for the upliftment of society or the organization to which one belongs to

2.14 MODESTY

The self-confidence explained above should not lead one to arrogance. One should be humble and should not be a show-off. *The Oxford Dictionary* defines modesty as having a humble view of one's abilities and achievements. The synonyms are diffidence, humbleness, inconspicuous, plain, simple unassuming, unostentatious, and unpretentious.

2.15 GENEROSITY

Generosity is the expression of kindliness to others. It is the virtue of freely giving to others more than expected. The synonyms for being generous are benevolent, big-hearted, charitable forgiving, liberal, magnanimous, philanthropic, and open-handed.

2.16 CHARACTER

The term *character* refers to the presence of all good human values and forms the basis for one's personality and credibility. The *Oxford Dictionary* defines *character* as the strength and originality in a person's nature (synonyms: attitude, constitution, disposition, manner, temperament). The other definition is the particular qualities that make a person or thing different from others (synonyms: distinctiveness, individuality, peculiarity, quality, stamp, and uniqueness). The other meanings not related to ethics are, a person's role in a drama or play, and a printed or written letter or symbol.

All the human values that constitute character are described more in detail in the previous paragraphs of this chapter.

2.17 THE TEN COMMANDMENTS OF CHARACTER

Joseph Telushkin, a Jewish Rabbi, in his book *The Ten Commandments of Character*, indicates the following as essential characteristics of an ethical person.

1. Know your weaknesses.
2. When ethics and other values conflict, choose ethics.

3. Treat all people with kindness, and with understanding that they, like you, are made in God's image.
4. Be fair.
5. Be courageous.
6. Be honest.
7. Be grateful.
8. Practice self-control.
9. Exercise common sense.
10. Admit when you have done wrong, seek forgiveness, and don't rationalize bad behavior.

2.18 RESPONSIBILITY

Responsibility is the characteristic of a person where he attributes a moral virtue within himself. That is, he

- Is interested in doing right things,
- Does his duty with care and effort,
- Meets obligations with great care, and
- Carries out his duties with due consideration for others.

2.19 SENSES OF RESPONSIBILITY

In practical applications, the term *responsibility* can be said to have five meanings.

1. Commitment By saying a person is responsible, we mean he is sincerely committed to do the right thing in the right manner.

2. Obligation By saying a person has moral responsibilities, we mean he is morally obliged to do his duties, whether as a professional (like a process control engineer feeling his obligation to check the process parameters regularly instead of sitting in a comfortable chair till his boss comes on rounds), social (committed to the society), or as a person (being obliged to pay the school fees of his children).

3. Moral Capacity By saying a person has a capacity to act in a responsible manner, we mean his moral autonomy has been developed to post-conventional level as theorized by Kohlberg.

4. Accountability By saying a person is accountable, we mean he is ready to accept his accountability for all his actions and is ready to subject himself for assessment.

5. Praiseworthy By saying a person is responsible, we mean his praiseworthiness. For example, if an engineer designs and develops a novel car, he is praiseworthy. But if the car fails and crashes during his first ride then he is blameworthy for this car design. Thus, the person's responsiveness during both the success and failure of his product is an indication of his responsibility.

2.20 LEGAL VS. MORAL RESPONSIBILITIES

As an illustration, in regard to the responsibility of causing harm, we can distinguish the motives:

- *Intentionally* causing harm (knowingly and deliberately causing harm)
- *Recklessly* causing harm (not aiming to cause harm, but acting in conscious awareness that the harm is likely to result)
- *Negligently* causing harm (not knowingly causing harm but failing to exercise due care)

2.21 IMPEDIMENTS TO APPRECIATION OF RESPONSIBILITY

1. ***Self-interest*** with a concern for satisfying one's own interest even at the cost of others
2. ***Egoism,*** unwilling to accept one's own faults
3. ***Fear*** of loss of job or importance
4. ***Self-deception*** Betraying a willful lack of self-understanding, saying that everyone else does this mistake without being made liable. So why should I?
5. ***Ignorance*** of vital information, though it cannot be treated as an excuse.
6. ***Misinterpretation*** due to limited perspectives, similar to the acts of children
7. ***Microscopic vision***, which is like the above but exhibited even in grown-ups. This is a combination of ignorance and misinterpretation. This can also be termed as *mindset* or *wood-headedness*.
8. ***Uncritical acceptance of decision*** especially when there can be no one else to comment or offer advice on what you decide.
9. ***Groupthink*** Even though this is opposite to what is as stated above and sometimes provides the needed moderation (two heads are better than one), this groupthink sometimes makes

groups come into agreement at the cost of critical thinking, that is when most of the group does not want to spend time and energy in analyzing and thinking. Irving Janis, in his book *Groupthink* identifies symptoms of groupthink as follows:

(a) *Illusion of morality* that assumes the inherent morality of the group, thereby discouraging critical examination of the moral implications of what the group does or thinks.

(b) A tendency of individual members towards *self-censorship*, resulting from a desire not to 'rock the boat'.

(c) An *illusion of invulnerability* of the group to failure.

(d) A strong *'we' feeling* that views outsiders as enemies or aliens.

(e) *Rationalization* or mindset that tends to shift responsibility to others.

(f) An application of *direct pressure* on those who show signs of disagreement often exercised by the group leader who intervenes in an effort to keep the group unified.

(g) *Mud-guarding* or protecting the group from outsiders who want to present dissenting views to the group.

2.22 SPIRITUALITY

Spirituality means the personal path of the soul consciousness. It is the internal instinct and the conscious soul which are directed towards the attainment of eternal peace. The goal of spirituality is for us to go towards the goal with honest and sincere intentions, well-focused attentions, being ethical in our dealings with others, and the clarity to appreciate and embrace the well being of all around us. Spirituality involves the practice and teaching of the several aspects of ethics and human values like integrity, honesty, tolerance, forgiveness, patience, obedience, self-confidence, commitment, etc., some of which are described in earlier paragraphs. Chapter 3 explains the concept of spirituality in broader details, referring to several scriptures in this connection.

Spirituality inspires us to stimulate our inner mind and ponder over the philosophical and moral aspects. It is an active and vital connection to a force, power, or sense of the deep self. Some proponents indicate that spirituality is a two-stroke process. The upward stroke related to the inner growth and the downward stroke relates towards adapting ourselves to the reality and world around us which is dynamic as a result of the inward change.

Spirituality may include the belief in God and supernatural power as in religion, but the emphasis is on self-experience. The concept of spirituality makes us believe that there are several spiritual paths while religion specifies one of these paths.

2.23 SPIRITUALITY VS. RELIGION, SUPERNATURAL, AND FAITH

In contrast to the spirituality as explained above, *religion* (based on the Latin word *religion*, meaning *good faith*) is a belief in the divine, supernatural, or sacred forces that result in worship in institutional or culturally bound expressions. The *supernatural* refers to conscious, magical, or unknown forces that cannot be ordinarily perceived except through significant effort. Unlike the natural forces, these supernatural forces cannot be shown to exist by scientific methods. Claims of supernatural phenomena conflict with current scientific thinking. *Faith* means trust, belief, or confidence. The object of faith can either be a person or an inanimate object or a proposition.

2.24 RELIGION AND ETHICS

1. They are related historically. Our morals, ethics, and outlooks are molded by the tenets of the religion to which a person belongs.
2. Religious views support moral responsibility, which provides additional motivation for being moral.
3. Religion sometimes sets higher moral standards than conventional ones.

2.25 THE GOLDEN RULE IN RELIGIOUS ETHICS

The golden rule that says ‘Treat others in the way you want them to treat you’ is reflected in many religions in some form or the other.

Christian Version: ‘Treat others in the way you would like them to treat you’ *(Luke 6.31, New English Bible)*

Hindu Version: ‘Let not any man do unto another any act that he wishes not done to himself by others, knowing that it would be painful to himself’ *(Mahabharata, Santhiparva cclx 21)*

Buddhist Version: 'Hurt not others with that which pains yourself' *(Udanavarga, v. 18)*

Confucian Version: 'Do not do to others what you would not want them to do to you' *(Analecs, Book xii, #2)*

Jewish Version: 'What is hateful to yourself, do not do to your fellow man. That is the whole of the Torah.' *(Babylonian Talmund, Shabbats 31a)*

Muslim Version: 'No man is a true believer unless he desires for his brother that which he desires for himself' *(Hadith, Muslim, Imam 1-72)*

Question Bank

PART A

(Each question carries 2 marks, which you are expected to answer in 3 minutes)

1. Define the term *virtue*.
2. What are the four basic types of virtues?
3. What are the virtues identified by Aristotle?
4. What is McIntyre's' list of virtues?
5. What do you mean by moral integrity and moral unity?
6. What do you understand by self-respect?
7. How does self-appraisal help an engineer in increasing his ethical behavior?
8. What are the basic concepts of right action?

PART B

(*These are mostly 8-mark questions to be answered in 12 minutes, presuming that the time allotted for a 100-mark question paper is 3 hours. Sometimes the same question may be asked as a 16-mark question to be answered in 25 minutes.)*

1. Discuss the four basic classifications of virtues.
2. Discuss some of the ways of misusing the truth especially in data collection for R&D.
3. What are the senses in which the term *responsibility* can be applied? Illustrate.
4. What are the impediments in the appreciation of responsibility?

PART C

(Objective-type Questions)

1. Fill in the blanks:

(a) Over-talkativeness is excessive possession of the virtue ________ as named by Aristotle.

2 (a) Match the following:

(i)	Duty ethics	—	John Rawl
(ii)	Human rights ethics	—	Immanuel Kant

(b) Match the following:

(i)	Courage	—	Teamwork virtues
(ii)	Fair play	—	Proficiency virtues
(iii)	Collegiality	—	Public-spirit virtues
(iv)	Competency	—	Self-directive virtues

UNIT II

ENGINEERING ETHICS

LIST OF CHAPTERS

3

History and Development of the Concept of Ethics

- Pre-Historic Days
- Ethics in Hindu Mythology
- Code of Dharma
- Ethics in Hindu Philosophy
- The Ashoka Chakra
- The Ten Commandments
- Medieval Era
- Post-Industrial Revolution Scenario
- Development of Modern Precepts of Ethics

After introducing the concept of ethics in the pre-historic, medieval and pre-nineteenth century eras, this chapter divides the development of ethics into five-decade periods. It also highlights setting up of the Ethics Resource Centre, National Whistleblowing Centre, etc. Scriptures are quoted to illustrate the existence of the ethical concept in ancient times.

Keywords: *Hindu mythology, Vedas, Dharma, Bhagavad Gita, Vidura Neethi, Yaksha Prasna, Panchatantra, Chanukha Sasthra. Hindu philosophy, ombudsman, Ashoka Chakra, The Ten Commandments, medieval era, seven social sins, modern precepts of ethics, ethical climate, ERC, Corporate ethics, NWBC, and Sarbanes Oxley Act.*

3.1 PRE HISTORIC DAYS

The concept of moral behavior is as old as the days when humans started living as a social animal.

The first pre-historic man lived alone without any moral values excepting his need for satisfying his hunger and protecting himself from other predators. After he found a female partner and started living in small communes, consisting of his family and children, his need increased from providing food for his commune to his duty of protecting his family from dangers and other communes.

Gradually, more families joined the communes, forming *tribes* or *sects*. This necessitated the individuals to develop and follow certain rules of inter-relationships. They framed among themselves certain rules of how to behave with women and children and with rival tribes. There were rules how to share the food, how to hunt, and how to protect the women and children from dangers.

3.2 ETHICS IN HINDU MYTHOLOGY

In most Hindu scriptures, ethical concept and ethical teachings are recorded. Moral values have been specified in the *Ramayana*, *Mahabharata* and *Bhagavad Gita*, the three major epics in Sanskrit, and also in *Tirukkural*, *Vemana Sathakam*, *Sumathi Sathakam* as well as several other scriptures in regional Indian languages of Hindu mythology.

The *Vedas* deal with the spiritual well being (inner life of the self) of the individual as well as the core ideals of social life where one's rights and duties towards oneself and to others are indicated. The preceptors who feature in the *Upanishads* had intuitively grasped this eternal truth and tried to give expression to their understanding.

According to the Vedas, *Dharma* is the basis of the whole universe. Dharma is eternal and therefore existed even before creation, and all sentient and insentient beings of the universe owe their existence to Dharma. *Vedas* allude Dharma as the tap root on which the Vedas stand as the trunk while the *Puranas* and other epics form the branches. Unless the root is healthy and strong, the tree cannot survive. Just as the tree must have strong roots, if it has to withstand a cyclone, Dharma has to be upheld for the harmonious functioning of the universe and must be protected so that the entire universe can be sustained.

The innate wisdom of their universal ethical content elucidates different aspects of human virtues or vices on one hand, while on the other hand the pithy, yet definitive description of God evokes awe, wonder, and faith. Both *Bhagavad Gita* and *Tirukkural* teach the way of life that is aligned to ethical and moral values while impressing on the individuals the need to strive for liberation. In the Bhagavad Gita, Lord Krishna instructs people to get involved in their work while renouncing the fruits of actions. The message is that an individual is responsible for his/her actions and shapes his/her present and future.

Spiritual teaching was basic to the traditional system of education through the *guru-sishya* mode. The disciples were much exposed to the moral values embedded in the scriptures to influence and help in shaping their character. Much insight is given in our scriptures into the human nature as given by the guru to the disciples who are about to embark into the life of a householder and also as a public servant in the job he/she would be required to perform. All human beings are susceptible to fail since there is no one who is perfect and guaranteed to be above faults. Even the likes of greats such as Yudhistira and Viswamitra had succumbed to odd failures. The student is hence exhorted to cultivate a sense of discrimination between the good and bad of human nature so that the former can be emulated and the latter, ignored.

Every royal family had a *Rajaguru* (adviser to the king) who taught moral values and human virtues to the princes so that when they grew into kings or other notaries, they remembered these teachings and behaved accordingly. Illustrations of these are Viswamitra's teachings to Sri Rama and his brothers, the *Panchatantra*, etc. Apart from these, *Chanukha Sasthra* written by Chanakya of the medieval period is an authority of international diplomatic relations, and brings out several ethical concepts in that field.

3.3 CODE OF DHARMA

In the *Mahabharata*, Dhrithrashtra's brother Vidura counsels him to leave aside his undue support to his son Duryodhana, and instead develop a code of dharma from society's perspective. His series of advices to the king is full of morals and human values and is called *Vidura Neethi*. The gist of his advice is

> "The entire creation of mankind is sustained by Dharma and human beings have a moral responsibility to uphold righteousness for the sake of the welfare of the entire world."

In *Mahabharata's* episode of *Yaksha Prashna*, Dharmaraja Yudhistira answers a series of queries on the precepts of Dharma posed by King Nahusha in serpent form. The gist of his reply to one of the queries is, *It is not the birth or status that characterizes a person's worth, but only the moral code he upholds. Truth, magnanimity, patience, good conduct, and a heart free from envy, are the prime indicators of a truly evolved soul.*

The scriptural injunctions of Hindu mythology were framed with these points of view. The significance of this can be appreciated only if one understands that individual happiness and well being is subsumed within the welfare of the society at large. This, besides precluding selfishness, promotes the virtues of tolerance and compassion for others.

3.4 ETHICS IN HINDU PHILOSOPHY

'Esa sarveshu bhuteshu gudho atma na prakasate,

Drsyate tvagryaya buddhya sukshmaya suksma darshibi'

Atma, the soul, is in all beings, but hidden and, therefore, is not manifest. It can be realized however, by the concentrated reasoning of those who have trained themselves in perceiving subtle and more subtle truths. This is the basic principle behind all the engineering techniques, whether method study or reengineering, or any analytical process.

As Huxley says, progress or evolution has to be guided by value systems. But where do these values come from? Hindu philosophy (*Vedanta*) calls the science of spirituality as *Adhyatma* or *Vidya* (science) of *Atman*. This science of spirituality is the birthright of all human beings. The source of evolution and the source of the universe, the Supreme Bliss is present in all. Nature has provided only human beings the capacity to realize this fundamental truth that the Divine reality is present in all. Dharma, or the science of values, is the product of this manifestation, a little or more of the Atman in life, in action and in inter-human relationship. When it begins to glow and manifest, life becomes brightened by values like love, purity, compassion, truthfulness, tolerance, spirit of service, etc., in place of traits like hatred, selfishness, violence, exploitation, destruction, etc. (*Swami Ranganadhananda*)

3.5 THE ASHOKA CHAKRA

The Ashoka Chakra, which today forms the centerpiece of the Indian flag, is an embodiment of the ethics emphasized in ancient Hindu scriptures. The Magadhan Emperor Ashoka who ruled a major part of India during 273–232 BC set up the first Ashoka Chakra at his capital, Saranath, near Kashi. This wheel has 24 spokes, each representing a human virtue, namely

1. Love
2. Courage
3. Patience
4. Peace-loving
5. Generosity
6. Kindness
7. Empathy
8. Loyalty
9. Dignity
10. Self-confidence
11. Sacrifice
12. Honesty
13. Integrity
14. Responsibility
15. Fairness in Justice
16. Rationality
17. Friendliness
18. Joyful
19. God-fearing
20. Abhorrence to evil customs
21. Knowledge
22. Empathy
23. Non-profit oriented
24. Dharma

3.6 THE TEN COMMANDMENTS

The Ten Commandments of the Bible, propagated by Moses to his Jewish subjects, were among the earliest known and popularized tenets of moral behavior. They are

1. Thou shalt not kill.
2. Thou shalt not commit adultery.
3. Thou shalt not steal.
4. Thou shalt not bear false witness against thy neighbor.
5. Thou shalt not covet thy neighbor's house, thou shalt not covet thy neighbor's wife, nor his manservant, nor his maidservant, nor his ox, nor his ass, nor anything that is thy neighbor's.
6. Honor thy father and thy mother that thy days may belong upon the land which thy Lord, thy God giveth thee.

7. Thou shalt have no other Gods before me.
8. Thou shalt not make unto thee any graven image, or any likeness of anything that is in heaven above, or that is on earth beneath, or that is in the water under the earth.
9. Thou shalt not bow down thyself to them, nor serve them, for I the Lord, thy God, am a jealous God, visiting the iniquity of the fathers upon the children unto the third and fourth generation of them that hate me.
10. Thou shalt not take the name of the Lord, thy God, in vain, for the Lord will not hold them guiltless that taketh the name in vain.

3.7 MEDIEVAL ERA

The historic era up to the medieval periods, both in Europe and India, saw the springing up of several kings and chieftains who ruled over their respective kingdoms. In general, these kings were in favor of doing good for their subjects and to maintain law and order in their kingdoms. This resulted in each king developing moral guidelines and do's and don'ts in the behavior not only to maintain law and order among the subjects but also to maintain his self esteem of being called a noble king.

These do's and don'ts were in the form of moral tenets that still govern the moral behavior of people and rulers of these days.

Aristotle (384–322 BC) was among the first philosopher to document his thoughts on human virtues, in his book *Nicomachean Ethics*. He defined virtues as acquired habits that enable us engage effectively in rational activities; his thoughts are explained in more detail in Chapter 5.

Julian Huxley, the well-known biologist, in his book *Evolution, the Modern Synthesis* emphasized the following:

- Human evolution has ceased to be organic and has become psycho-social since nature has endowed man with the most versatile organ, the cerebral system teat is the brain.
- The human being has taken over from the hands of the nature, the direction and control of further evolution.
- To do this successfully, man needs to develop and live by the science of values.
- What was natural selection at the pre-human phase has now become psycho-social selection, thereby making human evolution more cultural than organic.
- Every experience or achievement has objective criteria. But when it comes to human evolution and progress, it has to be

subjective also. You have to deal with human feelings, human desires, and human values.

3.8 POST-INDUSTRIAL REVOLUTION SCENARIO

The Industrial Revolution, which started in Europe and spread to America, raised considerable issues in human relations and labor problems, in view of the industry owners perception of higher productivity even at the cost of employee morale and well being. This sparked several management thinkers to give guidelines to the managers on how to increase productivity without sacrificing worker morale. These guidelines blend well with the concepts of corporate ethic of today.

3.9 DEVELOPMENT OF MODERN PRECEPTS OF ETHICS

The development of modern ethical concepts can broadly be categorized into five decade periods apart from the post Industrial Revolution era. After the Second World War, several companies changed into professional management and the era of corporate sectors started. A new area of ethics, called the *corporate ethics* or *business ethics*, too was created. The modern thoughts of business ethics or corporate ethics can be traced to the sixties and seventies of the twentieth century. The following chronology indicates the development of ethical thought in the past five decades.

1. The 1960's saw social unrest and anti-war feelings that cascaded into employee militancy, that is the development of trade unionism. Civil right issues developed into significant awareness among the workforce. Companies began establishing codes of conduct and value statements.
2. The 1970's saw universal recession and escalation of unemployment. However, this resulted in the change of the concept of work ethics. The Ethics Resource Center was established in 1977 in Washington. Almost every corporate has created an Ethics Department with a view to promote ethical awareness and practices among managers and employees. Compliance with ethics and other laws was highlighted.
3. The 1980's saw the redefining of social contract between employers and employees. Health-care ethics was given importance. Some companies created ombudsman positions in addition to

the position of an Ethics Officer. The *Cambridge Encyclopedia* defines *ombudsman* as an official who investigates complaints regarding administrative actions in the government like maladministration. The findings do not have the force of law but are put in the form of a report from which it is hoped remedial actions will result. The first such institution was created in Sweden in the beginning of the 19th century and today most countries have followed the lead.

4. The 1990's saw one of the most significant steps in industry and economy, particularly in India, viz. *globalization*. With it, MNCs spread out all over the developing world, as highlighted in Chapter 20. Survival of the fittest with reference to quality production became the buzzword. This resulted in a significant change in the concept of professional ethics. Increased corporate liability for personal damages has been emphasized. Like those of the cigarette companies, and more recently the case of the Union Carbide plant at Bhopal. On the computer front the world saw great strides in the invention of the Internet to the benefit of the layperson, but at the same time, it brought innumerable computer-related vices as highlighted in Chapter 22.
5. The 2000's saw unprecedented economic growth followed by financial failures. Ethical issues have destroyed some famous companies like Union Carbide and Enron. A significant step in the USA scenario was the enactment of the Sarbanes Oxley Act of 2002 (SOX), which has regularized the ethical climate in the corporate sector. This decade saw the development of mobile phone culture and with it new forms of mobile vices have emerged, as discussed in Chapter 22. While the 1990's can be called the Internet era, the 2000's can be called the mobile era.

Question Bank

PART A

(Each question carries 2 marks which you are expected to answer in 3 minutes.)

1. Discuss the ethical concepts of prehistoric humans.
2. What is *Vidura Neethi*?
3. What is the role of Dharma in Hindu philosophy?
4. What is ERC?
5. Explain the role of ethics departments in corporate sector.

PART B

(*These are mostly 8-mark questions to be answered in 12 minutes, presuming that the time allotted for a 100-mark question paper is 3 hours. Some times the same question may be asked as a 16-mark question to be answered in 25 minutes.)*

1. Discuss the codes of Dharma cited in the *Mahabharata* with illustrations.
2. Discuss how each of the Ten Commandments of the Old Testament reflects ethical concepts.
3. Discuss the chronology of development of modern precepts of ethics.

4

Professionalism

- Profession
- Public Scrutiny of Engineers' Work
- Attributes of a Profession
- Professional Engineer
- Difference between Engineering and Other Professions
- Occupation vs Profession
- Characteristics of a Professional
- Professionalism as Independence vs Professionalism as Employee
- Models of Professional Roles

This chapter defines and discusses aspects of a professional and professionalism, to make the engineer appreciate his role in his profession.

Keywords: *Profession, professional, professionalism, occupation vs. profession, professionalism as independence, professionalism as employees, models of professional roles*

4.1 PROFESSION

A *profession* is a type of job that requires specialized training and qualifications in performing the required activities basically to earn a living. The *Oxford Dictionary* gives two definitions:

- A job that needs training and formal education
- A body of people engaged in a type of job

Other related terms are business, career, craft, employment, job, line of work, occupation, trade, and vocation.

Here, an occupation or employment may be undertaken just to earn a living, whether the person is skilled in the job or not. But a profession, as defined above, needs formal training and qualification. In general, a profession brings a fairly high status to a person, for example, engineering, medicine, law, education, servicing, administration, or corporate governance, etc.

Whatever may be the field of the profession as listed above, in its true sense it is a privilege given to serve the people. As said by Mahatma Gandhi, *a customer gives the professional an opportunity to serve him*. This privilege of service entails in him a professional responsibility. It requires social commitment and resolution to protect the dignity and honor of the profession.

Of the professions cited above, engineering is that profession which requires creativity and judgment to develop new processes and products that would increase the standard of living of the public.

The *Oxford Dictionary* offers the following definitions for *Engineer* and *Engineering*:

Engineer

(a) A skilled person who designs, builds or maintains engines machines, bridges, railways, etc.

(b) A skilled person who controls an engine or engines, especially in a ship or in an aircraft.

Engineering

(a) The practical application of scientific knowledge in the design, building and control of machines, roads, bridges, electrical apparatus, chemicals, etc.

(b) The work, science, or profession of an engineer.

The former American president, Herbert Hoover, an engineer himself, has described the engineering profession in this way:

It is a great profession. There is the fascination of watching a figment of imagination emerge through the aid of science to a plain paper, and then it moves to a realization in stone or metal or energy. Then it brings jobs and homes to men. Then it elevates the standards of living and adds to the comfort of life. This is the engineer's high privilege.

4.2 PUBLIC SCRUTINY OF ENGINEERS' WORK

Today, the importance and liability of an engineer as compared to that of other professionals is that the work of the engineer is subject to scrutiny. Again, to put it in the words of Hoover:

The great liability of the engineer compared to men of other professions is that his works are out in the open for all to see. His acts, step by step, are in hard substance. He cannot bury his mistakes like a doctor. He cannot argue into thin air or blame the judge like the lawyer. He cannot cover his shortcomings by trees and vines like an architect. He cannot blame his opponents for his failures like a politician. The engineer simply cannot deny that he did it. If his works do not work, he is damned.

Nevertheless, it may be noted that in many large projects, whenever there is a failure, more than the individual, the company for which they work is hauled up, and made accountable. That is why Martin calls these employee engineers as almost invisible, despite the large number of engineers present today. The dominant image of the engineer is that of being a servant to the organization than to the public. Though the former component of this characteristic is akin to loyalty as discussed in Chapter 14, the latter component, that is his answerability to the public, is the most essential from ethics point of view and hence, this aspect of his answerability to the public is much discussed in this book.

4.3 ATTRIBUTES OF A PROFESSION

Knowledge Works involving skills of sophisticated nature, theoretical knowledge, judgment, etc., need formal education including technical, humanistic, and ethical studies. Continuing education and knowledge updating also is a required.

Organization Organizations controlled by professionals like the corporate need the engineers to play a key role in setting up of quality standards, ethical codes of conduct, etc. Hence, the profession needs personnel capable of these activities.

Public Good The profession serves significant aspects of public good by the development of processes and products and also, in general, ethical decisions. For example, if a new product is developed, it has first to be investigated into the possible impact of the process on the environment. This is the gist of *Green Design* as explained further in Chapter 21.

4.4 PROFESSIONAL ENGINEER

The term *professional,* as an adjective, has the following dictionary meanings:

- Competent
- Relating to or belonging to a profession
- Skilled in a particular activity

As a noun, *professional* has the following meanings:

- A professional person
- A person engaged in an activity as a paid employee rather than as an amateur
- A person very skilled in a particular activity

Professionalism, a derivate term (abstract noun), is defined as the ability or the skill expected of a professional.

4.5 DIFFERENCE BETWEEN ENGINEERING AND OTHER PROFESSIONS

1. Lawyers are typically self-employed and are guided more by personal ethics. Doctors, in general, have their own practice like lawyers. Even if they are employed in a hospital, they have full authority in their decision making and are fully liable for their actions. On the other hand, engineers are rarely self-employed and become a small part of a large organization. They are generally bound by the ethics and professional commitments of the organization.

2. Training needs are different. A fresh engineer can be employed straightway and given responsibilities. But it is not so in case of doctors or lawyers.
3. Doctors and lawyers need a license or registration to perform their profession. But engineers need no such license unless in case of architects.
4. Engineers are manufacturing oriented that is value-addition oriented, whereas doctors and lawyers are service oriented.

4.6 OCCUPATION VS PROFESSION

Though we have used the terms *occupation* and *profession* in similar contexts so far, we may have to distinguish the former as any job undertaken whether the person has skills in that or not. However, a professional needs a good amount of skills acquired as explained in the previous paragraphs.

4.7 CHARACTERISTICS OF A PROFESSIONAL

1. Entering into a profession requires an extensive amount and period of training which shall be of intellectual character.
2. A professional's skill and knowledge are based on theory.
3. A professional's skill and knowledge are vital to the well being of the society.
4. Professionals have a commitment to do public good.
5. They usually have a monopoly or near monopoly on the provision of the professional services.
6. They usually have an unusual degree of autonomy in the workplace.
7. They are regulated by ethical standards, generally by a code of ethics of the professional society they belong to.
8. They have a significant degree of self-regulation.

4.8 PROFESSIONALISM AS INDEPENDENCE VS PROFESSIONALISM AS EMPLOYEE

Persuasive definitions mean giving a narrower and more specific look at the characteristic. *Professionalism as Independence* and *Professionalism as Employee* are the two components, and the explanation is similar to what is given in Paragraph 2. *Professionalism as independence* means the skill and capability of thinking independently and take ethical decisions as required for public good, with full freedom from the use of force. Thus, by definition, only consultants may be said to have professionalism as independence.

On the other hand, *professionalism as employees* (or serving employers) means being loyal to the employer or the client and take decisions based on the employer's directive. Most engineers come under this classification. Though the first definition appears logical, the second one is more practical and is being accepted by most.

4.9 MODELS OF PROFESSIONAL ROLES

We have stated the profession of engineering is aimed at doing public good. There are different interpretations as to what public good is, and also different concepts exist as to how the engineers contribute to it. However, we can make this statement simpler by expecting the engineers to play the following role models.

1. As Saviors Engineers hold the key to create an Utopian society, free from poverty, inefficiency, waste, and the drudgery of manual labour.

2. As Guardians Even if they cannot create a Utopian society, they know the direction and pace at which it can be almost achieved. Hence, they may be given positions of authority based on their expertise.

3. As Bureaucratic Servants The proper role of engineers is to receive and translate the directions of the management into concrete achievements. This follows the concept of *professionalism as employees.*

4. As Social Servants The role of engineers may, of course, be in obedient service to the organization, but the true master is the society. This follows the concept of *professionalism as independence.*

5. As Social Enables and Catalysts This is a combination of the above two. Here, engineers are neither servants nor masters of any. They are game players. The ultimate power and authority may lie with the management but the engineers play vital and active roles beyond mere compliance of orders. Sometimes engineers are needed to act as mediators between the management and society, make them understand their own needs, and make informed decisions about desirable ends and means of the technological development.

Question Bank

PART A

(Each question carries 2 marks which you are expected to answer in 3 minutes)

1. What do you understand by the term *profession*?
2. Why do you consider engineering a great profession?
3. What are the attributes of a profession?
4. Distinguish between a profession and an occupation.
5. What are the characteristics of a professional?
6. What are the professional obligations for engineers?
7. What is the role of an engineer in a society?
8. What do you understand by professionalism as an independent and professionalism as an employee?

PART B

(*These are mostly 8-mark questions to be answered in 12 minutes, presuming that the time allotted for a 100-mark question paper is 3 hours. Sometimes the same question may be asked as a 16-mark question to be answered in 25 minutes.)*

1. Justify the statement that the *engineer is a professional*.
2. How do you distinguish an engineer from those of other professions?
3. Illustrate the several role models the engineer has to play.

PART C

(*Objective-type Questions*)

1. *Fill in the blanks:*

(a) ______________ is a skilled person who designs, builds or maintains engines machines, bridges, railways, etc.

(b) Engineering is the profession of an ______________

5

Virtues and Ethical Theories

- Theories of Virtues
- The Seven Social Sins
- Ethical Mentalities in Business
- The Golden Mean of Virtues
- Modern Theories of Virtues
- Summary of the Theories
- Uses of Ethical Theories

This chapter discusses the concept of the Golden Mean of Virtues and discusses several theories put forth on virtues.

Keywords: *Seven social sins, golden mean of virtues, ethical theories, act utilitarianism, rule utilitarianism, spirituality, religion, golden rule in religious ethics.*

5.1 THEORIES OF VIRTUES

The theories of virtues generally can be classified into *traditional theories* and *modern theories*. Traditional theories are those developed by several philosophers of the pre-medieval era like Aristotle and Chanakya. Most of these theories emanated from Hindu scriptures and mythology. The modern theories are those developed in the recent past by management thinkers like Lawrence Kohlberg, McIntyre, Immanuel Kant, and John Rawls. While Kohlberg's theory has been explained in Chapter 4, those of the latter are explained in the subsequent paragraphs.

5.2 THE SEVEN SOCIAL SINS

Mahatma Gandhi signified seven social sins in the newspaper *Young India*. The Japanese prime minister appreciated a banner displaying this during his visit to India in April 2005, as highlighted in Table 5.1.

Table 5.1 *The seven social sins as signified by Mahatma Gandhi*

Seven Social Sins
◆ Politics without Principles
◆ Wealth without Work
◆ Pleasure without Conscience
◆ Knowledge without Character
◆ Commerce without Morality
◆ Science without Humanity
◆ Worship without Sacrifice

5.3 ETHICAL MENTALITIES IN BUSINESS

Some of the mentalities of the individuals and management in the corporate sector for leading to their ethical behavior can be summarized as below in Table 5.2.

Table 5.2 *Ethical mentalities in business*

Nature	Reason	Attitude
Self-interest vs. others' interests	Egoistical mentality	'I want it'.
Company's interest vs. others' interest	Bottom-line mentality	'We have to beat others at any cost'.
Boss's interest vs. subordinates' interest	Authoritarian mentality	'Do as I say or else…'
Company's interest vs. diverse cultural traditions and values	Ethnocentric mentality	'Foreigners have funny notions of what is wrong and right'.

5.4 THE GOLDEN MEAN OF VIRTUES

Aristotle (384–322 BC), in his book *Nicomachean Ethics* defined virtues as acquired habits or traits that enable us to engage actively as human beings like

- *Courage,* which governs the confrontation with dangers,
- *Truthfulness*, which governs truth telling and honesty,
- *Generosity*, which governs giving and kindness, and
- *Friendliness,* which governs personal relationships.

He also put forward the theory that each of these virtues should be in moderate quantity, neither in excess nor in deficiency. For example, the virtue of courage may range between rashness of a daredevil (in excess) to cowardice (deficient). The ideal virtue is to possess this characteristic midway between these two extremes; similarly, truthfulness may lie between revealing everything in violation of secrecy or tact and absolute lying. Generosity may lie between squandering or *aprachya daanam* and being miserly. Friendliness may vary between being effusive or over-indulging, and sulking and unfriendly. Table 5.3 would illustrate how each of the virtues in moderation is what we should have. This, according to Aristotle, is the *golden mean*.

He propounded that these virtues, if acquired, makes a person involved in all rational activities in an effective manner. Moral virtues help a person to follow and practice social goods within his community or group.

Table 5.3 *The golden mean of virtues*

Sl. No.	Virtue	Definition of Excess	Scale 1 2 3 4 5 6 7 8 9 10	Definition of Deficiency
1.	Courage	Rashness or daredevilness	←——→	Cowardice or no self-control in case of danger
2	Truth-fulness	Over-talkativeness or over-indulgence	←——→	Over-secretive or reluctance to part with information
3	Gener-osity	Squandering or wasting one's scarce resources	←——→	Miserliness
4	Friendli-ness	Annoyingly effusive	←——→	Very unfriendly and surly

5.5 MODERN THEORIES OF VIRTUES

While Kohlberg's and Gilligan's theories are based on development of moral autonomy, other authors and thinkers put forward theories that highlight the virtues and their impact on ethical behavior of people.

1. Theory of Virtues and Practices by McIntyre says that acts are morally right when they fully support relevant virtues making possible the achievement of social goals. As indicated in Para 5, McIntyre adds the following to Aristotle's list: integrity, unity, honesty, self-respect, responsibility, and accountability.

2. Theory of Act Utilitarianism by John Stuart Mill (1806–1873), says acts are morally right if they produce most good to most people giving equal consideration to everyone that is effected.

3. Theory of Rule Utilitarianism by Richard Brant, says acts are morally right when they fall under a rule that widely followed, would produce most good for most people. Here, the conformance to the rules or the ethical codes is a must before interpreting what is *most good for most people.*

4. Theory of Respect for Person or Duty by Immanuel Kant, says that acts are morally right when they fall under one principle of duty that respects autonomy and rationality of persons and that can be universally applicable to all people.

5. Theory of Valid Principles of Duty by John Rawl, says that valid principles of duty are those that would be voluntarily agreed upon by all rational persons. Acts are morally right when they fall under principles that would be agreed by all rational persons. In philosophy this is called *deontology*, from *deonto*, a Greek word meaning duty.

6. Theory of Rights by John Locke (1632–1702) says a person is entitled to have human rights of life, liberty, and prosperity generated by his labor and others should accept these rights.

7. Theory of Community-related Rights by A T Meldon (1910–1991), says that having more rights presupposes the capacity to show concern to others and be accountable to comminatory. This is more or less the same as what Chanakya, the well-known authority on political doctrines and the author of *Chanakya Neethi*, said:

> *Sacrifice the individual for the sake of the family*
> *Sacrifice the family for the sake of a village*
> *Sacrifice the village for the sake of the nation*

5.6 SUMMARY OF THE THEORIES

In short, the above modern theories can be classified into four groups:

1. ***Virtue theories*** highlighting the virtues that make it possible to achieve social goods like those of Aristotle and McIntyre.
2. ***Utilitarian theories*** consisting of the theory of *act utilitarianism* of John Stuart Mills and the theory of *rule utilitarianism* of Richard Brant. As per *Cambridge Encyclopedia*, utilitarianism is the theory that all actions are to be judged by their consequences for the general welfare. The greatest happiness of the greatest number is the sole criterion for the moral choice.

Table 5.4 ***Comparison between act utilitarianism and rule utilitarianism***

	Act Utilitarianism	Rule Utilitarianism
1	Put forth by John Stuart Mill	Put forth by Richard Brant
2	Focuses on individual actions	Focuses on moral rules
3	Acts that do most good to most people	Acts that are performed under certain set moral rules, generally proved to do most good for most people
4	If a purchase action even with a kickback does overall good then this purchase is not immoral	Even for the best purchase, if a kickback is involved then the purchase is immoral
5	An act is good if it can achieve higher levels of happiness, pleasure, etc.	An act is good if it satisfies rational desires that are approved based on psychology

3. ***Duty theories*** consisting of the theory of respect for a person or duty by Immanuel Kant and the theory of valid principles of duty by John Rawl.
4. ***Rights theories*** consisting of the theory of rights by John Locke and the theory of community related rights, by A T Meldon.

5.7 USES OF ETHICAL THEORIES

1. They identify the moral considerations or reasons that constitute moral dilemmas.
2. They provide precise sources of information relevant to solving moral dilemmas and also identify what types of information are to be collected and used.
3. They help in ranking the relevant moral considerations in order of their importance thereby providing guidelines in solving moral problems.
4. They help in identifying alternative courses of action with wide perception on the moral implications of the options and provide a systematic framework for comparing the alternatives.
5. They augment the precision with which we use moral terms and provide a framework for reasoning.
6. They provide a framework for development and strengthening of our ability to reach balanced and insightful judgment.

Question Bank

PART A

(Each question carries 2 marks, which you are expected to answer in 3 minutes)

1. What are the seven social sins signified by Mahatma Gandhi?
2. What do you understand by the golden mean of virtues?
3. Distinguish between act utilitarianism and rule utilitarianism.

PART B

(*These are mostly 8-mark questions to be answered in 12 minutes, presuming that the time allotted for a 100-mark question paper is 3 hours. Sometimes the same question may be asked as a 16-mark question to be answered in 25 minutes.)*

1. Discuss the concept of golden mean of virtues.
2. Explain and illustrate the different theories of virtues.
3. Apply these theories of virtues in resolving the following moral problem and give your judgment about the right action.

   Building of large dams across rivers certainly leads to great benefit to the society, by providing stable supplies to irrigation and drinking water. However, these benefits often come at the cost of the people who get displaced by the reservoirs. They lose their homes, livelihood, and are made to reorient their lifestyles. It may also result in some loss of prime forests, endangered species historic cultural treasures, etc., which would be submerged.

4. What are the uses of the theories of virtues?

PART C

(Objective-type Questions)

1. Fill in the blanks:

(a) The theories of act utilitarianism and rule utilitarianism are similar except that the ______________ (former/latter) emphasizes on the conformance to the rules or the ethical codes.

2. (a) Match the following:

(i)	Golden mean of virtues	—	Richard Brant
(ii)	Act utilitarianism	—	Aristotle
(iii)	Rule utilitarianism	—	Stuart Mills

6

Moral Autonomy

- Ethical Issues vs. Moral Issues
- Illustrations
- What is Morality?
- Where and Why do Moral Problems Arise
- How is the Engineer Influenced in Decision Making?
- Moral Dilemmas
- Specific Moral Problems vs. General Moral Problems
- How do you Distinguish between a Gift and a Bribe?
- Steps in Analyzing Moral Dilemmas
- Three Types of Inquiries
- Moral Autonomy
- Skills Needed to Develop Moral Autonomy
- Kohlberg's Theory
- Gilligan's Theory
- Comparison between Kohlberg's and Gilligan's theories
- Heinz's dilemma
- Consensus and Controversy
- Reciprocal Ethics

After comparing ethical and moral issues, this chapter highlights the reasons for moral dilemmas and suggests systematic procedures to solve such dilemmas. The development of moral autonomy is traced and the theories of Kohlberg and Gilligan are explained and compared with each other. A feature of this chapter is the discussions on the moral dilemma whether to treat a gift as a gift or a bribe.

Keywords: *Ethical issues, moral issues, morality, moral dilemma, decision-making process, inquiries in ethics, moral autonomy, Kohlberg's theory, Gilligan's analysis, consensus, controversy, Heinz's dilemma. Metropolitan Transportation Authority of New York and SPCA*

6.1 ETHICAL ISSUES VS. MORAL ISSUES

From chapters 1 and 2, we have seen that the term *ethical issue* is used as a synonym to the term *moral issue.*

- Strictly speaking, ethical issues are the typical day-to-day decision problems faced by the engineer, like deciding on the safety factor and his attitude in his perception of the probability of the accidents. In this case, the engineer does not have any selfish motive but it is his attitude that magnifies the issue.
- Moral issues are those when the engineer deliberately takes a wrong decision motivated by some self-interest, like wanting higher profits to the company or accepting a bribe or any form of corruption.
- Unethical actions can arise when the engineer designs or produces products that are unsafe and of poor quality due to his ignorance or unintentionally yielding to pressure. Immoral actions arise when unsafe components or products are passed knowingly and deliberately under some selfish consideration.
- Ethical issues can also refer to professionally virtuous conduct whereas moral issues refer to virtues centered on selfishness or sexual desire.

In a nutshell, we can say that ethical issues are those that can be tried in a civil court, whereas moral issues are those which are to be tried in a criminal court.

6.2 ILLUSTRATIONS

The following examples illustrate the distinction between ethical and moral issues.

1. An engineer finds a certain material-handling equipment faulty and recommends it to be taken off the line. However, the production manager believes it is too minor to afford production hold-up. Here, the difference in ethical thinking is due to the differences in the judgment of what constitutes the true state of affairs. However, if some mishap occurs and the production manager passes on the blame to the poor maintenance of the equipment then he is immoral.
2. A certain bicycle factory lets its waste oils into the public sewage pipelines. This is unethical but may not be immoral if no law exists prohibiting this. But if a notice has been received from the Pollution Control Board or the Municipal Corporation and if the company takes no action, it is immoral.

These examples give rise to the following ethical questions:

- To what extent can the employer pass on the directives to guide the engineer's conduct?
- What happens when there are differences in individual judgment?
- Should one follow the law to the letter?
- Should the engineer follow only the specifications even if the resulting problems are more serious than initially anticipated?
- What is the engineer's responsibility in anticipating and influencing the social impact of the process?

6.3 WHAT IS MORALITY?

The term *morality* is concerned with

- What is right or wrong in handling a situation
- What ought to be done or not to be done in a given situation
- What is good or bad about the principles, policies, or the persons involved in the situation

If an action or a principle is to be considered as morally right then there should be some moral reasons supporting it. These moral reasons may include

- Respecting others
- Respecting the rights of others
- Avoid creating unnecessary problems for others
- Showing gratitude to others
- Encouraging them to work

6.4 WHERE AND WHY DO MORAL PROBLEMS ARISE

As engineers perform their specified tasks in the manufacture of products, sometimes their activities may lead to products that are of poor quality or less useful or unsafe. This may happen due the following three reasons, as already indicated in Section 6.1:

- The first is due to their ignorance, poor knowledge, poor workmanship, or poor management, which may not be exactly classified as immoral.
- The second may be passing off unsafe or lower quality products under pressure against their own consciousness, just because the boss says 'pass it'. There are several cases of major accidents happening by passing these products, even half-heartedly. The Challenger, the Enterprise or the Chernobyl accidents are clear examples of this.

- The third is due to intentionally passing poor products for self-benefit or corruption or bribery. This may sometimes be done only to do good to the company without self-benefit, at the cost of the customers or, in general, of the society.

If the engineering decision has to be a right one, it has to conform not only to the technical specifications but also to ethical specifications like safety, reliability, ease of maintenance, and environment-friendliness.

6.5 HOW IS THE ENGINEER INFLUENCED IN DECISION MAKING?

The engineer may be confronted with contrary opinions from within the company, from sister companies, from competitor industries, or from the customers and stakeholders, etc. Besides, there are several factors like experience, personal morality, codes of ethics, etc., that influence engineers in their decision making as per Fig. 6.1. The decision-making process itself would be as illustrated in Fig. 6.2.

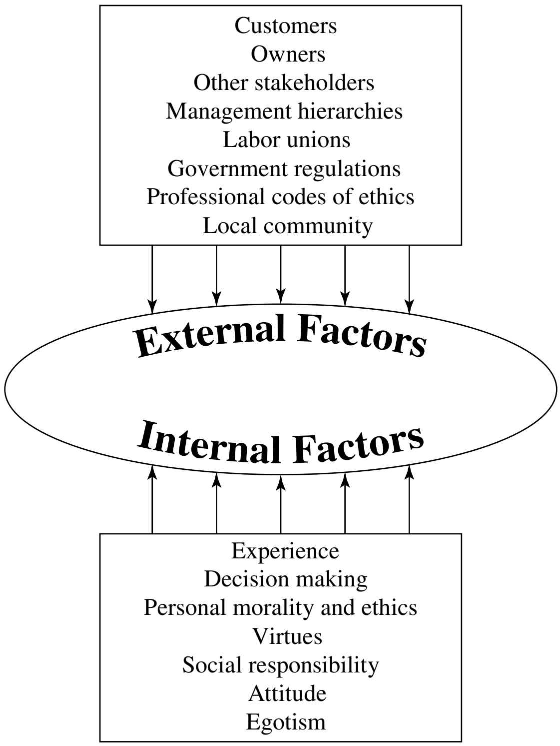

Fig. 6.1 *Factors influencing an engineer in his decision-making process.*

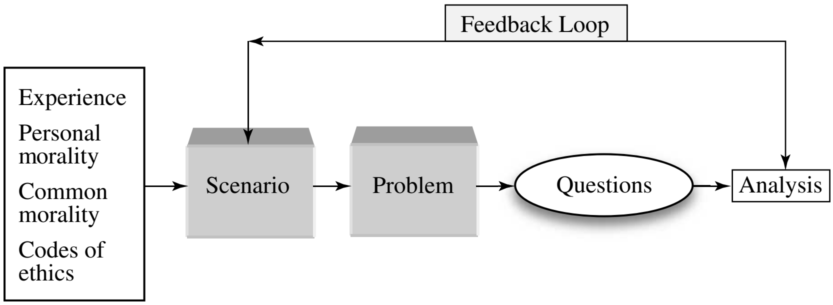

Fig. 6.2 *Decision-making process*

6.6 MORAL DILEMMAS

In view of the several factors influencing the engineer as depicted above, his decision making involving moral values is quite complex. The following may be some of the causes for this complexity.

1. Due to Vagueness

The factual or conceptual points may not be clearly stated and an engineer may be unclear about the moral nature of alternative decision that can be made.

Example: The dilemma faced by a new employee in accepting a New Year gift offered to all the staff by a client.

2. Due to Conflicting Interests

Even though vagueness is not present, there may be two or more clearly applicable ethical principles that come into conflict. In other words, the dilemma results in two or more ethical obligations or duties or rights or ideas that come into conflict with one another.

Example: You fix up an appointment with an important visitor at 4 p.m. and suddenly at 3 p.m. you hear that someone near and dear to you is hospitalized and you should call on him/her immediately.

3. Due to Conflicting Instructions

On many occasions, an employee has to obey two bosses, each giving contradictory instructions.

Example: Your immediate boss gives you, as a production engineer, a task to be completed by afternoon, whereas your GM gives you another task to be completed on priority.

4. Due to Disagreement

When you disagree with the decision of the boss as being unethical, but as a subordinate you cannot question it.

5. Due to Lack of Experience and Skill

Several times, a fresh engineer faces moral dilemmas in taking decisions due to his lack of experience or skill.

Example: This is exactly what happened in the case of Challenger spaceship launch. The engineers pointed out the possibility of failure of the O-rings but the boss was in disagreement and overruled it.

6.7 SPECIFIC MORAL PROBLEMS VS. GENERAL MORAL PROBLEMS

General moral problems are like whether we should advertise for competitive bidding or whether codes must be followed. Specific moral problems are those that occur in specific situations such as whether Ramaswamy must correctly report the data of the tests he had done.

6.8 HOW DO YOU DISTINGUISH BETWEEN A GIFT AND A BRIBE?

Many times whenever vendors visit their clients' offices, they offer some gifts to the staff. The recipients, especially the new employees, cannot know if that was offered as a bribe or a simple gift and are faced with an ethical dilemma whether to accept them or not, as illustrated in Paragraph 6. True, it is very difficult to distinguish between a legitimate gift and a bribe. The following points may serve as guidelines.

1. The Size of the Gift Is it a pen inscribed with the vendor company's name? Or a simple but attractive stationery item? A coffee mug of less than ₹100? Or a domestic appliance of value ₹1000 or more? Or an expensive watch or gold jewellery? Is the employee invited for a private dinner in a star hotel? Or a complementary membership to a local club?

2. The Occasion Is it during the year end as a New Year gift? Is it during a launching function? Is it during the visit of a VIP like the MD or a foreign associate of the vendor? Is it before placing an order or after the placing of an order?

3. The Recipient Is it given to all the staff in a department or to all senior officers of the company? Or only to one or few employees responsible for the selection of the vendor or placing the order?

4. Confidentiality in Offering Is the gift or invitation given in an open office when all are watching, or is it done secretly and in whispers? (dubbed as *myaa,* or *under the table!)*

5. Place of Offer Is it outside the office or at the residence of the recipient?

6. The Background Relationship between the Vendor and the Staff Is it a convention that the vendor distributes such gifts every year irrespective of whether he has been getting the coveted orders or not? What does the boss or the colleagues advise on receiving the gifts? Is it possible that the vendor is sincere and gets offended by your refusing this small gift, thereby effecting his future supplies to your company?

7. Invitation for Seminars The vendor is organizing a sales conference in New Delhi and has invited you to attend the same. Is he paying for the delegate fees? Is he paying for the travel and other expenses also? How many more persons has he invited and what are their positions in their respective companies?

8. Possible Motive What motive you can assign to the expenses incurred by the vendor?

6.9 STEPS IN ANALYZING MORAL DILEMMAS

1. Identify the relevant known facts, including the relevant laws, codes, etc. Bear in mind that this cannot be done independently without ethical considerations.
2. Identify the relevant moral facts and reasoning.
3. Identify the relevant conflicting ideals, interests, competing rights, and clashing responsibilities.
4. Rank the moral considerations in order of their importance befitting the situation.
5. Identify and attempt to clarify and resolve the factual issues, and consider how the unknown facts might effect the decision.
6. Revisit earlier phases in the process of analysis while bringing in new facts that might have cropped up or been discovered while considering the factual or conceptual issues.
7. Discuss with colleagues and friends seeking their suggestions and alternative perspectives.

8. Identify any additional relevant moral rules, principles or concepts while rethinking the case.
9. Arrive at an optimally reasonable judgment.
10. Check with the colleagues once again at this final stage.

This procedure can also be represented by the following figure.

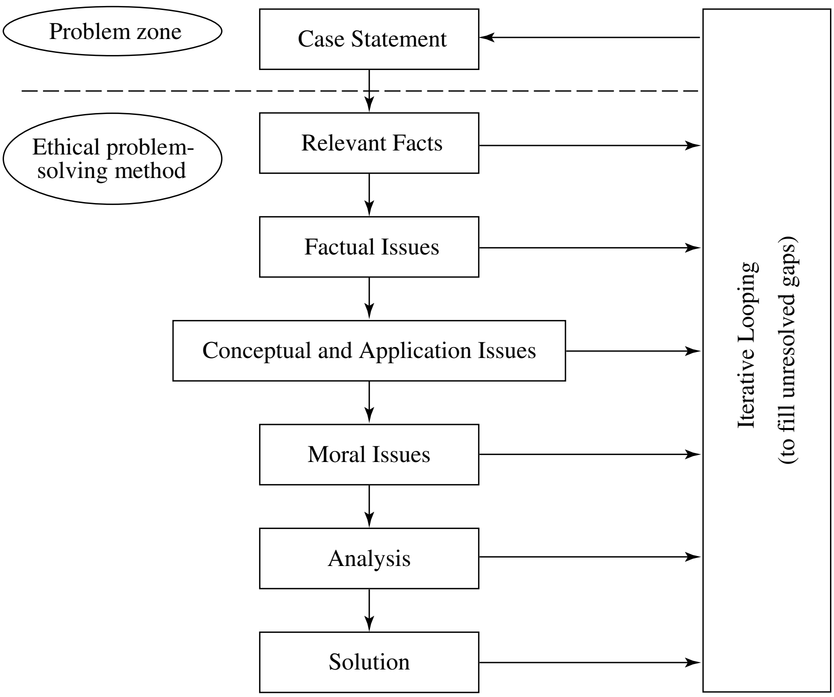

Fig. 6.3 *Procedure for analyzing a moral problem*

6.10 THREE TYPES OF INQUIRIES

The situational inquiry is the basic step of getting information for investigating, analyzing, and adapting on ethical issues. The inquiries (or enquiries) fall into three categories.

1. Normative Enquiries

They seek to identify and justify the morally desirable norms and standards that guide individuals or groups in taking decisions.

Examples

- What must be done and what is good in this situation?

- What is the engineer's obligation to protect public safety?
- When should the engineer whistleblow (refer Chapter 20) or alarm the superiors about some immoral or hazardous activity going on in the company?
- Which laws or procedures effecting engineering practices are morally valid and must be followed?

The above questions make it clear that the theoretical goal of normative inquiries is to collect information with reference to the justification of the moral judgments.

2. Conceptual Inquiries

They clarify and describe the meanings, important concepts or ideas, and principles and issues related to ethics.

Examples

- What does safety mean?
- What is a bribe? And what are its bad effects on society?
- What is a profession? What defines a professional?

3. Factual Inquiries (or Descriptive Inquiries)

They provide the facts needed for understanding and finding solutions for value-based issues. They provide information on business realities of the engineering practices by using proven theories and scientific techniques. They provide us with the information required to understand the background conditions that create the moral problems. They also help in developing alternative solutions.

Examples

- What procedures do other industries follow for safety on similar cases?
- What alternative practices are available and possible?
- What do the codes adapted by the relevant professional societies say in these matters?
- What is the procedure adapted in making risk assessment?

These three types of inquiries are interrelated and complementary to each other. If the engineer wants to whistleblow, he has to make all the types of inquiries, collect information and analyze of the problem on the basis of the moral values and issues related to the wrong act. Then only can he convince the superior, or his whistle would be neglected or rejected.

6.11 MORAL AUTONOMY

Moral autonomy means independence or self-determination in facing moral issues. It is the skill and attitude of thinking rationally about the ethical issues on the basis of moral considerations and the general response to moral issues. It is the ability to think critically and independently about moral issues and to apply this critical thinking to the situations that arise in the course of the professional practices. This derives from the training we receive as children and the attitudes we develop, in being sensitive to the needs and requirements of others around us.

Thus, the probability of children of responsible and loving parents developing into responsible and ethically conscious adults is more than that of neglected or abused children. This fact is reflected repeatedly in cinema of every language!

Another interesting report says that children who are violent in infancy and in childhood, tend to grow into violent adults unless they are guided properly during the transformation age at the nursery level itself. The gist of a recent newspaper report is given below.

> *Violent children become violent adults. Preventing violent offenders works best if you begin in the nursery. At present, when all the known factors are taken into account, it is possible to predict with an 80% accuracy which three-year old boys would become violent men. This has been known for at least a decade and politicians have been pondering over its implications.*

6.12 SKILLS NEEDED TO DEVELOP MORAL AUTONOMY

1. A thorough knowledge in one's profession, and the moral problems and issues in that profession
2. Possessing skills in clarifying and accessing various issues
3. Proficiency in recognizing ethical problems and issues in engineering—this skill distinguishes ethical problems from legal, economic, religious, or other physical issues
4. Skill in comprehending, classifying, and assessing arguments on the opposing ethical values. (illustrated in Fig. 6.3).
5. The ability to form consistent and comprehensive viewpoints based on the considerations of relevant facts
6. Ability to generate creative solutions for practical problems
7. Sensitivity to genuine difficulties

8. Willingness to undergo and tolerate certain uncertainties in making complex ethical judgments
9. Precision in the use of ethical language to be able to express and defend one's ethical views and convince others
10. Ability to resolve moral conflicts and the need to tolerate differences in perspective among morally reasonable persons
11. Integrating one's professional life with personal conviction and maintaining one's integrity

6.13 KOHLBERG'S THEORY

Lawson Kohlberg (1927–1987) distinguished the two developments of human thoughts as

- Moral development (development of moral autonomy)
- Cognitive development (development of IQ, etc.)

He suggested three basic stages of development of moral autonomy in his book *The Philosophy of Moral Development*. He emphasized that the transition from stage to stage is fueled by cognitive development.

1. Pre-conventional Level

- Self-interest dominates and individuals are motivated to satisfy their needs or to avoid punishment (me against the world).
- Recognize that your immediate friend can help as long as you help him (you scratch my back and I will scratch yours).

This is comparable to the level of development of children and a few adults whose mental growth is slow.

2. Conventional Level

- Norms of one's family, group, or society are accepted as ethical requirements. One is motivated by the desire to please others and for close identification with others.
- This is at some cost of his self-interest.
- Recognition of good and bad, and fear of law and order are developed in this level. A majority of adults grow to this stage.

3. Post-Conventional Level

- They clearly understand the principles of ethics, the rights and wrongs, and also their duties and responsibilities to society,
- They cannot accept unethical practices of others and do their best to tutor others.

- They do what is morally correct for morality's sake but not with any other ulterior motive.
- They are willing to risk their chances for others.

Only a small fraction of people grow to this level.

General Observations made by Kohlberg

1. Stage development is invariant.
2. In stage development, subjects cannot comprehend moral reasoning at a stage more than one beyond their own.
3. In stage development, individuals are cognitively attracted to reasoning of one level above their own present predominant level.
4. In stage development, movement through the stages is effected when cognitive disequilibrium is created, that is, when a person's cognitive outlook is not adequate to cope with given moral dilemmas.
5. It is quite possible for a human being to be physically mature but not morally mature.
6. Only about 25% of persons ever grow to the post-conventional level of accepting universal ethical principles and the majority remain at the conventional level.

6.14 GILLIGAN'S THEORY

Carol Gilligan, a student of Kohlberg, had critically reviewed his theory and modified the same in her book *In a Different Voice*, published in 1982.

- She disagreed with Kohlberg's assessment of the moral system within which people developed.
- She felt there was male dominance in his development theory and interviewed several female workers.
- She felt that Kohlberg's studies were made only in relation to and among privileged men, that too white men.
- She felt there was a gap in the morality research which excluded women and accordingly her book looks at women's perspectives.
- She suggested that women mostly think about the caring thing to do rather than the thing allowed by the rules, the latter being the general view of men.
- Unlike Kohlberg, she felt that the transition is fueled by the changes in the sense of self rather than the cognitive capability. Her theory is therefore;
    - Transition from pre-conventional level to the conventional level is from selfishness to responsibility to others.

- Transition from conventional to post-conventional is from goodness to truth and respect for the rights of others.

6.15 COMPARISON BETWEEN KOHLBERG'S AND GILLIGAN'S THEORIES

Table 6.1 *Kohlberg stages of moral development*

Approximate Age Range	Stage	Sub stages
Birth to 9 years of age	Pre-conventional	Avoid punishment Gain reward
9 to 20 years of age	Conventional	Gain approval Avoid disapproval Duty and gift
20 and above years of age	Post-conventional	Adapt accepted rights Personal moral standards

Table 6.2 *Gilligan's stages of moral development*

Approximate Age Range	Stage	Sub stages
Not specified	Pre-conventional	Goal is individual survival
Transition is from selfishness …….. to …….. Responsibility to others		
Not specified	Conventional	Self-sacrifice is goodness
Transition is from goodness …….. to …….. Truth that he/she is a person too.		
Not specified, but says ***'may be never'***	Post-conventional	Principle of nonviolence Do not hurt others or self.

6.16 HEINZ'S DILEMMA

A popular case study by the ethicists in this context is that of Heinz, a poor man, whose wife was suffering from cancer and a very costly drug was prescribed to treat her. He struggled hard to get the money for it but failed, and even the druggist refused to lend the drugs to him. Finally, with no other choice left to save his wife, he entered the pharmacy and stole the drug. In fact, it is this case study that Kohlberg used in his experiments to question several people on whether Heinz was morally right or wrong.

The men gave two sets of responses. One set of opinion was based on conventional-level thinking, saying Heinz was wrong, while the second set of opinion was based on post-conventional thinking, saying Heinz was right as the life of his wife was more important than the proprietary right of the pharmacist. This is like saying 'he is ethically right though morally wrong'. On the other hand, in Gilligan's study, a majority of the women gave the conventional opinion that Heinz was wrong. He could have tried other methods like convincing the pharmacist further than stealing**.**

6.17 ETHICAL DILEMMA—KITTENS' LIFE OR COMMUTER SERVICE?

The following news item appeared in Times of India of 1st September 2013, perhaps referring to an incidence that occurred during the last week of August 2013.

> *Two kittens have been rescued after shutting down New York City subway for more than an hour. Metropolitan Transportation Authority bosses cut power of two lines in Brooklyn when the cats were spotted on the track. Delays continued in both directions as rail staff were sent to rescue the kittens.*
>
> *Public service announcement were made as the search continued for more than an hour. One conductor told frustrated commuters, "There is no service in Manhattan on two lines because if cats and kittens on the track at Church Avenue.*
>
> *Eventually a rail worker and two police officers captured the kittens and put them in a milk crate. Some passengers vented their anger that services had been cut to rescue the animals.*

Fig. 6.4 *The kitten happily watching the fun from the rail track*

This is an illustration for the ethical dilemma faced by the Metropolitan Authorities under a conflict of interests between the commuters and the directive from SPCA (Society for Prevention of Cruelty to Animals). If you are the head of MTA (Metropolitan Transportation Authority) would you justify the above stoppage? Discuss.

6.18 CONSENSUS AND CONTROVERSY

In the course of his duty, an engineer has to exercise his normal autonomy. Similarly, every engineer related to this duty also exercises his autonomy. The concept of moral autonomy is more subjective than objective and even Aristotle says that the subject of morality is not a precise and clear-cut subject like arithmetics. Every engineer has his own interpretation and concept of morality on the performance of the same duty. Hence, there is always a possibility of two ethical persons disagreeing with the ethical conclusions of the other, which is due to the differential development of moral autonomy of each.

This agreement or disagreement, though each is right on his own, are called *consensus* and *controversy* respectively. Since these types of disagreements are inevitable, there should be some extent of tolerance among individuals. As per the principle of tolerance, the goal of practicing ethics is not only to produce an agreed conformity, but also to highlight and adapt ways of promoting tolerances to achieve moral autonomy.

In short, the principle of tolerance says that ethics education shall aim not only at providing uniform conformity of outlook but also to uncover ways of promoting tolerances in the exercise of moral autonomy.

This also implies that in a workplace, be it a classroom or a workshop, there is a need for certain specified authority and there should be some consensus concerning the role of the authority.

6.19 RECIPROCAL ETHICS

Consider the following case study.

> *A professor in a private engineering college wanted to leave his institution to join another. As required per rules, he resigned on the last day of the working semester in the month of April. Having served the college for 5 years, he had 45 days of vacation leave to his credit from the next day of his resignation and requested the management to pay him the vacation pay together with the 22 days' salary of the current month. The college was silent on paying either and after a long correspondence and three months of procrastination, the college released only the 22 days' pay and not the vacation pay earned by him.*

What is the lesson learnt from this? The professor was quite ethical in resigning on the day of his leaving though his friends advised him to collect his vacation pay and then resign, which was conventional. Nevertheless, the professor wanted to be ethical. Was the college management ethical? They not only deprived him of his vacation pay, even after serving for 5 years, but also created unethical procrastination. The lesson is that when the other person or group is determined to be unethical, tending to being immoral, you should also be less ethical and more tactical. This is called *reciprocal ethics*. Every engineer would have faced this problem in his day-to-day dealings within his office or outside the office.

Question Bank

PART A

(Each question carries 2 marks, which you are expected to answer in 3 minutes)

1. Distinguish between moral issues and ethical issues.
2. Justify the statement *Ethical issues : Moral issues :: Civil courts : Criminal courts.*
3. What is morality?
4. Cite the three causes that normally give rise to moral problems.
5. What are moral dilemmas? How are they caused?
6. Distinguish between moral dilemmas due to conflicting interests and that due to conflicting instructions. Give an example each.
7. Why is a systematic procedure required to solve moral dilemmas?
8. What is the need for systematic enquiries in analyzing ethical issues?
9. Distinguish between normative enquiries and conceptual enquiries.
10. What do you understand by moral autonomy?
11. How does Kohlberg distinguish between moral development and cognitive development?
12. Illustrate moral development at the pre-conventional stage.
13. Distinguish between conventional stage and post-conventional stage of moral development.
14. Why do neglected and abused children tend to become violent adults?
15. Distinguish between consensus and controversy.
16. What is the meaning of reciprocal ethics?

PART B

(*These are mostly 8-mark questions to be answered in 12 minutes, presuming that the time allotted for a 100-mark question paper is 3 hours. Sometimes the same question may be asked as a 16-mark question to be answered in 25 minutes.)*

1. Discuss several factors that influence the engineer in his decision making.
2. Discuss with illustrations, the various situations by which moral dilemmas may occur among engineers.
3. Explain in detail the systematic procedure for analyzing moral issues.
4. Explain and illustrate the three types of enquires to be made for collecting information for solving ethical issues.
5. Discuss when a gift becomes a bribe.
6. What are the general observations made by Kohlberg in his study of moral development?
7. Explain the three stages of moral development theorized by Kohlberg.
8. Why and how does Gilligan differ from Kohlberg in his analysis?
9. What do you understand by the Heinz dilemma? How did it help Kohlberg in his analysis?
10. What do you understand by reciprocal ethics? Cite some case studies.

PART C

(Objective-type Questions)

1. Unethical actions : products of poor quality due to ignorance :: Immoral actions : products of poor quality due to ______________.
2. In case of moral dilemmas, every one should follow the law to the letter. (True/False)

UNIT III

ENGINEERING AS SOCIAL EXPERIMENTATION

LIST OF CHAPTERS

7

Experimentation, Learning from the Past

- Engineer as an Experimenter
- The Engineer as a Responsible Experimenter
- Learning from the Past
- Laboratory Experiments vs. Social Experiments
- Informed Consent
- Conditions Essential for a Valid Informed Consent

The engineer's chief responsibility is to develop new products and processes whose impact on the society and the public is unknown. It is like conducting experiments on the society and the public. Hence, this chapter develops the perspective of the engineer's role as an experimenter and discusses the various aspects of his decision making with reference to its impact on the society and public.

Keywords: *Laboratory experiments, social experiments, responsible social experimenter, learning from the past, informed consent.*

7.1 ENGINEER AS AN EXPERIMENTER

The function of the engineer is to develop new products and processes. Since each stage of the design or development is experienced for the first time, there are uncertainties at every stage and the engineer is bound to make presumptions either from data books or from his experience. These uncertainties can be in the form of

- Models used for the design calculations
- Performance characteristics of the materials
- Inconsistencies in the materials purchased
- Nature of the pressure the finished product will encounter

His success lies in his capacity to accomplish his task with this partial knowledge. This brings forth the need to develop prototype or simulation models at every stage and conduct experiments to test them. Rough designs are thus developed from simulation tests conduced from time to time which form the basis for developing more detailed designs, till the final product or the process emerges.

Thus, it is clear that every engineering activity is based on experimental processes. These experiments are done not only in the laboratory but also in the field from the point of view of public safety and performance.

7.2 THE ENGINEER AS A RESPONSIBLE EXPERIMENTER

As per Murphy's law*, if anything is to go wrong, it will go wrong, sooner or later*. It means that all products of technology present potential hazards to some extent due to failure, making engineering a risky activity. Thus, each engineering project, whether development of processes or setting up a new plant or building a new railway track or even preparing for launching a luxury cruiser like Titanic with a full load of passengers should be viewed as an experimental process. Before introducing to the public, every engineering product must undergo various experiments not only in the laboratory but also from the point of safety to the public, especially wherever the lives of several people are involved. That is the reason why the engineer is called not only an experimenter, but a responsible experimenter in view of his concern for public safety as he is experimenting with his design with the society at stake.

The engineer, being a responsible experimenter, should bear in mind and appreciate fully the fact that the experiments are to be done from the society and safety point of view.

- His major duty is to protect the safety of human beings and respect the rights of consent.
- He should have a clear awareness of the experimental nature of the project, forecasting its possible side effects.
- He should monitor these effects, or side effects, meticulously and record any significant issues that arise.
- He should ensure full personal involvement in all the steps of the project.
- He should have a fairly well-developed moral autonomy. His moral beliefs and attitudes must be held only on basis of critical reflection rather than merely through the passive adoption of the conventions of the society.
- He should be accountable for the results of the project.
- He should exhibit their technical competence and other characteristics of professionalism.

7.3 LEARNING FROM THE PAST

It is expected that engineers have to learn not only from their own earlier designs and operating results but also from the past experience of similar projects as well as the design results of other engineers. But several times the engineers working on a particular design shun collecting data or advice from other engineers due to the following reasons:

- Lack of established channels of communication
- Egoism or pride in not seeking information from others
- Lack of trust
- Embarrassment of failure
- Professional pressure from above
- Fear of litigation
- Lack of time
- Plain neglect

Several of the above factors become glaring when accidents continue to take place under similar circumstances causing several fatalities and losses. People just don't learn from past experiences.

1. Collisions and Lack of Safe Exits

(a) On May 1833, the passenger liner 'Lady of the Lake' bound from England to Quebec struck an iceberg and sank, when 215 people died.

(b) Again on 15 April, 1912, the luxury cruiser Titanic collided with an iceberg under similar circumstances and sank resulting in the death of 1513 passengers. The captain, despite being aware of the dangers of the icebergs, and despite a similar accident as stated above, underestimated the danger. The interesting thing here is that the huge number of fatalities is not because of the collision or sinking alone, but because of insufficient number of lifeboats to evacuate the passengers.

(c) Two years later on 29 May 1814, the liner 'Princess of Ireland' sank after collision in St. Lawrence River when 1024 people died.

(d) On 2 Oct., 1942, 'Queen Mary' collided with a British liner and 338 people died.

(e) It is reported that in November 1948, a Chinese troopship evacuating nationalist troops from Manchuria sank, killing some 6000 people, the huge number again due to overcrowding and lack of sufficient lifeboats.

This aspect of safe exit and a more detailed case study of Titanic are dealt with in future chapters.

2. Boiler Explosions or Fires on Board are Common Causes for Marine Accidents

(a) On 27 April 1865, on Sultana', a Mississippi River Steamboat, a boiler explosion killed 1547 people.

(b) Again on 17 Sept., 1949, 'Noronoc', a Canadian Great lakes cruiser had a major fire due to which 130 people died.

(c) On 25 May, 1983, 'Ramadan', an Egyptian steamer caught fire and sank in Lake Nasser on Nile near Aswan Dam, when over 272 people died.

3. Collision of Ships with Bridges

(a) Ships are known to brush against bridges under which they pass, and cause minor or major damages to the ships and the bridges. This happened in 1964 at the Maracaibo bridge at Venezuela and similarly in 1975 at Tasman bridge in Australia.

(b) These incidents should have given sufficient time and precedence for bridge engineers as well as marine engineers to learn from the past. Yet, in 1980, a moving ship hit the Sunshine Skyline Bridge in Sweden due to the unexpected horizontal impact forces. Couldn't this have been foreseen and avoided?

4. Control Valves

(a) Valves are notorious to be least reliable and a lot of effort is expected to be put during design and maintenance of the valves at any plant. There were several cases of malfunctioning of valves resulting in accidents in several places.

(b) Yet, a pressure relief valve and lack of correct indication on whether the valve was open or shut, contributed to a major accident at the Three Mile Island Nuclear Power Plant, as explained in detail in Chapter 12.

(c) Similarly, it was the poor maintenance of the valves combined with poor management of the situation that caused the Bhopal Gas Tragedy, as explained in detail in Chapter 13.

(d) The Tettron Dam disaster near Los Angeles was due to a sudden gush of water. The engineers who built it did not bother to consider the case of the Fontenelle Dam which collapsed due to a similar problem.

5. Fire Accidents in Fireworks Manufacturing Units

In India, Sivakasi in Tamil Nadu is the center for the manufacture of fireworks. Every year, millions worth of crackers and fireworks are manufactured by hundreds of small units and supplied throughout India. Nevertheless, these units are based on age-old technology, and methods of manufacture involve thousands of unskilled labor including women and children who are employed for filling the containers with explosive powders by hand. This makes them highly exposed to explosion and fire hazards and hundreds are reported to be killed every year. The latest accident is the fire on 2 June, 2005, at a fireworks unit near Sivakasi.

Despite the obvious hazardous working conditions and processes, and heavy death toll year after year, no one—neither the owners nor the Government departments nor other NGOs—have learnt from the past to develop safety standards and enforce them in these units. The gist of a newspaper report can be cited as illustration:

> *There are many (fireworks) units in this (Sivakasi) region and we find workers dying every month. These mishaps do not make news as the factory owners silence the bereaved families with money. Most of the cracker units do not follow the mandated safety norms. They set aside some money (which is a pittance compared to the legal compensations) to accident victims rather than spend larger sums on creating fireproof infrastructure. While it is stipulated that the factories should have fire extinguishers in adequate number in all the rooms, a bucket of water, often empty, is all that can be sighted in the rooms where the workers deal with the incendiary stuff.*

These examples illustrate how engineers should study case examples instead of designing from data books alone. The engineering profession demands professionals to remain alert and be well informed at every stage of the project's history.

7.4 LABORATORY EXPERIMENTS VS. SOCIAL EXPERIMENTS

We have earlier compared engineering experiments with laboratory experiments. But there is one difference. In the laboratory, experiments are generally done on materials, products, etc., and if they fail it may at the most result in disappointment and loss of money but will not affect the health and safety of the public. But engineering experiments that we are referring to in this chapter are conducted on humans who are not in control of the experimenters and any variations in the results would affect the subjects with adverse consequences on the society. The persons or the community, which is put under the experiment, has to be given all the needed information to allow them to make an appropriate decision.

7.5 INFORMED CONSENT

As discussed above, any experiment made in introduction of new products or processes that have public impact can be compared to the testing of new drugs or medicines or techniques on a sample of population before introducing them into the market. If the drugs have side effects on humans, it is the innocent public who are not aware of the technical aspects of these drugs, and are effected adversely sometimes with permanent effects on their lives. It is, hence, necessary that the subjects should be informed that they are being administered with that particular drug as an experiment to observe its effect on humans and the possible side effects on them. If the subject consents to be subjected to the experiment, only then should the drugs be administered. This is called *informed consent*.

In a similar manner, if an engineer or a company introduces a process that may effect the environment, a proper meeting should be called among the community elders or at least a newspaper notification should be given inviting public debate or objections. When the engineer carries out an engineering activity as if it were an experiment, he should be prepared for unexpected outcomes, which sends him in search of new knowledge, involving a new experiment or an extension of the original experiment. In any case, these results give opportunities to assess the results and take any further steps for the improved safety of the re-experiment and also to provide a safe exit for the subjects in case of emergency. Of course, most of the companies do not follow this procedure which is absolutely unethical on their part.

7.6 CONDITIONS ESSENTIAL FOR A VALID INFORMED CONSENT

1. The consent must be given voluntarily and not by any force or coercion.
2. The consent must be based on relevant information needed by a rational person and must be presented in a clear and easily understood form.
3. The consumer or the subject of the experiment must be capable of understanding the information and make rational decisions.
4. The experiment involves not an individual but a community; hence the group that collectively represents many subjects of the group with like interests and concerns and exposure to risk must endorse the subject's consent.

Question Bank

PART A

(Each question carries 2 marks which you are expected to answer in 3 minutes)

1. Why do uncertainties occur during the design process?
2. List some of the forms of the uncertainties that arise during the design process.
3. Compare laboratory experiments with social experiments.
4. List some factors that deter an engineer to learn from the past precedence.
5. List some accidents that have taken place due to malfunctioning of control valves.
6. Why is the Titanic disaster treated as an experimental failure?
7. What do you understand by informed consent?

PART B

(*These are mostly 8-mark questions to be answered in 12 minutes, presuming that the time allotted for a 100-mark question paper is 3 hours. Sometimes the same question may be asked as a 16-mark question to be answered in 25 minutes.)*

1. Discuss why the engineer is called a *social experimenter*.
2. Discuss the statement: *People do not learn from past experience*.
3. Discuss the above with specific reference to the fireworks manufacturers.
4. What is the significance of informed consent? Discuss the conditions needed for informed consent.

PART C

(Objective-type Questions)

1. *Fill in the blanks:*

(i) ______________ in the materials cause uncertainties in the design of a product.

(ii) Laboratory experiment : experiment on chemicals :: Social experiment : experiment on ______________

2. You are introducing a new product that would be useful for the public. But it has some inherent risks. The process of informing the public about these inherent risks is called ______________ ______________.

8

The Engineer as Manager and Leader

- Is the Engineer Different From the Manager?
- Motivating Factors for the Engineer to Become a Manager
- Functions of Managers vs. Engineers
- Proper Management Decision (PMD) and Proper Engineering Design (PED)
- Managers as Professionals
- What is Moral Leadership?
- Attributes of Moral Leadership
- Leadership Categories
- Contributors for Moral Leadership
- Participation in Professional Societies
- Leadership in Communities

Every engineer has to play the dual role of an engineer and a manager in his career. While distinguishing between the two aspects of his dual role, this chapter discusses his role as a manager in providing effective leadership and institute systems that facilitate ethical conduct by all employees.

This chapter also focuses on the engineer as a moral leader within his profession and community. The attributes for a moral leader are indicated. The significance of participation in professional society activities by the engineers is highlighted.

Key words: *Engineer, manager, self-esteem, white-collar jobs, proper engineering decision (PED), proper management decision (PMD), moral leadership, dictatorial attitude, leadership categories, autocratic, persuasive, democratic, laissez faire, professional societies, community leadership.*

8.1 IS THE ENGINEER DIFFERENT FROM THE MANAGER?

An engineer is basically a technologist. Soon after his graduation, he starts working directly in his field of appointment as a trainee or a junior engineer. His job is mostly hands-on. Once he gains sufficient experience in the technical aspects of this job, he is given more and more responsibilities of decision taking and also training other juniors. He then moves up in the hierarchy to a managerial position.

8.2 MOTIVATING FACTORS FOR THE ENGINEER TO BECOME A MANAGER

1. Financial Advancement

Besides higher pay levels, a managerial position enables an engineer become a technocrat or a successful entrepreneur.

2. Self-esteem

Like any other human being, an engineer too wants to satisfy his self-actualization needs to win acclamation from others as an efficient manager. This is in line with the theory of hierarchy of needs propounded by Abraham Maslow, which states that as and when the lower levels of needs are satisfied, a person wants to climb to a higher level of needs, the ultimate level being the satisfaction of his self-actualization needs.

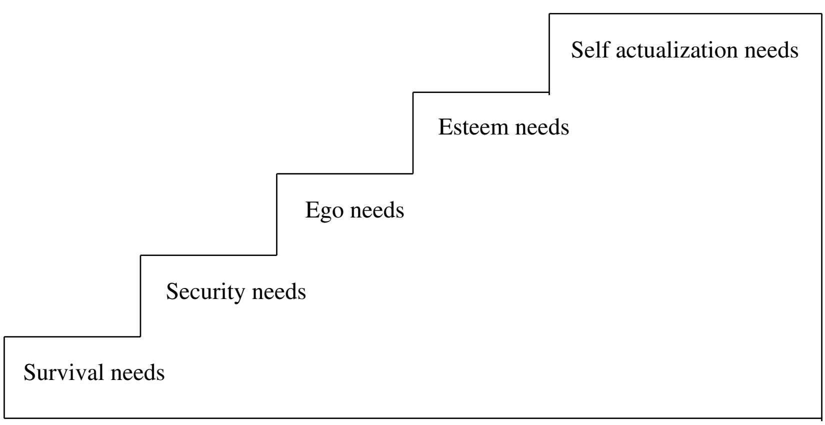

Fig. 8.1 *Maslow's hierarchy of needs*

3. Power, Influence, and Status

Engineers are motivated by the need for power and influence over others in the same or other organizations. They want authority, responsibility, and leadership. Holding a manager position would help an engineer achieve the same.

4. Fear of Technological Obsolescence

As explained in the next paragraph, the engineer's major work related to technology and the day-to-day advancement in technology would render his qualifications and experience obsolete unless he learns more of the latest technologies. On the other hand, the advancement in management thinking is more of conceptual adaptation.

5. White-collared Jobs

The general impression among the youth is that the job of a manager is a white-collared one while that of an engineer is a blue-collared one, that is working with grease and tools.

8.3 FUNCTIONS OF MANAGERS VS. ENGINEERS

The factors explained in the previous paragraphs would be understood better if we classify the company decision makers into two categories, the managers and the engineers.

8.3.1 Managers

1. They generally possess very good management capabilities, but with less technical background.
2. Their primary function is to direct the activities of the organization including the activities of the engineers.
3. They are governed more by the standards that prevail in the company rather than the standards that prevail in the group industry or the community. To some extent, they are guided by their own personal morals and beliefs.
4. They are the custodians of the organization and are concerned with its present and future well-being and performance. While the term *well-being* refers to economic viability or profitability, it also refers to other subjective aspects like public image and employee morale.

5. They are answerable to the top management or the stakeholders about the expenditure, sales, assets, and overall profitability of the company. Managers enumerate all the relevant considerations rather than thinking in terms of professional practices and standards alone, and then balance them one against another to make a decision.

8.3.2 Engineers

1. They are generally technically qualified and are able to realize the technical consequences of any decision made.
2. Their professional loyalty goes beyond their immediate bosses.
3. Their primary function within the organization is to use their technical knowledge and training to create engineering products and processes that are of value to the organization and customers.
4. They must assess the safety of the product and process and ensure that the processes and products are safe and environment-friendly. They should embed in the standards certain criteria like efficiency and economy of design, the degree of vulnerability to improper manufacturing and the extent to which state-of-the art technology is used.
5. They should have special concern for quality in all aspects of manufacture.
6. They must advise the management on the above and technical matters relating to the processes and products.
7. They must uphold the standards that the profession has decided and follow their guidelines.

8.4 PROPER MANAGEMENT DECISION (PMD) AND PROPER ENGINEERING DESIGN (PED)

The functions, as described above, have given new concepts and terminology for distinguishing managerial and engineering decisions like Proper Management Decision (PMD) and Proper Engineering Design (PED)

Proper Management Decision (PMD) is a decision that should be made by managers or at least governed by management considerations, because

- It involves factors relating to the well-being of the organization such as cost, scheduling, marketing, and employee morale and welfare, and

- The decision does not force engineers or other professionals to make unacceptable compromises with their own technical practices or ethical standards.

Proper Engineering Decision (PED) is a decision made by the engineers or at least governed by professional engineering practices because it either

- Involves technical matters that require engineering expertise, or
- Falls within the ethical standards embodied in engineering codes, especially those requiring engineers to protect the health and safety of the public.

8.5 MANAGERS AS PROFESSIONALS

As explained in Section 8.1, engineers wish to move up the corporate ladder after gaining substantial experience. The management too wants to have managers in top positions to have substantial technical hands-on experience on the job, more than theoretical knowledge of the management precepts. These engineers might also have been trained sufficiently in management skills during their education, Even otherwise, they would be given sufficient training by the management in the precepts and practices of management principles like finance, scheduling, and in improving their skills in coordinating and motivation. They would acquire additional skills in making risk-taking decisions and technical considerations. More than anything else, the engineers would be fully trained in the precepts and practices of ethics in their day-to-day work.

8.6 WHAT IS MORAL LEADERSHIP?

The engineer, in the course of his career, gains experience and climbs up the ladder to become a manager. As discussed earlier, when the engineer becomes a manager, he has the additional responsibilities of answerability to the management as well as supervising the work of other engineers, leading them towards the achievement of goals. This *leadership quality* is that trait that distinguishes a manager and builds his image.

This leadership may take several forms and, in general, it indicates the success story in moving a group towards its goal. But it is the goal or the leadership attitude that distinguishes a good leader from a bad leader.

Hitler was a leader. He could successfully control a large German army and move them towards his goal of conquering Europe. But his goal was not just and fair. Similar was the case of Joseph Stalin of Russia and Idi Amin of Uganda. Because of their evil goals and dictatorial attitude, people obeyed them out of fear but not out of regard. After their fall, all, including their own followers, were happy to be relieved of their tyranny.

On the other hand, Mahatma Gandhi too could lead a large population in achieving the goal of independent India. He never used power and his charismatic personality, his conviction, honesty, integrity, and the ability to guide people towards the goal makes him respected all over the world even today. This is moral leadership.

8.7 ATTRIBUTES OF MORAL LEADERSHIP

Moral leadership, hence, requires the qualities of

- Influencing,
- Motivating,
- Directing,
- Organizing,
- Communicating, and
- Creatively managing

moving people towards morally valuable goals.

8.8 LEADERSHIP CATEGORIES

Early management books have highlighted the leadership types and traits as follows:

Autocratic where the leader forces his group to achieve the targets as *he* perceives them without giving any scope for thinking and judgment by the subordinates.

Persuasive where the leader does discuss with his subordinates and persuades them to achieve the targets either by incentives or by snooper vision.

Democratic where the leader gives good value to the feelings of the employees and gives prime importance to the employee morale.

Laissez faire where the leader is too passive and gives full freedom to the subordinates without having any control over them. This would sometimes cause miscommunication and disputes between the employees but the leader does no serious attempt to solve these disputes. These categories are represented in the following disputes.

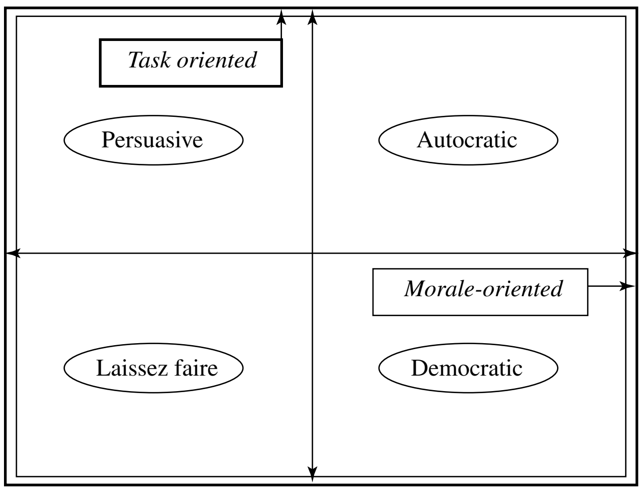

Fig. 8.2 *Leadership categories*

In addition to the above, moral leadership is of prime importance to a manager. In view of the several points discussed in the previous chapters, the requirement of moral leadership in the engineering profession is highly felt today.

8.9 CONTRIBUTORS FOR MORAL LEADERSHIP

The main contributions for moral leadership are the following:

1. Respect Respect to other persons irrespective of their position is the very basis of moral leadership.

2. Behavioral Pattern As indicated in Chapter 2, as the leader ascends up the ladder of the hierarchy of needs, he is driven by this unconscious desire to win, to be loved, to be appreciated, to be perfect, and to be successful. If this desire in the leader to win takes preference over the need to be fair and to be reasonable, this would affect the moral leadership adversely.

3. Style Every leader has his own style of functioning and dealing with his subordinates or peers, which has direct bearing on the responsiveness of others and consequently his success as a moral leader.

4. Habit Habits are behaviors a person picks up over the years. He may not be conscious of these habits, but they certainly affect the way he interacts with others. They may be positive or negative habits. Examples are the use of certain expressions, jokes, or gestures.

5. Intention Here the leader consciously and intentionally acts in ways that harm others either physically or mentally. This can take two forms:

- Behavior in which harming others is accepted by the leader as necessary to achieve something valued by him.
- Behavior in which the leader has no bad intentions but does not see or realize the harm his actions do to others.

8.10 PARTICIPATION IN PROFESSIONAL SOCIETIES

Professional societies have established themselves as inseparable associations linking themselves with both the corporate sector and the educational institutions. They help their members in the following manner:

- Serve to unify a specific profession and to speak and act on behalf of their members
- Promote continuing education to their members
- Provide a forum to discuss difficulties experienced by the engineers during the course of conducting their professional activities
- Promote awareness of ethics among members by organizing seminars and workshops in specific issues emphasizing upon the need for moral leadership among engineers and the best practices in leading their teams towards the achievement of goals
- Provide guidelines for employment practices and conflict resolution, thereby helping in solving moral and ethical conflicts among the members
- Recognize moral leaders and responsible engineers by presenting awards for outstanding professional achievements, for example IEEE has established awards and other forms of honorary recognition for whistleblowers who act according to its ethical code

- As cited in Chapter 18, they also promote healthy whistleblowing among corporations by publishing in professional journals, the names of companies who take unjust reprisals against whistleblowers

The last three activities of the professional societies do promote the attributes as indicated in section 8.8, for moral leadership of their member engineers. It has hence become imperative that every professional becomes a member of professional societies related to his profession and takes active part in its activities to develop the team spirit, society consciousness, and behavioral pattern.

8.11 LEADERSHIP IN COMMUNITIES

As we have seen earlier, the engineer has his responsibilities to the society in ensuring a healthy and safe environment as a social experimenter. In addition to being a citizen himself, he has to provide moral leadership in guiding others in the society in social and cultural aspects of the day-to-day life. As a technical person and as an educated person, he is fully aware of the goods and evils of several issues that are occurring around and guide and advise the society towards issues of public good. This conforms to the general viewpoint that all the citizens have obligations to spare some of their time and energy for public issues and public policy decision-making.

Question Bank

PART A

(Each question carries 2 marks which you are expected to answer in 3 minutes.)

1. Represent Maslow's hierarchy of human needs by a figure.
2. What is meant by white collared job?
3. Expand the abbreviations PMD and PED.
4. Define moral leadership.
5. Represent the leadership categories in a neat chart.

PART B

(These are mostly 8-mark questions to be answered in 12 minutes. Some times the same question may be asked as a 16-mark question to be answered in 25 minutes.)

1. What are the several factors that motivate an engineer to become a manager?
2. Discuss the role of an engineer as a professional.
3. Discuss and distinguish the functions of manages and engineers.
4. Discuss why an engineer should possess moral leadership.
5. Analyze the parameters that contribute to moral leadership.
6. Discuss the role of professional societies in promoting moral leadership.

PART C

(Objective-type Questions)

1. State if the following statements are true or false:

(i) Managers are the custodians of the organization.

(ii) 'Remove your engineer's hat and put on your manager's hat' is an ethical statement.

9

The Engineer as Consultant and Expert Witness

- Who is a Consultant
- Key Features of a Consultancy
- Why are Consultants Needed?
- Requirements of Consultants
- Attributes of a Consultant
- Qualities of Consultants as per P W Shay
- External and Internal Consultants
- Consultants' Responsibility to the Clients
- Sample Code of Ethics
- Eyewitness vs. Expert Witness
- Scope for Expert Witness
- Vehicular Accidents
- Insurance Evaluation
- Technical Probe into Damaged Materials
- Test Result Evaluation
- Expert Witness in a Court of Law
- Other Professional Investigations
- Value Neutral Analysts and Value Guided Advocates
- Moral Dilemma Faced by Expert Witnesses
- Ethical Aspects of Expert Witnesses
- Ethical Guidelines for Expert Witnesses
- Conclusion

This chapter examines the role of the engineer as a consultant who is different from a full-time employee from the ethical point of view, though they share the company's other ethical codes. Consultants' responsibilities to the clients are also highlighted for the benefit of both the internal and external consultants.

On several occasions, the engineer may be asked to provide his opinion and testimony in disputes like the cause of accidents and extent of damages. This chapter discusses the several roles played by the engineer in these circumstances, and the ethical aspects of these roles.

Keywords: *Consultant, attributes, consultant qualities, consultant ethics, consultant responsibilities, external consultant, internal consultant, creativity, confidentiality, codes of ethics, project safety, project implementation, SREDDIM, eyewitness, expert witness, insurance evaluation, damage assessment, Titanic disaster, Kanishka air crash, courts of law, agency loyalty, hired guns, financial influence, ego bias, sympathy bias, value neutral analysts, value guided advocates.*

9.1 WHO IS A CONSULTANT?

A *consultant* is an independent and qualified person providing services in identifying and investigating into management problems concerned with an organization, procedures, methods, policy, etc., recommending appropriate actions and helping in the implementation of these recommendations.

9.2 KEY FEATURES OF A CONSULTANCY

- Consulting is an independent service.
- It is in an advisory role.
- It provides specialized knowledge and skills.
- It provides practical solutions for problems.

9.3 WHY ARE CONSULTANTS NEEDED?

- The provide special knowledge and skill.
- They supply intensive professional aid on a temporary basis. This is very significant to small-scale industries, which find it more economical than to employ full-time senior staff, especially when the problems are occasional.
- They give impartial viewpoints. In certain cases like job evaluation and standard setting, the worker's union may sometimes feel that the recommendation made by the company's industrial engineer is pro-management and they insist such studies which would affect the labor, done by outsiders. In some cases, the unions also employ their own similar consultants to work in tandem with the management-appointed consultant.
- They provide the management with arguments that justify the predetermined measure.

9.4 REQUIREMENTS OF CONSULTANTS

- Technical know-how
- Professional experience
- Creativity and analytical ability
- Diplomacy and tact
- Effective communication and ability to put across ideas effectively

9.5 ATTRIBUTES OF A CONSULTANT

- He shall possess systematic knowledge and skill to perform functions with authority.
- He shall have autonomy in his decisions. He cannot be controlled, supervised, or directed by the client.
- He is not subject to political ideologies or controls, but sees himself affected by public interest.
- He is bound by ethics in the performance of his duties.
- He will use his knowledge, skill, and authority ethically.
- He shall not knowingly do harm to his clients.
- He shall not have bias in his judgments.

9.6 QUALITIES OF CONSULTANTS AS PER P W SHAY

P W Shay in his book *The Common Body of Knowledge for Management Consultants* cites the qualities of consultants as follows:

1. Good physical and mental health
2. Professional etiquette and courtesy
3. Stability of behavior and action
4. Self-confidence
5. Personal effectiveness (drive)
6. Integrity
7. Intellectual competence
8. Good judgment
9. Independence, must be self-reliant but not subordinate to other's opinions
10. Must be able to form his own opinions in areas of his competence and the experience and at the same time recognize the limitations of his competence, experience, and judgment
11. Strong analytical or problem solving ability
12. Creative imagination
13. Skill in interpersonal relationships.
14. Ability to communicate with above average facility
15. Psychological maturity

9.7 EXTERNAL AND INTERNAL CONSULTANTS

An *external consultant* is administratively and legally independent of the organization for which he works except his contractual obligations.

Internal consultants are generally employees on full-time contract with a monthly salary for a fixed period. They include internal auditors, legal consultants, and industrial engineers. Their functions are similar to the consultants to the effect that they are asked to study certain specific aspects and report. Here lies their need for detailed knowledge and effective communication. In fact, every engineer himself is an internal consultant in his company, whether conducting a method study program or maintenance planning, and hence needs to have independent thinking and effective communication.

9.8 CONSULTANTS' RESPONSIBILITY TO THE CLIENTS

1. Confidentiality

The engineer as a consultant would be given access to certain confidential documents or processes or information as a part of his task. At the same time, he is not in full-term employment and he normally works for some other client also. If the second company happens to be the competitors of the first, there are always pressures on him to leak the confidential information. As an ethical consultant, it is his primary responsibility to ensure that he does not pass off any information nor make use of that information without the consent of the first company. This aspect with reference to the engineering employees of the company has been discussed in detail in the chapter on conflict of interests..

2. Codes of Ethics

The consultant shall understand and know all the relevant canons and codes developed by the respective association and follow them where possible.

3. Safety of the Project

Consulting engineers have the responsibility in decision-making concerning safety. As an outsider, the consultant should use his own judgment and ethical thinking in incorporating safety in every aspect of the project, even though the client feels it is too expensive.

4. Refusal to be Part of the Unethical Process and Practices of the Client

As explained above, the consultant can always and must refuse to tow the line of the client if he feels that the client is deliberately asking for inferior designs, just for reducing the cost of the project. If their professional judgment is overruled where the safety, health, property, or the welfare of the public is endangered, they shall notify the client or the employer or such authority as may be appropriate. They will take a similar action when they find that the codes of practices are violated by the client.

5. When the Project is Weak

Consultants shall advise frankly when they believe the project would not be successful.

6. Implementation of the Project

The consultant's duty does not end in developing and executing a project. He has the responsibility to ensure that the project is successfully implemented and maintained. This is similar to the method improvement studies done by industrial engineers, wherein the 7-step procedure (SREDDIM) is as given in Fig. 9.1 below. Here the last two, viz. *install* and *maintain*, are emphasized.

7. Design-only Projects

Even after completing the design only projects like building design project of an architect, he should continue to hold responsibility of the strength of the building even after the completion and occupancy, as long as the construction is as per his specifications. It is his moral duty to check at random the quality of the construction.

8. Legal Responsibilities

As an independent on contract with the client, the consultant is subjected to many legal issues during the performance of his work. If anything goes wrong in the project, it is the consultant who would be questioned first. The consultant must realize this aspect before he accepts a contract.

Select
Record
Examine
Develop
Define
Install
Maintain

Fig 9.1 *SREDDIM, The seven-step procedure for method improvement*

9.9 SAMPLE CODE OF ETHICS

The codes of ethics for professional consultants framed by The European Federation of Association of Management Consultants (FEACO), are given in the annexure. Nevertheless, the do's and don'ts are reproduced here as an illustration.

All member associations must subscribe to FEACO's Code of Conduct and Practice under which the following are regarded as unprofessional conduct.

1. Advertising in a blatant and commercial manner
2. Accepting any trade commission, discounts, or considerations of any kind in connection with the supply of services or goods to a client
3. Having interest in firms supplying goods or services to their clients, or to be under their control, or to fail to make known any kind of interest likely to effect their service
4. Calculating remuneration on any basis other than the agreed professional scale of fees
5. Disclosing confidential information regarding the client's activities
6. Paying or accepting payment for the introduction of clients except in accordance with the recognized and generally accepted professional practice in the country concerned
7. Doing anything that does not accord with the statutes of the profession

9.10 EYEWITNESS VS. EXPERT WITNESS

An *eyewitness* is a person who gives evidence on what he sees actually. He is not expected to add his inference on what might have happened in his absence.

An *expert witness* not only gives evidence on what he has seen actually but also gives his own inference and reasoning on what might have happened by expertise based on systematic analysis and reporting.

9.11 SCOPE FOR EXPERT WITNESS

In case of any eventual happening like accidents, the courts or the investigating committees depend on the testimonies of the engineers who are expected to probe deeper into the accident including the events leading to it and investigate by considering all the technical and other aspects. These engineers are expected to be well qualified and trained in such analysis.

Usually, engineers are hired as consultant or may be a part of the investigating committee. The following paragraphs illustrate their role.

9.12 VEHICULAR ACCIDENTS

In cases of accidents to large carriers like the rail accidents or ship accidents, a team of experts visit the sight to gather and look at the evidence, conduct enquiries, and make a thorough analysis of the root cause. Their report normally includes

- The nature and extent of the human errors involved, so that suitable action can be taken on the personnel involved,
- The comprehensive details of the technical snags in the system so that they can be rectified immediately,
- General recommendation on the several improvements that should be made in all related aspects of the system,
- Focus on future issues like public planning, policy making, etc., that involve technical knowledge, and
- The aspect in which the management shall be made accountable, so that it can be more serious in containing the snags before they resurface.

9.13 INSURANCE EVALUATION

This is one of the most common cases of giving an expert advice. Qualified and trained engineers are engaged as consultants by the insurance companies to assess the damages to the vehicles involved mostly in road accidents, There are several certified evaluators to assess the scrap value of even ships that sink mid-ocean due to collision or other causes.

Civil engineers, architects, etc., are engaged as consultants for probing into collapses of buildings and bridges.

9.14 TECHNICAL PROBE INTO DAMAGED MATERIALS

The materials and remnants from the accident sites, especially of air crashes could be tested and analyzed to detect the actual cause of the accident. which sometimes could be different from the eyewitness reports. The following two cases illustrate this point.

1. *In the Titanic disaster, the study of the hull after it was sunk disclosed the yielding of the rivets during the impact with the iceberg. This discovery helped in adapting better metal-fixing methods like welding in ship building.*
2. *In the Air India flight Kanishka which crashed into the sea after take-off from London, all the damaged fuselage and metal parts were retrieved from the sea and spread over the land. It was discovered that while the rest of the fuselage indicated no fatigue damage or impact failure, one of the toilets showed a gaping hole, an evidence of a powerful explosion, confirming the theory of sabotage. Interestingly, the black box did not give any evidence of alarm to the pilots till the explosion. An Indian NDE expert was a member of this investigation committee.*

9.15 TEST RESULT EVALUATION

In some cases, especially during pilot projects or product testing, engineers are engaged as consultants to analyze the test reports and suggest recommendations in case of any abnormalities in the procedure or results.

9.16 EXPERT WITNESS IN A COURT OF LAW

Apart from giving reports as indicated in section 9.12, engineers are also hired by lawyers to give their expert testimony in criminal or civil suits so as to substantiate the lawyer's defense arguments. This is the aspect of the role highlighted by Martin et al. as *hired guns*.

9.17 OTHER PROFESSIONAL INVESTIGATIONS

While most criminal investigations are done by police or CIDs, engineers are sometimes hired when technical or engineering aspects are involved. Many times what was thought to be a case of suicide could later be proved to be murder or vice versa, when the material clues are technically analyzed. It has now become common during the forensic investigations and even after autopsy, for the concerned doctor or the professional to consult his engineering friend or associate to clarify certain technical queries.

9.18 VALUE NEUTRAL ANALYSTS AND VALUE GUIDED ADVOCATES

In light of the above-mentioned moral dilemmas and responsibilities faced by expert witnesses, Martin et al. suggest three models of how to balance the responsibilities.

1. Hired guns whose obligation to the hirer is paramount, indicated above as agency loyalty.

2. Value neutral analysts who are fully impartial and guided by their ethical thinking, in contrast to the hired guns. Their role is to identify all options and analyze the factual implication of each option.

3. Value-guided advocates where the engineers remain honest and independent in their professional judgments except in controversial issues. If the controversial issue involves the society, they choose the one which is good for the society. They understand that values are interwoven with facts and give priority to the society-related values. If a controversial issue is between the hirer and the opponent and has two options that are both equally ethical and not related to the society at large, they choose the one favorable to the hirer.

9.19 MORAL DILEMMA FACED BY EXPERT WITNESSES

Despite the full appreciation of his ethical role, the engineer is subjected to certain forces

1. Agency Loyalty

As explained in section 9.16, when a lawyer engages an engineer on payment, he expects and spoonfeeds the latter to give the opinion in his favor. Here, the engineer is used as a hired gun to shoot at the opponent. The following illustration would highlight this.

> *Kumar, an electrician, climbed up a fairly new ladder to repair a certain electrical fitting of the ceiling in a college building. The ladder buckled and he fell down resulting in serious injuries. The college management sued the ladder manufacturer for supplying a defective product. The lawyer for the ladder manufacturer hired an engineer to prove that the fall was due to the electrician's carelessness. The engineer on studying the ladder noticed a crack in one of*

the joints which caused the ladder to skid while climbing. However, the engineer deliberately ignored this and unethically reported that the ladder was quite sturdy and it was the carelessness of the electrician that caused the fall.

2. Financial Influences

The very idea that someone is paying makes the engineer feel agency loyalty. The following factors also influence decision.

- *Contingency payment*, that is if the engineer receives the payment only after the case is won, he is interested to ensure that the case is won so as to get his payment.
- *Moral attitude of the engineer*, who considers earnings to be more important than ethics, especially if he does not have regular salary from lawful sources.
- *Desire for additional consultancy assignments*, since by satisfying the hirer on his expertise together with agency loyalty, he has better chances of getting similar assignments in future either from the same hirer or others.

3. Ego Bias

Sometimes the opponent lawyer also engages another engineer. Unless the personal rapport between the two engineers is good, they develop a competitive attitude. Each sees himself and his client as an innocent victim and the other a guilty party. In this case, the engineer gets more easily identified with his client, and gives a favorable report, even unethically, just to defeat his counterpart.

4. Sympathy Bias

It is not uncommon to see human dramas in courts. If the engineer of one party sees and believes the plight of the victim of the opposite party, he may sometimes get over-influenced by the drama enacted and gets influenced by sympathy bias in his report even though he knows it is wrong.

9.20 ETHICAL ASPECTS OF EXPERT WITNESSES

We said earlier that lawyers hire engineers to give certain witnesses or opinions to support their point of argument. Logically, this opinion benefits one party at the cost of another party and hence involves ethical dilemmas and the engineer is expected to possess moral autonomy as defined in Chapter 6. Basically, they are expected to note the following:

- They have responsibility to be objective in determining the truth and telling it honestly.
- They have to share the moral responsibility with the society.
- Their role must be understood in terms of a morally justified legal system.
- They should have professional standards and actions guided by the codes of ethics.
- They shall maintain confidentiality.
- They should not be guided by ego bias or sympathy bias.
- Whoever might be paying him for the services, whether the court or the lawyer, the engineer should not let his financial obligations or agency loyalty prevail over moral obligations and social responsibilities.

9.21 ETHICAL GUIDELINES FOR EXPERT WITNESSES

1. Do not accept a case unless you think the case is justified. First weigh the pros and cons of the case from available data.
2. Do not accept the case unless you have the mood and attitude to conduct a fair analysis and investigation.
3. Do not accept the case unless you have the sufficient time for a thorough investigation. Rushed preparations can be disastrous to both the hirer and to your reputation.
4. Discuss extensively with the lawyer and apprise him of the technical aspects so that he can prepare himself for a good cross examination.
5. Maintain your integrity at all the stages.
6. Maintain an objective and unbiased posture on the witness box, keeping an even temper and sticking to the questions.
7. Always be open to new information at any stage, even during the latter part of the trial.
8. A right approach suggested by Harris et al. is illustrated in the following statement of an expert witness.

    I will have only one opinion. My opinion will be unbiased and objective as I can possibly make it. I will form my opinion after looking at the case and you should pay me to investigate the facts of the case. I will tell the truth and the whole truth as I see it on *the witness box, and I will tell you what I will say beforehand. If you can use my testimony, I will serve as an expert witness for you. If not, you can dismiss me.*

9.22 CONCLUSION

Engineers serving as witnesses in courts of law are regarded by the judges as responsible in being impartial and give their opinions based on ethics. Yet being paid by the lawyer for one disputed party, combined with additional finances and desire for additional consultancies in the future can influence the engineer creating a conflict of interest. Especially those engineers hired as advisers for public projects and policy making should have full moral autonomy and shun any biased judgment.

Question Bank

PART A

(Each question carries 2 marks that you are expected to answer in 3 minutes.)

1. Define a consultant.
2. Illustrate at least one reason why companies hire consultants
3. What are the features of a consultant?
4. Who are internal consultants?
5. What is SREDDIM?
6. Distinguish between eyewitness and expert witness.
7. Explain how the post-mortem of the Kanishka air crash acted as an expert witness.
8. What is the role of an engineer in test evaluation during new product development?
9. Relate agency loyalty to expert witness.
10. What is the meaning of ego bias for an expert witness?
11. Who are hired guns? Why are they called so?
12. Distinguish between value-neutral analysts and value-guided advocates.

PART B

(These are mostly 8-mark questions to be answered in 12 minutes, presuming that the time allotted for a 100-mark question paper is 3 hours. Some times the same question may be asked as a 16-mark question to be answered in 25 minutes.)

1. Illustrate and explain the attributes and qualities of a consultant.
2. Discuss the consultants' responsibilities to their clients.
3. Explain some of the codes of ethics that are applicable to the consultants.
4. Discuss the role of an engineer as an expert in insurance evaluation in case of accidents to automobiles, ships and aircrafts.
5. Discuss the moral dilemmas faced by the engineer as an expert witness.
6. Examine the ethical guidelines for expert witnesses.

PART C

(Objective-type Questions)

1. State if the following statements are true or false:

(i) Post-mortem of the sunken Titanic helped in developing new processes of manufacture.
(ii) An engineer's opinion is not needed in criminal investigation.
(iii) A mechanical engineer is generally called up to give expert opinion in case of building collapses.

2. Fill up the blanks:

(i) Roadside tramp : Engineer : Eyewitness : __________
(ii) Automobile engineer : car accident :: _________ : building collapses

10

Ethical Codes

- What are Codes of Ethics
- Purposes Served by Codes of Ethics
- Limitations of Codes
- Internal Conflicts Created by Codes
- Professional Societies that have Drawn Codes of Ethics
- Corporate Codes of Ethics
- Balanced Outlook on Law
- Swami Sivananda's Observation on Balanced Outlook on Moral Issues
- International Moral Code

This chapter discusses the need for some guidelines to the professionals and illustrates how various professional associations and institutions have developed codes to be followed by their members, aimed at deterring and disciplining unethical professional conducts. A series of such developed codes are appended in the annexure. This chapter also discusses the balanced outlook of laws and regulations and their limitations in governing these engineering practices.

Keywords: *Codes of ethics, moral standards, rational persons, guidelines, inspiration, self regulation, discipline, internal conflicts, corporate codes of ethics, balanced outlook on law and international moral code.*

10.1 WHAT ARE CODES OF ETHICS?

1. They provide guidelines for the professionals as to how to conduct their routine professional tasks with relation to the public well being and with ethical thinking.
2. Professional associations are best geared to develop these codes that can be used by government or legal channels for discussions.
3. The *Oxford Dictionary* gives the following two definitions for codes
   - A set of moral principles accepted by the society or a group of people
   - A set of rules arranged in a system
4. The codes of ethics express an implicit agreement among professionals and between professionals and public. Professionals agree among themselves that they would abide by these codes. They agree with the public that with these uniform standards and codes, they will promote the well being of the general public as far as it relates to the professional area of expertise.
5. Harris et al. in their book *Engineering Ethics* define professional codes of ethics as articulated and shared standards of professional ethics. They reiterate principles and standards that are already accepted as responsible engineering practices.
6. Almost every professional association has developed its own code of conduct displayed and publicized widely among its members. A majority of such codes relating to engineers is given in the annexure.
7. The following are some of the important articles that discuss the pros and cons of the codes as referred by Harris et al.
   - *Codes of Ethics and Moral Education of Engineers* by Heinz Luigenbiehl from *Ethical Issues in Engineering* edited by Deborah Johnson
   - *The Quest for a Code of Professional Ethics: An Intellectual and Moral Confusion* by John Ladd also in the same publication.
   - *Why are Codes of Ethics for?* By Judith Lichtenberg in *Codes of Ethics and Professions* (Melbourne University Press, 1996)
   - *Controlling Technology* by Stephen H. Unger (John Wiley Publishers, 1999)
   - *Thinking Like an Engineer* by Michael Davis (OUP, 1998)
8. Codes cover the standards that every rational person wants every other person to follow like
   - *Honesty* and *truth*

- *Honor,* showing respect for integrity and reputation for achievement
- *Knowledge*, gained through education and experience
- *Efficiency* in performance with minimum effort
- *Diligence* and personal effort
- *Loyalty* to employer's goals
- *Confidentiality* and dependability in safeguarding information
- Protecting *public safety* and health

10.2 PURPOSES SERVED BY CODES OF ETHICS

1. Guidelines to the Engineer They provide guidelines to the professional as to how he should perform his functions ethically in various situations. They inform him about his moral obligations to the society.

2. Ethical Decision Making Codes serve as the starting point for ethical decision making in case of ethical dilemmas.

3. Inspiration The very fact that codes of practice exist, related to his field of work, inspires an engineer to study them, understand them, and practice them where appropriate.

4. Support Codes always support an engineer who follows ethical principles. If an engineer comes under pressure to act unethically, the publicly proclaimed codes allow the engineer to defend himself by saying, *I am bound by the codes of ethics of my profession*. They support him legally also.

5. Deterrence and Discipline They serve as the formal basis for investigating unethical conduct. Where such an investigation is possible, it also acts as a deterrent for the immoral acts contemplated.

6. Education and Mutual Understanding Codes can be used in the education process of the students and young professionals in classrooms or elsewhere to prompt discussion and reflection on moral issues and to promote shared understanding among the professionals, public as well as government organizations.

7. Contribution to the Profession's Public Image Codes reflect a positive image of ethically committed profession, and make the engineers serve the public more effectively.

8. Self-regulation It helps the engineers maintain self-regulation and self-control in ethical aspects of their profession.

9. Promoting Business Interests Codes ensure moral conduct among all professionals in dealing with business. Such moral conduct creates an atmosphere conducive to the dealings related to the business.

10. Focus for Debate Professional codes provide a focus for debate on how professional ethics should be modified. Almost every professional association, has introduced or modified their codes in a number of areas as a result of changing perception of professional obligations.

10.3 LIMITATIONS OF CODES

The privilege of the profession to serve the society should be protected by carefully developing codes of ethics and conduct for the professionals, These should become a binding on the members and any deviation from the defined path should be punishable or else the *privilege to serve* becomes the *privilege to exploit*. Nevertheless, as on date, that is till the precepts and mindset among all professionals towards the ethical codes get improved, the following may be cited as the limitations for adapting codes to the letter.

1. Codes are formed in general wording and hence cannot be applied to all situations directly.
2. It is not possible to analyze fully and predict the full range of moral problems that arise in complex situations. In these cases, codes form guidelines but not solutions.
3. Engineering codes represent a compromise between differing judgments.
4. Often codes create internal conflicts. At the same time, these conflicts help development or modification of codes by debates and discussions.
5. They are not the final moral authority for any professional conduct.
6. Not all practicing engineers are members of professional societies and are not aware of the existence of codes for their society or their profession.
7. Even if they are members, the society cannot make the codes mandatory.
8. Even if some societies try to make them mandatory and force the members to follow, many professionals do not like it and give some justification, by reciprocal ethics, for not following the codes.
9. Codes cannot be reproduced in a rapid manner.

10.4 INTERNAL CONFLICTS CREATED BY CODES

As indicated in the previous paragraph, codes of ethics in many occasions create internal conflicts with no instructions on how to resolve these conflicts. For example, if an employer instructs or directs an engineer to follow certain factors in the design which the engineer knows would be against the codes, how can this conflict be resolved? The Challenger case study is a typical example of this type of conflict. In the codes, there is a certain hierarchy and some clauses take precedence over others. In general, there is no explicit indication in the code of what the hierarchy is. In such dilemmas, one point must be remembered. The duty to protect the safety of the public is paramount and takes precedence over the duties to the employer as explicitly discussed in Chapter 14. By specifying such priority and hierarchy, the codes provide clear support to the engineer, who must convince his boss that he cannot design the product as requested. Unfortunately, not all internal conflicts can be resolved that easily.

10.5 PROFESSIONAL SOCIETIES THAT HAVE DRAWN CODES OF ETHICS

The Centre for the Study of Ethics in the Profession at the Illinois Institute of Technology (USA) has created a website wherein the codes formulated by several professional associations of United States are compiled and detailed. Annexure I gives some of the relevant codes and also adds the codes of some Indian and Australian associations.

Apart form these societies, many other organizations have also developed codes of ethics applicable to relevant professionals even though they do not have any regular members. The following may be cited as examples:

- Academy of Management having developed codes on advancement of managerial ability, student relationship, etc.
- Council for Exceptional Children
- Several universities which have developed student codes
- Computer organizations like Microsoft, who have developed codes for ethical use of computers

10.6 CORPORATE CODES OF ETHICS

The Ethic Resource Centre set up in USA in 1977 has promoted establishing of Ethics departments in several large and medium organizations in the corporate sector whose major function was to create an awareness of professional ethics among their employees, besides developing codes of ethics applicable for their organization.

Codes developed by corporations are tailormade for their specific circumstances and the unique missions of the company and as such they would be more widely adapted and recognized by the engineers of that corporation.

These corporate codes tend to be coercive in nature and an employees' compliance to these codes is a must for continued employment in the company. They tend to be relatively long and detailed as they frequently spell out the company policies on

1. Business practices
2. Relationships with the customers and suppliers
3. Relationships with government agencies
4. Compliance with government regulations
5. Health and safety issues
6. Issues related to environmental protection
7. Equal employment opportunity
8. Discrimination and sexual harassment
9. Diversity and ethnic tolerance, etc.

10.7 BALANCED OUTLOOK ON LAW

A balanced outlook on law emphasizes the necessity of laws and regulations and also their limitations in governing engineering practice. Laws are needed because people do not feel their responsibility and also because the competitive nature of the enterprise system restricts the sincere application of the moral initiatives of the corporations. Hence, application of regulations by law may become necessary.

On the other hand, the effect of the laws is limited because they affect productivity resulting in the reluctance of the corporations to comply with the law. Because of this, they tend to violate the spirit of the law. Another factor is that the laws inevitably lag behind technological development.

Thus, engineering as social experimentation needs the effective enforcement of clear laws. But it also places equal emphasis on the moral responsibility of the engineers, an emphasis that is essential than merely following laws and is essential for those working on projects that have significant technological development.

In other words to live, work, and play together in harmony with other members of a society, we should carefully weigh our individual needs and desires against collective needs and desires that are governed by law. This is called *altruism*, which is defined by the *Oxford Dictionary* as the concern for the needs and feelings of other people above one's own.

However, the prime need of life is the cultivation of a right perspective, which will not be distorted by rigors of circumstances. Engineers should play an active role in establishing or changing enforceable rules of engineering as well as in enforcing them.

10.8 SWAMI SIVANANDA'S OBSERVATION ON BALANCED OUTLOOK ON MORAL ISSUES

Swami Sivananda has made the following observations in respects of the development of moral concept.

> *From the very beginning of the history of mankind, the necessity for establishment of the moral law has been very keenly evident. At the root of all religions, civic laws, or any kind of idealism, there is a pronounced objective that pertains to peace, happiness, and progress of the individual, and harmony, welfare, and evolution of community and society. These can be ensured only through the construction of an ethical fountain.*
>
> *At no time the world has been free from the stresses of conflict and disharmony, and at no time has man felt the absence of need for peace and amity. There is an eternal struggle between his higher self and the lower desires, the interaction between the material and the spiritual always keep the human spirit in a state of ferment. Man cannot do without his material needs and can never have peace or happiness without spiritual integration and realization.*

10.9 INTERNATIONAL MORAL CODE

The world is divided into several major power blocks, each trying to extend its influence into wherever there is political vacuum, or wherever there is a possibility of gaining such an objective through whatever means that might be possible. In history, we have seen several such instances of the European countries extending their political as well as cultural influence on other nations, especially Africa and Asia.

- At lower tiers, the same thing is found by the stronger trying to overpower the weaker, either among nations or communities or individuals. Rivalries between small kingdoms during the medieval era, whether in Europe or in India, are illustrations.
- Any international moral code by itself cannot be of much use except having the benefit of statute value, unless the spiritual conscience of humankind is awakened on the individual level.
- The individuals constitute mankind and communities and the nations. Humans must inculcate the spirit of moral law in his heart first. Without this inner light, all his endeavors would be barren.

There is no dearth of spiritual codes in all scriptures of the world. Practically, in every constitution of every nation, the moral idealism is the significant factor. They draw inspiration from the ethical idealism and justice for the common man. Religious teachings are based on ethics. Chapter 23 discusses more issues related to multinational corporations

Question Bank

PART A

(Each question carries 2 marks, which you are expected to answer in 3 minutes)

1. What are codes of ethics?
2. What is the need for such codes of ethics?
3. Indicate some of the characteristics of human values that are reflected in the codes.
4. Explain how the engineer is inspired by the codes of ethics.
5. How do codes of ethics contribute to the business development of a corporation?
6. Discuss on the internal conflicts created by codes of ethics.
7. What do you understand by corporate codes of ethics?
8. What do you understand by international moral code?

PART B

(*These are mostly 8-mark questions to be answered in 12 minutes, presuming that the time allotted for a 100-mark question paper is 3 hours. Sometimes the same question may be asked as a 16-mark question to be answered in 25 minutes.)*

1. Explain the several purposes served by the Codes of Ethics.
2. Discuss the statements *People do not learn from past experience*.

3. Discuss the above with specific reference to the fireworks manufacturers.
4. What is the significance of informed consent? Discuss the conditions needed for informed consent.
5. List and explain some of the company policies spelt out by the corporate codes of ethics.
6. What do you understand by balanced outlook on law. Explain its application with reference to the introduction of a new process.

PART C

(Objective-type Questions)

1. Fill in the blanks:

(i) Codes of ethics provide _______________ (guidelines/commandments) for the engineer.
(ii) The very existence of codes in his field of service _______________ (inspires/frightens) an engineer.
(iii) ERC means _______________ _______________ _______________
(iv) Placing equal emphasis in the enforcement of clear laws as well as the moral responsibly if the engineer is called _______________ outlook on law.

2. Answer if the statement is true or false:

(i) Codes of ethics form a basis for debate and modification of the same.
(ii) Any amount of laws cannot be of much use unless the spiritual conscience of humans is awakened at the individual level.
(iii) Commitment to safety, loyalty, and confidentiality are specially highlighted in the codes.
(iv) Only professional associations have drawn the codes of ethics.

UNIT IV

ENGINEERS' RESPONSIBILITY FOR SAFETY AND RISK

LIST OF CHAPTERS

11

Safety and Risk

- Why Safety?
- Three Categories of Consumers
- Definitions of Safety and Risk
- Lawrence's Definition of Safety
- Underestimation and Over-estimation of Risk
- Is Safety Objective or Subjective?
- Relative Safety
- Engineers and Safety
- Designing for Safety
- Does Minimizing the Risk and Designing for Safety Always Result in a More Expensive Alternative?
- Faulty Assumptions on Safety
- Codes of Ethics on Safety by Professional Associations
- Safety Obligations of the Engineer
- Factors on which Risk Depends Upon
- Reducing Risk
- Safety Audit
- Safety Management and Audit System
- Requirements of OSHA Hazard Communication Standards
- Safety Audit Checklist in a Factory
- IATA Operational Safety Audit (IOSA)
- Significance of Safe Exits
- The Following Come Under Safe Exits
- Safe Exit is the Responsibility of the Design Engineer
- Are Cinema Houses Safe Enough?

Despite our emphasizing the need for 100% safety in engineering products/processes, some amount of risk cannot be avoided in the development and execution of any project. Hence, this chapter discusses the need for assessing the risk and the methods of testing the risks involved.

Malfunctioning of any system or human errors can result in an unexpected event of an accident that can lead to serious injuries and even loss of lives. It is hence essential that each of the system is provided with safe exits at the design stage itself. In light of the fire accidents at a Delhi theatre and at a Kumbakonam school, the safe exit requirements for cinema halls and schools are cited with illustrations.

Keywords: *Safety, risk, relative safety, active consumers, passive consumers, bystanders, risk estimation, engineers' obligations for safety, acceptability of risk, voluntary and involuntary risk, immediate and delayed risk, short-term and long-term risk, threshold level, occupational*

risks, safety audit, Safety Management & Audit System (SMAP), Safety System Program Plan (SSPP), OSHA hazard communication standards, safety audit checklist, safe exits, safe disposal, abandonment, self termination, cinema theatres, school buildings, staircases, thatched roofing, National Building Code of 1977, fire extinguishers, safety drills and Fire Services and Rescue Department.

11.1 WHY SAFETY?

We have seen in the earlier chapters that the chief role of the engineer is to ensure the safety and well being of the society. He has a liability to the society to produce or operate products that are safe. That means his paramount duty is to ensure that each and every product he develops, produces, or operates is absolutely safe to the people who would be using it or effected by it. This factor is reflected by the codes of almost all professional associations as cited in section 11.12.

11.2 THREE CATEGORIES OF CONSUMERS

We can broadly classify the consumers into three categories as follows:

Active Consumers who have control in choosing the item or the manner in which it can be used safely. For example, when they use an appliance like lawnmower, kitchen mixer, washing machine, or bread toaster.

Passive Consumers who have less choice and less control over the use, like consumers of gas, electricity, water, etc.

Bystanders who are exposed to dangers even without using them, like those living around polluting factories. The more classical examples are those living in the slums around Union Carbide factory at Bhopal, when the 1984 tragedy occurred.

11.3 DEFINITIONS OF SAFETY AND RISK

The following are the definitions as given in the *Oxford Dictionary*.

Risk The potential that something unwanted or harmful may occur. It is the possibility of meeting a danger or suffering harm or loss.

Safe Protected from danger and harm. Not likely to cause or lead to damage, injury, loss, etc.

Safety The ability to make or keep something safe.

11.4 LAWRENCE'S DEFINITION OF SAFETY

One of the original definitions of safety was given by William W Lawrence as

'A thing is safe if its risks are judged to be accepted.'

Significantly, Lawrence's definition brings out an important factor, the acceptability of the risk involved. However, the safety characteristics of a product cannot be fully assessed because the factor *acceptability* is different for different people in view of their attitudes. For some, the risks may be acceptable and for some others, they may not be. Different consumers estimate the risk of an item in different proportions because of these attitudes that come into play.

Since such a situation is paradoxical, Mike Martin et al. modify Laurence's definition as

A thing is safe if, were the risks fully known, those risks would be judged acceptable in light of settled value principles. More fully, a thing is safe (to a certain degree) with respect to a given person or group at a given time if were they fully aware of the risks and expressing their most settled values, they would judge those risks to be acceptable (to that certain degree).

To make the above explanatory definition simpler, this author suggests the following definition:

A product is safe if it is judged so by rational-thinking people who have good concept of safety and fairly good knowledge about the technical aspects of the product.

11.5 UNDERESTIMATION AND OVER-ESTIMATION OF RISK

1. Underestimation of Risk

An unsafe product may actually be considered to be safe enough, because of the wrong judgment of the user. Sometimes the consumer is badly in need of the item and when no other alternative is available, he may mentally underplay the risk and satisfy himself about the safety of the product. For example, an unsafe electrical appliance may be purchased because it is cheap, or when the consumer needs it very badly and no other alternative is available.

2. Over-estimation of Risk

Sometimes, even if a product is comparatively safe and risks are less, some consumers may be overcautious, or overconsciousness for safety. Examples are, driving very slowly in normal traffic or avoiding a plane journey due to some air crashes that have taken place elsewhere in the world.

3. No Estimation of Risk

Some people do not make any judgment at all about the risk, may be because they are not informed well enough to make a proper judgment or they are too passive to make a judgment. They buy things at random without considering whether it is safe or not. By Lawrence's definition, such products can be termed neither safe nor unsafe.

The following queries, if asked, may throw some light on the concept of the term *risk*.

- What are the factors which contribute to decide whether the risk is acceptable or not?
- What knowledge has to be acquired to assess these risks?
- How are the settled value principles arrived at for the given risk?
- How can the risk be reduced?

11.6 IS SAFETY OBJECTIVE OR SUBJECTIVE?

The sense of safety can either be subjective or objective. If a rational group of consumers who know the risks involved, base their judgment on most settled value perspectives then safety perceived by them is an objective term.

On the other hand, if the value perspectives differ among rational persons and they cannot give an absolute assessment then safety is a subjective term.

11.7 RELATIVE SAFETY

Relative safety is an expression of risk when the alternatives are compared among themselves as regards to their safety. For example, comparing the safety of travel by air, train, or bus between two destinations, say Delhi to Mumbai, or Chennai to Hyderabad.

11.8 ENGINEERS AND SAFETY

As safety is an essential aspect for engineers, the following five criteria must be met to ensure a safe design.

1. Designs must comply with applicable laws.
2. Acceptable designs must meet the standard acceptable practices.
3. Alternative designs that are potentially safe must be explored.
4. The engineer must attempt to foresee the potential misuses of the product by the consumer and must design to avoid their problems.
5. Once the product is designed, prototypes as well as the final product must be rigorously tested not only with reference to the technical specifications but also for safety.

11.9 DESIGNING FOR SAFETY

Processes involved in safe design are as follows:

- Define the problem. This step includes determining the needs and requirements, determining the constraints and also the issues of safety in the product definition and specification.
- Generate alternative solutions, creating multiple alternative designs.
- Analyze each situation with reference to the pros and cons of each.
- Determine whether the solutions solve the problem.
- Test all alternatives.
- Select the best alternative. In assessing the best alternative, safety considerations must be paramount and should have relatively higher weightage than other issues.
- Implement the chosen design.

11.10 DOES MINIMIZING THE RISK AND DESIGNING FOR SAFETY ALWAYS RESULT IN A MORE EXPENSIVE ALTERNATIVE?

Spending a long time in design and spending extra money for meticulously providing safety features in the design may appear to be a very expensive proposition, especially early in the design cycle of developing the prototype. This is a short-time viewpoint. Unsafe products in the market ultimately result in costly replacements or repair processes or even expensive lawsuits. Hence, it is absolutely ethical to let the engineer spend as much time as required to achieve a safe design to minimize the future risk of injury or losses.

USA is known for large-sized cars including limousines, unlike small and compact foreign cars, especially from Japan and UK. In the late 1960's, the Ford Motor Corporation designed a compact car called Pinto weighing less than 2000 pounds and costing around US $2000, with estimated annual sales of about 11 million cars. Anxious to be in competition, Ford Motors provided a very short time for the design process due to which styling preceded engineering design. One of the compact features resulted in positioning the fuel tank between the differential and the rear bumper. The possibility of the differential bolts puncturing the gas tank during rear impacts was not given due consideration. After the car had been put into the market, reports had poured in about the seriousness of this puncturing and the high number of accidents it caused and the lawsuits/claims that were filed. On a review of the design, the cost of providing a safe feature for the car was calculated as US $11 per unit. On comparing with the social costs of US $20,000 per death as the claim cost, the management had surprisingly decided that the annual cost of improving the design was more than the social cost and decided to continue the design. However, apart form the death claims, what they did not consider is the loss of reputation. The car Pinto had poor sales subsequently, and the company paid a much higher price.

11.11 FAULTY ASSUMPTIONS ON SAFETY

The following are some of the misconceptions prevalent about safety.

Table 11.1 *Faulty assumptions on safety*

S. no.	Notion	Fact
1	Operator negligence is the root cause for any accident.	Accidents are caused by dangerous working conditions that are human-made and can be eliminated.
2	Minimizing risk at the design stage increases the cost of the product.	The above illustration on Pinto cars is self-explanatory.
3	Safety is to be incorporated after the product is designed and tested.	People, especially the operatives, can be effected during the testing stage itself.
4	Insurance coverage is cheaper than planning for safety.	Accident cost is lot more than just the compensations paid.

11.12 CODES OF ETHICS ON SAFETY BY PROFESSIONAL ASSOCIATIONS

As safety must be the paramount consideration for an engineer, almost all professional associations have emphasized this in their codes of ethics. To illustrate:

Institution of Engineers (India) *Hold Paramount, the safety, health, and welfare of the people, protection of environment, and promote health and safety within the workplace.*

Institution of Engineers (Australia) *Members shall at all times place the responsibility for the welfare, health, and safety of the community before their responsibility to sectional or private interests or to other members.*

Institution of Electrical and Electronic Engineers *To accept responsibility in making engineering decisions consistent with safety, health, and welfare of the public and to disclose all factors that might endanger the public or the environment.*

American Society of Mechanical Engineers *Engineers shall recognize that the lives, safety, health, and welfare of the general public are dependent upon engineering judgments, decisions, and practices incorporated into structures, machines, products, processes, and devices.*

American Society of Civil Engineers, American Institute of Chemical Engineers, American Consulting Engineers, National Society of Professional Engineers, etc. *Engineers shall hold paramount, the safety, health, and welfare of the public in the performance of their professional duties.*

11.13 SAFETY OBLIGATIONS OF THE ENGINEER

The safety obligations of the engineers stem from the following four views.

1. Engineers acquire moral obligations concerning safety by being subjected to the laws or enforced codes of the nation that require them to be obligated.
2. Engineers acquire safety obligations on account of their profession or by joining a professional society and following that society's codes of ethics.

3. Engineers acquire special obligations by way of their contractual agreement with their companies or employers.
4. Engineers get themselves committed to their obligation to the society to protect and safeguard it while performing their day-to-day tasks.

11.14 FACTORS ON WHICH RISK DEPENDS UPON

- Whether the risk is voluntary or involuntary
- Whether the risk is immediate or delayed
- Whether the consequences are of short term or of long term
- The expected probability of occurrence
- Whether the effects are reversible or not
- Personal or public risk
- The threshold level of the risk
- Information available
- Occupational risks

1. Voluntary or Involuntary Risk

It is common fact in human psychology that many consider something safer if they knowingly take the risk, but would consider it unsafe if they are forced on it. For example, consider the case of the CMDA residential layout at the residential locality of Manali Pudur in north Chennai, where industrial pollution is present. If the plot is very cheap, a buyer may explain to himself/herself that the pollution is not that much and may prefer to buy a plot, despite knowing the long-term effect of the pollution on himself/herself. However, if the price is very high comparable to other residential localities elsewhere, he/she would not buy it saying it is a highly polluted area. Those participating in car races or cross-country races fall into this category. Another classic example is the mushrooming of slums around the Union Carbide factory in Bhopal, where even those not working in that plant reside. They would simply underestimate the risk even to satisfy themselves.

2. Immediate or Delayed Risk

People consider an activity that will not have immediate impact on them as safer than that by which they would be effected immediately. For several years there has been a campaign against smoking and everyone is aware that it may cause cancer at a later date. Still some persons, including the youth, smoke because the risk is perceived to happen only after thirty or forty years. The same persons would not be trying narcotic drugs because they know their effect is immediate. Similar is the case with the usage of high-fat diet which people are aware as the cause behind heart attacks, but at a later date.

3. Short-term or Long-term Consequences

Something that will cause a short-term illness or disability would appear safer that that which will cause a long-term illness or permanent disability. In athletic practices, participating in 100-meter dash is considered less risky than participating in pole vaulting without a proper landing cushion, since the former may at best result in a leg fracture which is short term, whereas the latter might result in spinal fracture, with a permanent disability. This factor plays a major role in insurance policies.

4. Expected Probability of Occurrence

It is common to accept an activity which has a one in a million probability of severe injury than that which has a 50:50 probability of fairly minor injury. Perhaps swimming in a beach infested with jellyfish may not be acceptable though jellyfish cause only little pain but not serious injury. However, even when there is a possibility of sharks coming near a beach earmarked for swimming, people would consider it less risky, since the possibility of a shark coming near the beach is remote.

Factors for risk may fall into one of the following four alternatives:

(a) Low probability, low consequence like the risk of being hit by sailing boats in a beach where the boats are not allowed.

(b) High probability, low consequence like swimming in a beach infested with jellyfish, as cited above.

(c) Low probability, high consequence like the risk of being attacked by sharks in a beach earmarked for swimming (air travel may come under this type of risk)

(d) High probability, high consequence like swimming in a far-off lagoon, known to be infested with sharks.

5. Reversibility of the Consequences

If the bad effects of an activity are ultimately reversible, this activity may be less risky. If the bad effects can be reversed in fair time then it is like a short-term consequence and if the bad effects cannot be reversed, it is like a long-term consequence.

6. Personal Risk or Public Risk

The risk as perceived by an individual and the manner in which it effects him, is different from the public perception. If an individual is given sufficient information, and his consent is obtained (informed consent), he would be more willing to accept the voluntary risk, even if it is more dangerous. On the other hand, though sufficient information is given to the public in the form of press news or TV briefings, it is difficult to obtain voluntary consent in view of different mental attitudes of different personnel. Everyone feels it has been thrust upon him.

Nevertheless, it is easier to assess the risks faced by and benefits accrued to the public than that for individuals. This is because the assessment would be based on the average public, where the individual differences get smoothened out in the statistical pattern of the study.

This assessment of personal risk is very significant in determining

- The compensation to be paid to an individual in case of a mishap
- Wage or incentive determination for jobs involving several types and grades of occupational hazards
- The insurance premium together with the loading factor or the acceptance criteria for individuals for life insurance

The questions to be asked in these cases are

- How do we assess the money value of the life of an individual?
- Is the compensation based on tolerance of an average person?
- What will be one's compensation if his/her tolerance level is below or above the average?

7. Threshold Level

For several activities there is always a threshold level for their impact, below which it may be accepted and above which it may not be accepted. This is mostly true in radiation levels, pollution levels, etc. Nevertheless, the newspaper report cited below makes it necessary to be judicious while fixing the threshold levels for various activities.

> *Though Fredderman cites studies which have shown that low levels of nuclear radiation have in fact beneficial effects on human health, a news item of July 2005 cited the study report of the Committee on Biological Effects of Ionizing Radiation (BEIR Committee), the effect of ionizing radiation is present even at lower levels and is proportional to the dose and that there is no threshold dose below which the effect is supposed to be zero. It means even low levels of ionizing radiation may cause harm, the extent of the harm depending upon the individual. This committee did not endorse the*

earlier report that low doses (less than the threshold value) are substantially less harmful than estimated and may even have beneficial effects, cited as above by Fredderman.

8. Information Available

The manner in which the information is made available to the consumer can greatly influence the manner in which the risk is perceived. Just telling a person that heavy smoking would result in cancer may not have much effect on a smoker, as he would convince himself that he is not a heavy smoker. But if video film cuttings or other visual presentations are made to him, he may see the risks more clearly and more effectively.

9. Occupational Risks

Every occupation by the workers have some inherent occupational hazards, especially those working in chemical and other processing industries. Even in manufacturing industries, the workers of paintshops are affected by the fumes, in textile industries the workers are effected by the lint and fibers floating in air and may contact asthma, municipal workers working in sewerage pipes get asphyxiated by the poisonous fumes inside, etc. The risk in such occupations is considered to be very high. In most cases, employees in high-risk jobs do not use the safety protections because of

- Lack of proper training and awareness among the employees about the hazardous nature of the job and the need to use the safety equipment
- Employer does not provide the safety equipment
- Even if provided, the employee does not use it out of overconfidence and/or negligence
- The equipment may be improperly designed causing discomfort to the employee that he stops using them
- Lack of enforcement or supervision for ensuring that the safety equipment is used

A classic example is the practices adapted by the linemen of the Electricity Boards of India, in repairing or providing new connections by climbing the electric posts without any protective gloves. This author has, on several occasions, tried to advise them to use rubber gloves, but they only said there are no cases of linemen getting into contact with live wires and that they are well trained to do their work carefully without getting a shock. Nevertheless, an inevitable event did happen. On 21 July

2005, a lineman was killed on the spot due to electric shock while repairing an electric post without any safety precautions, in Suryaraopet, Andhra Pradesh, as per a newspaper report. Perhaps several such incidences might be taking place without being reported.

11.15 REDUCING RISK

In general, engineers must involve themselves in

- Designing and producing safe products,
- Understanding and making public of the risks and benefits,
- Meeting the production schedules, and
- Helping their management get profits in the business.

However, product safety gets the priority and all efforts are to be made to reduce the risk in the product usage.

Some of the methods by which this can be done are the following:

- Application of inherent safety concepts in the design, like adapting cryogenic storage at low pressure than pressurized storage systems for storing liquefied gas
- Usage of diversity and redundancy principles in instrument protecting systems
- Regular inspection of safety systems and to ensure their reliability
- Training of operating personnel
- Development of well-planned emergency plans with regular safety drills
- Conducting of regular safety audits as explained in the following paragraphs, to ensure the workability of the systems and procedures

11.16 SAFETY AUDIT

Audit is defined as the official examination of the financial accounts or procedures to ensure that they are as per the set standards. This definition can be extended to quality audits, environment audit, energy audit, social audit (as explained in Chapter 24), safety audit, etc., depending upon the system that is audited.

Like any other audit, safety audit is preceded by the process of meticulously setting up of safety precautions in the products or services as explained in Chapter 10. Apart from this, it is more important to ensure that the systems are highlighted and documented as safe procedures in the normal operational procedures and standards. This is where the safety audit comes into picture, when an engineer belonging to a different department or a qualified and experienced consultant checks whether the systems, procedures, and documentation followed are as per the established policies and if all safety standards are met, by meticulously going through each and every document, and the element of operation by questioning and discussing with each and every concerned person.

11.17 SAFETY MANAGEMENT AND AUDIT SYSTEM

Safety Management and Audit System (SMAP) is an illustration of conducting safety audit in the industry. Its main purpose is to equip production systems in industry and create formats for developing a System Safety Program Plan (SSPP) and to provide formal evaluations on how well those SSPPs are implemented.

SMAP guides the production systems through a series of management processes that will strengthen and hone the quality of the safety practices and create a safer environment for the customers and employees. While SMAP does not focus on the actual physical condition of the production system, the safety management practices in place will be fully evaluated to assist each system in determining if its own SSPP is being implemented at a level consistent with the industry's best practices.

This SMAP had a triennial audit that will examine the following areas with reference to SSPP:

- Does the production system have an SSPP developed in accordance with the latest safety management practices?
- Is the production system's SSPP fully implemented?
- Does the production system conduct an internal safety audit program to identify, track, and resolve safety-program deficiencies?
- What safety-management practices exist in the areas of operations, maintenance, training, inspection, security, etc.?

11.18 REQUIREMENTS OF OSHA HAZARD COMMUNICATION STANDARDS

Occupational Health Association of USA (OSHA) requires employers to provide employees with the information and training on hazardous chemicals in the workplace at the time of their initial assignment and also whenever a new hazardous chemical is introduced into the workplace.

Employees must be trained and informed of

- The requirements of the Hazards Communication Standard
- Physical and health hazards of the workplace
- Operations in their work area where hazardous chemicals are present
- The location and availability of the written hazard communication program including the list of the hazardous chemicals
- Methods and observations that may be used to detect the presence or release of hazardous chemicals
- The measures employees can take to protect themselves from these hazards, such as emergency procedures, the personal protective equipment to be used

11.19 SAFETY AUDIT CHECKLIST IN A FACTORY

Apart from the pre-audit queries as above, the following checklist is suggested for industry especially to check on the firefighting equipment and safe exits.

Table 11.2 *Checklist for safety audit in a factory*

S. No.	Checklist	Yes	No
1	Can you safely exit from the building?		
2	Are the exits clearly marked and free from obstruction?		
3	If there is NO exit in the immediate vicinity, are there signs and arrows indicating in which directions to go?		
4	Where is the emergency equipment (like fire extinguishers) stored?		
5	Is the first-aid box clearly identified?		
6	Is the emergency shower and eyewash properly signposted?		
7	Are the firefighting equipment validated and tested?		
8	Is each of the above equipment correctly identified with a location triangle with correct color code and selection disc placed above it so that it can been seen from any part of the building?		
9	What hazardous situations exist that require the wearing of protective equipment?		
10	Do bench grinders carry mandatory eye-protection sign?		
11	Is smoking prohibited in areas around fuel, gas, and solvents?		
12	Which are the areas restricted either for certain personnel or specific actions?		
13	Are there any potentially hazardous equipment like cranes and hazardous areas that call for warning systems?		

11.20 IATA OPERATIONAL SAFETY AUDIT (IOSA)

International Air Travelers' Association (IATA) has developed IOSA, an internationally recognized airline accepted evaluating system designed to assess the operational management and control system of an airline with specific reference to the safety systems. Several airlines have adopted the IOSA audit systems and have accepted to be audited by the IATA appointed auditors, who use quality audit principles designed with inherent degree of quality, integrity, and security. The audits are conducted in a standardized and consistent manner.

Key Features of IOSA

- The establishment of the first internationally accepted operations audit standards
- A reduction of costs and audit resource requirements for airlines and regulators
- Continuous updating of standards to reflect regulatory revisions and the evolution of best practices within the industry
- A quality audit program under the stewardship of IATA with trained and qualified auditors
- A structured audit methodology with standardized checklists and development of auditor training courses and for the airline industry

The following news item that appeared on 22 June 2005 highlights the significant awareness in India on the concept of safety audit aviation sector, especially those among the low-cost airlines.

> *The Air Passengers' association of India has appealed to the Directorate General of Civil Aviation to conduct a safety audit on the low-cost airlines for their adherence to rules of the apex regulatory body.*

11.21 SIGNIFICANCE OF SAFE EXITS

Despite all the meticulous precautions and applications of all safety principles as discussed in the previous chapters, a product cannot turn out to be 100% safe and at some stage or other during its working life, it may fail and become hazardous. In such a situation, another safety requirement comes into play that the product has to be abandoned safely or the persons near it should safely escape. This is called *safe exit* and this aspect of safe exit has to be incorporated in the design of the product itself. If the malfunction of a system or component can lead to injuries, death, and other serious consequences, such a system must be equipped with safe exits.

11.22 THE FOLLOWING COME UNDER SAFE EXITS

- Environment-friendly disposal of pollutants
- Safe disposal of explosive and similar hazardous products
- Abandonment of a product if it becomes unsafe
- Safe termination of experiments
- Safe escape routes from worksites for persons involved in case of emergency

The following are some of the illustrations where safe exit has to be provided in the design and development stage.

- Fragile items with sharp edges like glass figures, components made of glass or ceramics, etc.
- Chemical containers
- High-pressure vessels like oxygen cylinders
- High-pressure vessels contain flammable materials
- Containers with explosives
- Laboratories, etc., where hazardous experiments are scheduled to be conducted
- Trucks or tankers meant for the transport of inflammable goods
- Multistoried buildings
- Houses and colonies surrounding chemical plants or plants manufacturing explosives, etc.
- More significantly, public halls like theatres and operas

11.23 SAFE EXIT IS THE RESPONSIBILITY OF THE DESIGN ENGINEER

The provision of safe exits in the design itself is the responsibility of the engineer responsible for the design, whether it is a product or a truck or a tanker. In case of a cinema theatre or a laboratory or a multistoried building, it becomes the responsibility of the architect to ensure that safe exits are liberally provided to permit the free and quick escape of the public in case of any eventuality.

It is advised that the following precautions may be taken in light of the fire accidents that occurred during 2003–2004 at a Delhi

theatre and at a Kumbakonam school, both of which had resulted in heavy casualties in the form of human lives.

Cinema Theatres and other Public Halls

1. All the exit doors should be wide and must be indicated well by lighted signs powered by emergency lamps that continue to glow even if power fails.
2. The doors should automatically open in emergency cases.
3. The safe route outside shall be well indicated in all the corridors by arrows.
4. The aisle lamps at foot level should be on throughout the show or at least be automatically switched on in case of emergency.
5. The staircases should be wide enough to let over 500 persons pass in a matter of few minutes. Fire extinguishers shall be placed at all strategic locations in each floor to be used by the common public in case of need.
6. A floor plan showing the location of stairs, lifts, fire extinguishers, fire hoses, etc., shall be exhibited at a prominent location on each floor.
7. Publicity slides shall be projected before start and during intervals depicting how to safely exit in case of emergency.
8. The employees of the theatres shall be well trained to handle and guide the public in emergency cases.

School Buildings

1. Every school building shall have a space of at least 10 feet on all the four sides.
2. No new school shall be allowed to come up in buildings that abut with neighboring buildings without any space between them.
3. In any part of the building, thatched roofs or materials like plastic sheets that are highly inflammable shall not be allowed.
4. The staircases shall be wide, with a minimum span of 4 feet.
5. The staircases shall be free of any obstructing materials.
6. The staircases shall not abut any danger zones like chemical containers or cooking areas.
7. All the children shall be well trained to leave the building quickly but in an orderly manner.

11.24 ARE CINEMA HOUSES SAFE ENOUGH?

In wake of the blasts in two cinema theatres at New Delhi, the following newspaper report appeared on 26 May 2005.

Are cinema houses safe enough? Last week's Delhi blasts throw up the question whether the city theatres are equipped to deal with crises.

After last weekend's blasts in two Delhi cinema halls, the question arises whether Chennai's theatres are equipped to deal with similar crises that call for a mass evacuation.

The dimensions for cinema halls and their safety measures are governed by the National Building Code of 1973, which is only a set of guidelines.

None of the safety measures can be enforced and it is largely up to the theatre owners to take precautionary measures, says the director of Fire and Rescue Services.

Moreover, many of the theatres were constructed before the code or its amendments came. The owners cannot be asked to pull down the theatres because they do not have enough exits or their staircases do not have the required width, but the owners have shown interest in making their cinema halls safer for moviegoers.

At a recent meeting with the Theater Owners' Association, the Fire Services Department and the owners agreed on an arrangement to train the theatre staff in safety measures for a fee.

Government Order

A Government order on the agreed upon norms is expected soon.

The secretary of the Tamil Nadu Theatre Owner's association says all members of the association go by the Cinema Regulation Act and Rules.

His 2300 seat theatre is well equipped with emergency lights, auto generator sets, and firefighting equipment. Every three months a fire drill is conducted.

Another theatre complex of Chennai has followed up with the suggestions of the Fire Services Department, says its owner.

"All the green exit signs are backed up by a UPS to remain lit in the event of power failure. Before the movie starts and during the interval, a slide showing all the emergency exits

is projected on the screen. All the doors have panic bars (mere push-open doors)"

Another theater complex of Chennai houses six theatres. Its CEO says that they are well prepared for any crisis. "We have a 24-hour security for the entire complex. There are detectives at the entrance checking people for any hazardous materials. The staff is trained to handle the situation that calls for evacuation. And we have a UPS back-up that takes care of emergency lighting and we project slides on emergency exits before each show."

Security

A regular moviegoer says that the only thing she finds worrying is that there is not enough security at the theatres. But she finds it reassuring that the staff wears uniforms and they look quite different.

Another moviegoer says, "I don't know if any of the cinema halls is well equipped for a crisis where everyone is trying to get out. In big theaters, even on a normal day, there is only one channel open to exit the hall after the show. It takes about five minutes to get out. So when people are hysterical and try to get out, I doubt it will happen in an orderly fashion. Some theatres have ramps, where people can just run down. So maybe there, I feel okay."

Safety Tips

These are a few tips from the Fire Services and Rescue Department.

- *Stay calm. Even if two people panic, the situation may snowball into something worse.*
- *Get out as soon as possible without pushing.*
- *If you are familiar with the way out, guide the others out. (This is where trained theater staff would come in handy. As matter of fact all theatre staff should be present inside the hall and along the exit route to guide the people to safety.)*
- *Emergency lights should be switched on immediately as more damages can be done in the dark.*

So if you notice your theatre does not have emergency lights, demand for them.

Question Bank

PART A

(Each question carries 2 marks, which you are expected to answer in 3 minutes.)

1. Explain the three categories of consumers.
2. Define risk and explain the difference between risk and safety.
3. What is Lawrence's definition of safety? What is the significance of the term *acceptability*?
4. Illustrate over-estimation and underestimation.
5. What do you mean by relative safety?
6. What is safety margin? Compare between probability of occurrence and severity of occurrence.
7. What is meant by threshold level?
8. Illustrate some of the occupational risks.
9. What are safe exits? Why they are required?
10. List the items that come under 'safe exits'.
11. Explain safety drills and their importance.

PART B

(*These are mostly 8-mark questions to be answered in 12 minutes, presuming that the time allotted for a 100-mark question paper is 3 hours. Some times the same question may be asked as a 16-mark question to be answered in 25 minutes.)*

1. Discuss the uncertainties that crop up during the development stage.
2. Give some illustrations to show how absence of testing for safety before launching a new product had proved expensive.
3. Discuss the eight factors on which a risk depends upon.
4. Discuss the statement 'Safe exit is the responsibility of the design engineer'.
5. Discuss the importance of safe exits in case of cinema theatres and school buildings.
6. What are the safety tips that are important in case of cinema theatres?

PART C

(Objective-type Questions)

1. Fill in the blanks:

(i) Bystanders are those consumers who have ______________ (absolute/no) over what they consume.

(ii) Informed consent is a ______________ (voluntary/involuntary) risk.

2. Answer if the following statements are true or false:

(i) Before launching a product, all the safety provisions must be tested.

(ii) The engineer must foresee the potential unsafe use of the product by the customer and incorporate design aspects to avoid the ensuing problems.

(iii) Minimizing the risk and designing for safety always results in more expensive alternative.

(iv) A thing is safe if its risks are judged to be accepted.

3. Match the following:

(i) Informed consent	(a) Long-term risk
(ii) Swimming in a far-off lagoon	(b) Occupational risk
(iii) Formula **1** car racing	(c) Voluntary risk
(iv) Swimming in a guarded pool	(d) High probability, high consequence risk
(v) Asthma in a cotton spinning mill	(e) Low probability, low consequence risk

12

Risk–Benefit Analysis

- Risk Analysis
- Uncertainties During Development
- Testing for Safety
- Suitability of Safety Margin for Cycle Loads
- Models That Can be Used to Represent a Problem
- Analytical Testing Methods for Safety
- Scenario Analysis
- Event-Tree Analysis
- Fault-Tree Analysis
- Failure Mode and Effect Analysis (FMEA)
- Risk–Benefit Analysis
- Further Reference

Since some amount of risk is inevitable in the development of any project, this chapter discusses the several types of risks and the individual perception of the quantum of the risk involved. While emphasizing the need for the assessment of the risks involved, it describes the various analytical methods including FMEA. Finally, this chapter discusses several aspects of risk–benefit analysis.

Keywords: *Risk analysis, inconsistencies, testing for safety, Titanic tragedy, analogue models, mathematical models, safety margin, preparatory drills, scenario analysis, event-tree analysis, fault-tree analysis, FMEA, risk–benefit analysis, probability of failure occurrence, severity of failure occurrence, cost of safety, iQRAS, conceptual difficulties.*

12.1 RISK ANALYSIS

The occurrences of large-scale accidents causing several fatalities or heavy damages to properties and environment had resulted in giving higher attention to safety within industrial plants during the design and concept stage. This necessitated in development of new risk-analysis techniques that have come to play a much bigger role in project management during every stage of a project. Some of the provisions made are

- Incorporating safety during design stage
- Applying safety measures
- Preventing or limiting damages
- Providing safety zones around industrial plants

As seen in the previous chapter, risk analysis is used for the assessment of risks associated with an industrial or commercial activity. It involves identifying the causes as well as the presence of unwanted hazards and estimating the consequences.

12.2 UNCERTAINTIES DURING DEVELOPMENT

We have seen in Chapter 6 that every product or project undertaken by the engineer is an experiment. Since each stage of the design or development is experienced for the first time, there are uncertainties at every stage and the engineer is bound to make presumptions either from data books or from his own experience. These uncertainties can be can be in the form of

- Models used for the design calculations
- Performance characteristics of the materials
- Inconsistencies in the materials purchased
- Nature of the pressure the finished product will encounter

Apart from the above the engineer may also experience uncertainties from the viewpoint of the following variables in the development:

- Size of the product, whether a medium-sized product or a large-sized product
- Volume of production, viz. batch production or mass production
- Specialized materials and skills used in the manufacture

12.3 TESTING FOR SAFETY

In view of these uncertainties, it is always necessary to test the product or the process for safety aspects. Like the testing with reference to the conformity to the technical specifications, these tests are also done with respect to the safety of the product, both as simulation tests or as prototype tests, or as field tests. In addition, the more effective test for the safety aspect is by group discussions among all concerned and rational persons in the company or outside to go meticulously into the safety aspects including the environmental effects. At the end of the discussions, a checklist may be prepared by that committee.

A glaring example of not subjecting a passenger cruiser for tests, or what is called drills, prior to the cruise, is that of Titanic. Had the preparatory drill prior to the voyage been perfect, that would have exposed the insufficiency of the number of the lifeboats, thereby saving a majority of the people. Similar is the case of the Russian submarine 'Kursk' which sank in August 2000 due to an explosion in the torpedo room. After the accident, the rescue capsule, which was not tested prior to the voyage, did not function and the number of deaths magnified.

During the fifties, a Comet aircraft crashed during flight. On subsequent testing of a similar aircraft by fully immersing the plane in a large body of water and gradually increasing the pressure resulted in a fuselage crack developed due to fatigue in one of the corners of the forward windows. This must have been the cause of the earlier accident. Had the testing been done for the first plane also and defects identified and rectified, costly accidents like that of this plane would have been averted.

12.4 SUITABILITY OF SAFETY MARGIN FOR CYCLE LOADS

It is a common practice to use a factor of safety while designing general engineering components and structures to calculate the static strength. However, this factor of safety is not effective for cyclic loading, because of development of stress concentration in the latter case due to several discontinuities either due to presence of design features like grooves, holes, or defects like cracks and blowholes.

12.5 MODELS THAT CAN BE USED TO REPRESENT A PROBLEM

1. Verbal models like explaining a problem in a discussion form

2. Schematic models like the graphical presentation in the form of charts, tables, or graphs

3. Physical models which are scale models, either in two dimensions or three dimensions

4. Analogue models that are physical systems having characteristics similar to the actual problem, for example, the flow of water through a pipe under varying condition of pressures can be represented as an analogy for the flow of electrical current in a wire

5. Mathematical models having the advantage of the precision of mathematics and are in the form of mathematical equations; either be deterministic or probabilistic

Deterministic models where the variables and their relationships are stated presuming static and ideal conditions, for example, the economic order quantity for a purchased item can be given by

$$Q = \sqrt{\frac{2Pr}{i}}$$

Probabilistic models which take into consideration the uncertainty of the variables and other dynamically changing situations by introducing the probability factor

12.6 ANALYTICAL TESTING METHODS FOR SAFETY

One of the earliest methods used for testing a product with respect to its strength is destructive methods like the UTS testing or impact testing. Or even the crash test performed by the automobile manufacturers. However, these cannot be done for a majority of cases especially from the safety point of view. The analytical methods of testing detailed below are useful tools in this regard.

- Scenario analysis
- Failure mode and effect diagram
- Fault-tree analysis
- Event-tree analysis
- Risk–benefit analysis

12.7 SCENARIO ANALYSIS

In general, this is a preliminary analysis before going into other testing methods. Here, the engineer starts from a given point and studies and analyses all the different sequences that might develop stage by stage from that event.

12.8 EVENT-TREE ANALYSIS

Here, the engineer presumes a faulty system, starts from an initial faulty event and traces in the forward direction to identity the possible effects of the failure. This is similar to the fault-tree analysis, except that the tracing is in the reverse direction. This is very useful in hazardous situations. This also can be called a mathematical version of the scenario analysis. Figure 12.1 is an illustration of the event-tree analysis.

12.9 FAULT-TREE ANALYSIS

Here, the engineer starts from a definite system failure or an undesirable event and goes backwards to trace possible causes of the fault. This method is very useful in emergency situations. This is similar to troubleshooting charts as a part of the operator's instruction manual given by all automobile manufactures and most domestic appliance manufacturers, especially those of electronic goods. Figure 12.2 is an illustration of the fault-tree analysis.

12.10 FAILURE MODE AND EFFECT ANALYSIS (FMEA)

FMEA, an extension of the fault-tree analysis, is an analytical technique to recognize and evaluate the potential failure of a product or a process and its effects. It defines, identifies, and plans the actions that could eliminate or reduce the chance of occurrence of these potential failures. In a table format, it records all the possible failure modes and establishes the priorities based on expected failures and the severity of these failures, and helps uncover oversights, misjudgments, and errors that may have been made. In short, FMEA is an act-before-the-event approach requiring team effort.

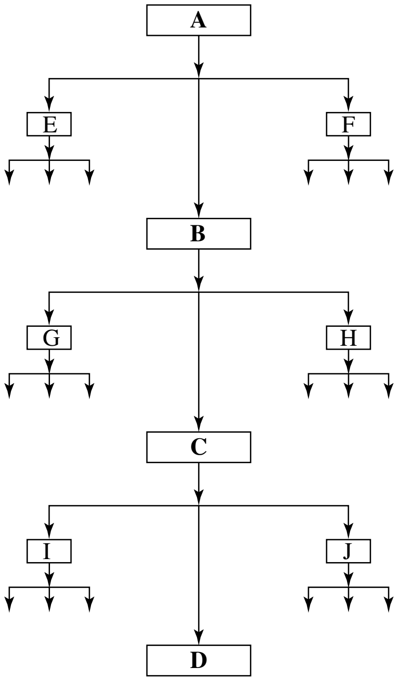

Fig. 12.1 *Event-tree analysis*

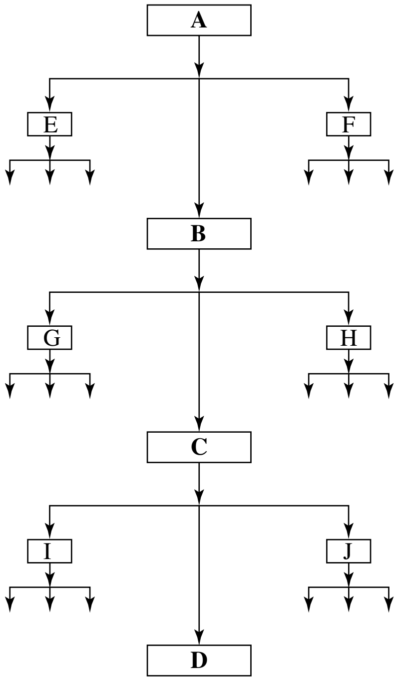

Fig. 12.2 *Fault-tree analysis*

Problem: Effects of heavy pressing of brake pedal	Problem: Causes for brake failure
Event sequence	***Fault sequence***
A: *Brake pedal pressed too heavily and suddenly*	***A***: *Brakes fail to hold*
B: *Brake tube gets punctured*	***B***: *Brake fluid leaks*
C: *Brake fluid leaks*	***C***: *Brake tube gets punctured*
D: *Brakes fail to hold*	***D***: *Brake pedal pressed too heavily and suddenly*
***E** to **J**: Other possible effects of the respective stages*	***E** to **J:** Other possible faults that contribute to the fault in the consecutive stage*

12.10.1 Multiple Causes and Effects Involved in FMEA

Most real systems do not follow the simple cause-and-effect model. As explained in the tree diagrams, a single cause may have multiple effects and a combination of causes may lead to a single or multiple effects. This can also be represented in the following diagram.

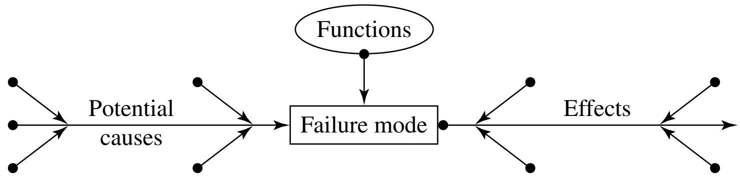

Fig. 12.3 *FMEA relationships*

12.10.2 The Procedure for FMEA

In principle, the causes or the specific faults are described in terms of those that can be detected and controlled. Action taken generally should result in a lower severity occurrence or higher detection rating by adding validation and verification controls:

1. Identify the functions.
2. Identify the failure modes.
3. Identify the effects of the failure modes.
4. Determine the probability of occurrence (see Table 12.1).
5. Determine the severity of occurrence (see Table 12.2).
6. Apply this procedure for potential consequences.
7. Identify possible causes.
8. Identify the root cause.
9. Calculate the criticality.
10. Identify special characteristics.
11. Assess the probability that the proposed system detects the potential weaknesses.

Table 12.1 *Probable occurrence rates for the failures*

S. no.	Probability of occurrence of the failure		Possible failure rate	Ranking
	Parameter	Explanation		
1.	Remote	No failure ever was associated with almost identical processes	< 1 in 1,500,000	1
2	Very low	Only isolated failures associated with almost identical processes	1 in 1,500,000	2
3	Low	Isolated failures associated with similar processes	1 in 15,000	3
4	Moderate	Generally associated with processes similar to previous processes that had experienced with occasional failures	1 in 2,000	4
			1 in 400	5
			1 in 80	6
5	High	Generally associated with processes similar to previous processes that have often failed	1 in 20	7
			1 in 8	8
6	Very high	Failure is almost inevitable	1 in 3	9
			> 1 in 2	10

Table 12.2 *Probable severity rates for the failures*

S. no.	Severity of the failure		Ranking
	Parameter	Explanation	
1.	None	No effect nor any possible mishap.	1
2	Very minor	Minor disruption to the production line or some discomfort to the persons using or handling the product.	2
3	Minor	Minor defect in the product resulting breakages, etc., causing injuries to those using or handling the product	3
4	Very low	Defect in the product or process causing hospitalization to one or two persons	4
5	Low	Defect in the system causing a moderate accident like car crash causing death to one or two persons	5
6	Moderate	Failure of the system causing moderate accident resulting in death of ten or more persons and permanent disability to several scores of persons	6
7	High	Failure of the system resulting in major accidents like train crash, resulting in death/injuries to several people	7
8	Very high	Failure of the system resulting in major disasters, resulting in death/injuries to several people and causing major environmental pollution	8
9	Hazardous with warning	Failure results in major accident like the explosion of Challenger space shuttle or air crash	9
10	Hazardous without warning	Failure results in catastrophic disasters like that of Chernobyl accident or Bhopal gas tragedy	10

12.11 RISK–BENEFIT ANALYSIS

One of the most popular methods of analysis that helps an engineer to determine whether to proceed with a project or not is the risk–benefit analysis. The risk–benefit analysis comprises a system of methods drawn from many disciplines and addresses the question whether a risk is acceptable or worthwhile taking. Whether this question is raised in the context of planning for a new process or deciding upon a public policy or in the context of clinical decision making, the principles are the same.

This analysis requires a comprehensive estimation and evaluation of the risks taken and the benefits that accrue by these risks. It entails careful quantification of the costs associated with a particular program for reducing or avoiding the risks. This is something like the cost–benefit analysis. Both deal with the resultant costs incurred by the company in the form of losses/damages, or the costs incurred in reducing the defects or improving the operating methods are estimated. However, in risk–benefit analysis, the risks and the costs due to these risks are focused, whereas in cost–benefit analysis, it is the cost of improving the quality or productivity, etc., that is focused.

In risk–benefit analysis, the risks due to the hazardous elements of the design or the operation are assigned a rupee or a dollar value and compare both the rupee or the dollar value of the benefit accrued by taking the risk. Then the most beneficial proportion of the risk is chosen.

In performing a risk–benefit analysis, we should consider who takes the risks and who reaps the benefit of the risk, because only the benefits accrued to those who take the risk should be considered. Ethically speaking, the engineer should ensure that the risks and benefits out of his project are shared equally by the society, to which he and his project are committed to serve.

Hence, the primary questions to be asked before initiating the RBA are

- Is the product/project worth applying the RBA?
- What types and extent of the risks are involved?
- Who are affected by the risk taking?
- Who are benefited by the projects?
- What are the benefits?
- Do the risks overweigh the benefits?

12.11.1 Cost of Maintaining Safety

To understand the risk–benefit analysis more clearly, let us plot down the costs for maintaining safety and the benefits accrued in the form of a graph as illustrated in Fig. 12.4. As and when the level of safety is increased, the costs of providing the safety system would increase as indicated by the curve **A** whereas the losses due to damages, compensations, etc., are reduced indicated by the curve **B**.

It can be seen that this relationship between the risks and benefits is somewhat similar to the relationship between the procurement costs and inventory costs in determining the economic order quantity. With this analogy, we can state that the optimal safety level would be where the total cost curve **C** attains the lowest point that is, **O**. However, it may have to be remembered here that the losses due to low safety level have to be carefully assessed considering all the possibilities, probabilities, and severities so that the losses curve would be far shallower than it appears in the graph. Consequently, the optimal safety level from the ethical point of view would be much at a higher safety level, that is to the right than it appears in the graph.

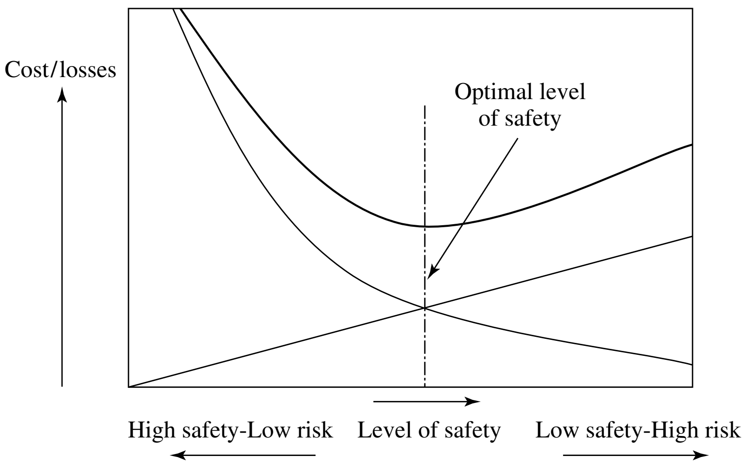

Fig. 12.4 *Determining optimal safety level*

12.11.2 Seven Criteria for Risk–Benefit Analysis

1. The purpose of the project must be identified and ranked in importance.
2. The risks related to the project must be identified.
3. The intended and unintended relationships between the individuals, groups, and also the machines or systems have to established.
4. The costs of reducing the risks must be estimated.
5. The costs must be weighed against the organizational goals like profit, reliability, reputation, etc.
6. The degrees of acceptability of risks to the clients and public should be established.
7. The project or product must be tested with reference to the above indicated issues and carried out.

12.11.3 Software on RBA

In 1997, NASA had funded for the development of an RBA software called Quantitative Risk Analysis System (iQRAS). Currently, a commercial version of this is available. This software combines user-friendly graphic interface with powerful modeling and analysis capabilities. The general procedure and other features of this software are the following:

1. The system outputs are identified.
2. For each output, the events that could have happened to the output or information are determined. Some events to be considered are
   - Long-term unavailability of the output
   - Intermediate-term unavailability

- Short-term unavailability
- Premature dissemination of time critical information
- Dissemination of output to unauthorized individuals
- Missing or lost output
- Errors or miscalculations in the output.

3. For each event, the criticality as important to the business is determined. The criticality is generally given in rupee amount of loss to the business as determined by considering some of the following results stemming from the events.
   - Loss or theft of money
   - Lost lead-time for products
   - Loss of information to a competitor
   - Incorrect decisions based on wrong data
   - Lawsuits
   - Fire, flood, or other disasters
4. The probability of the occurrences of each event identified above is determined.
5. For each event, one or more scenarios that could cause the event to happen are identified.
6. These scenarios without regard to any existing controls are developed and the probability of occurrence for each scenario is determined.
7. The *C/P* index (criticality vs. event probability index) is calculated.
8. At this step, further work needed to be done based on the event criticality versus the scenario probability (*C/P* index.) is identified.

12.11.4 Conceptual Difficulties in RBA

- Both the risks and benefits have different sets of units.
- It is very difficult to quantify the risks and benefits in monitory terms.
- What is a benefit to one person may be a risk to another person.
- The different perceptions of the risk depend upon the presentation of data.
- As both the risks and benefits are with reference to a future period, there will be heavy discounting of the present net worth and hence, it will not give the true picture.
- RBA is being increasingly challenged. The hard questions faced by the assessor or the engineer may be difficult for him to answer if his knowledge is insufficient.

12.11.5 Micro or Macro Level of RBA

The definition of the assessment strategies of the risk–benefit analysis is carried out at two levels:

1. At microscopic level which is for the individual user, or
2. At macroscopic level, on a socio-economic scale.

12.11.6 An Ethical Illustration of Risk–Benefit Analysis

Unlike industrial products, drugs and food items need to be packed and distributed under high care since even a little contamination raises a hue and cry from the public and result in the loss of reputation of the company. Below is an illustration of the ethical risk–benefit analysis done by the manufacturers of chocolate bars who valued their reputation higher than the costs, as reported in the newspapers of 4 July 2005.

> *Efforts to recall thousands of Mars and Snickers bars from the shelves in Sydney have been stepped up in the wake of a contamination scare, the manufacturers said on Sunday. Masterfoods, the company that makes Snickers and Mars bars, ordered a recall of tens of thousands of chocolate bars on Friday after receiving a letter claiming that seven contaminated bars had been placed on shelves.*

12.12 FURTHER REFERENCE

For further reference, readers are advised to read *Risk–Benefit Analysis* by Richard Wilson and A C Crouch, a 325-page book published by Harvard Centre for Risk Analysis.

Question Bank

PART A

(Each question carries 2 marks which you are expected to answer in 3 minutes.)

1. Cite the several models that can be used in problem solving.
2. Distinguish between deterministic and probabilistic models of presenting a problem.

3. List some of the analytical methods of testing for faults.
4. Define scenario analysis.
5. What is optimum safety level?
6. What are the costs to be considered in risk–benefit analysis?
7. Give an illustration for probability of occurrence at rank 10.
8. Give an illustration for severity of occurrence at rank 10.
9. What is iQRSA? Who developed it?

PART B

(These are mostly 8-mark questions to be answered in 12 minutes, presuming that the time allotted for a 100-mark question paper is 3 hours. Sometimes the same question may be asked as a 16-mark question to be answered in 25 minutes.)

1. Discuss the uncertainties that crop up during the development stage.
2. Give some illustrations to show how absence of testing for safety before launching a new product had proved expensive.
3. Discuss and compare event-tree analysis and fault-tree analysis.
4. Discuss the procedure for failure mode and effect analysis.
5. Illustrate the severity parameters of faults.
6. What is risk–benefit analysis? Discuss its merits and demerits.
7. What is meant by optimum level of safety in a system? Represent it in a graph.

PART C

(Objective-type Questions)

1. Fill in the blanks:

(i) FMEA means _____________ _____________ _____________ _____________

(ii) Crash testing : Field testing :: Scenario analysis : _____________ testing.

2. State if the following statements are true or false:

(i) Inconsistencies in the materials purchased contribute for variations in the designs.

(ii) Absence of preparatory drill prior to undertaking the voyage of Titanic resulted in many deaths.

(iii) Event-tree analysis starts from a failure and traces why that failure occurred.

(iv) RBA weighs between the cost of implementing a productivity improvement project and the benefits accrued by it.

3. Match the following

(i) Verbal models	(a) Formula for economic order quantity
(ii) Schematic models	(b) Possibility of occurrence of an event
(iii) Physical models	(c) Graphs
(iv) Analogue models	(d) Discussions
(v) Deterministic models	(e) Scale models
(vi) Probabilistic models	(f) Ammeter

UNIT V

ENGINEERS' RESPONSIBILITIES AND RIGHTS

LIST OF CHAPTERS

13

Collegiality and Loyalty

- Collegiality
- Features of Collegiality
- Collegiality Reflected in Codes of Ethics
- Connectedness
- Loyalty
- Professionalism and Loyalty
- Uncritical and Critical Loyalty
- Responsible Organizational Disobedience
- Respect for Authority
- Authority vs. Power
- Morally Justified Authority
- Accepting Authority
- Collective Bargaining

Loyalty to the employers as well as commitment to the society and colleagues are the two essential components of the ethics of an engineer. After citing how several professional institutions have highlighted the need for the engineer's cooperation with his/her colleagues, this chapter discusses the various aspects and types of collegiality, and the distinction between the functions of an engineer and that of a manager. It brings out the concept of critical and uncritical loyalty.

Keywords: *Collegiality, spirit of cooperation, respect, commitment, connectedness, agency loyalty, identification loyalty, uncritical and critical loyalty, collective bargaining, organizational disobedience, institutional authority, expert authority, morally justified authority.*

13.1 COLLEGIALITY

The term *collegiality* comes from the word *colleague*. It implies the respect shown to the attitudes, emotions, rights, and expertise of colleagues with whom you work in cooperation. It can also be called *camaraderie*.

- It is the team spirit and spirit of cooperation.
- It is the admiration and respect shown to the colleagues' expertise and devotion for work.

Craig Ihara defines collegiality as a kind of connectedness based on respect for professional expertise and in a commitment to the goals and values of the profession, and collegiality includes a disposition to support and cooperate with one's colleagues.

13.2 FEATURES OF COLLEGIALITY

1. It is a virtue and a valuable aspect of character.
2. From point of view of society, collegiality has an instrumental value and helps in promoting professional aims.
3. The spirit of cooperation among engineers developed by collegiality supports one's personal efforts to act responsibly in tandem with others.
4. It strengthens one's motivation to live up to professional standards.
5. From the professional point of view, it defines the professional community as composed of several individuals pursuing public good.
6. It promotes the community to have shared awareness of mutual commitment to professional ideals.
7. Sometimes, collegiality can also be misused or misinterpreted as developing group interest or degenerating into groupism.
8. It also may force the engineers to keep silence about corporate corruption.

13.3 COLLEGIALITY REFLECTED IN CODES OF ETHICS

In fact, several professional associations reflect this aspect in their codes of ethics as illustrated below.

1. National Society of Professional Engineers (USA)

Engineers shall not attempt to injure, maliciously or falsely, directly or indirectly, the professional reputation, prospects, practices, or employment of other engineers, nor untruthfully criticize other engineer's work. Engineers who believe others are guilty of unethical or guilty practices shall present such information to the proper authority for action.

2. Institute of Electrical and Electronic Engineers

We, the members of IIIE, do hereby commit ourselves to the highest ethical and professional conduct and agree

- To seek, accept and offer honest criticism of technical work to acknowledge and correct errors and to credit properly the contribution of others.
- To assist colleagues and fellow workers in their professional advancement and to support them in following the code of ethics.

3. American Institute of Chemical Engineers

- The engineer will take care that the credit for engineering work is given to those to whom the credit is properly due.
- He will not compete unfairly with another engineer.

4. Canadian Council of Professional Engineers

The professional engineers shall conduct themselves with fairness, courtesy, and good faith towards clients, colleagues, and others, give credit where it is due, and accept as well give honest and fair professional criticism.

5. Institution of Engineers (Australia)

Members shall act with fairness, honesty, and good faith towards all in the community including clients, employers, and colleagues.

6. Institution of Engineers (India)

A corporate member shall not directly or indirectly injure the professional reputation of another member.

13.4 CONNECTEDNESS

1. Respect

Respect means valuing one's colleagues for their professional expertise and their devotion to the social goods promoted by the profession. In other words, it is the affirming of the true value of the contribution to the society by other engineers in producing socially useful and safe products.

2. Commitment

It implies sharing of loyalty and devotion to the moral principles of engineering practice. The engineers must share their ideas freely and frankly with one another, despite the fact that there may be a competition among engineers in their profession. This is possible by their commitment to their profession getting the better of their need for individual recognition.

3. Connectedness

This is where team spirit lies. To be working closely with other engineers, one requires a spirit of cooperation and mutual understanding. Each should know the emotional attitudes of the other and be ready to share his/her personal feelings with them. This teamwork is the success of many endeavors. Teamwork is also called *synergy*, a term indicating synchronized application of individual energies.

Team means
Together
Everyone
Achieves
More

Also,

Coming together is the beginning,
Keeping together is progress, and
Working together is success.

Fig. 13.1 *Two illustrative slogans for teamwork*

13.5 LOYALTY

While collegiality implies upon team spirit and an engineer's commitment to the cause of his peers, loyalty implies his commitment to the cause of his employers. This character can be expressed in two senses.

1. Agency Loyalty

It is one's commitment to the contractual obligations to his employer. These duties are specified in the appointment order or the contract document, and the employer who is paying expects the engineer to follow these terms and regulations to the word. Agency loyalty is entirely a matter of actions irrespective of the motives. For example, if an action is committed contrary to the rules, it is viewed seriously, irrespective of the motive behind that act. In his day-to-day activities or in making decisions or in dealing with the public, the engineer considers himself as an agent or spokesman of his employer only. That is, he communicates the instructions of his employer rather than applying his own opinion or judgment or decision.

2. Identification Loyalty

By contrast, identification loyalty is more a matter of attitudes, emotions, and a sense of personal identity than the actions. This is motivated by the commitment and identification of one with the group to which he is loyal. Here, the engineer identifies himself and his knowledge in making decisions which may, to some extent, be differ from his employer's instructions.

Identification loyalty may be said to be obligatory if it fulfils the following conditions.

- Employees must be sure that their goals are achieved with the help of the group in which they work.
- Employees must be treated in a fair and just manner.

It has a reciprocal relationship between the employees and employers, that is, employees would be loyal only if the employer shows some commitment or recognition to them.

However, by the above explanations, identification loyalty does not imply disloyalty. It only implies trying or aligning one's moral duties to a group or an organization willingly with personal attachment and support as against disliking and resisting openly the actions, decisions, or directives of the employers, which amounts to disloyalty. This is more explained in later paragraphs.

13.6 PROFESSIONALISM AND LOYALTY

The relationship between professional responsibility and loyalty to employers or companies would be as follows.

1. Performing duties on professional commitments to the public should be the most effective way to serve a company instead of unquestioningly following the directives of the company.
2. Loyalty to companies or employers shall not be the same as obeying the immediate boss.

3. There shall not be any contrast between the normal status of the employers and professionals. In other words, the obligations to the public and the employers shall be towards the same direction.
4. Agency loyalty or identification loyalty depends upon the specific group, organization, and also the circumstances under which they are shown.
5. Loyalty is a dependent virtue that is depending upon the value of the project and on the communities surrounding it.

13.7 UNCRITICAL AND CRITICAL LOYALTY

Charles Harris et al. classify loyalty into uncritical and critical loyalty, more or less similar to the agency loyalty and identification loyalty respectively, as propounded by Mike Martin et al. Nevertheless, Harris emphasizes that the distinction is based more on the situation whether the employees accept the decision and directives of the employers questioningly or unquestioningly. It is recommended that the reader understand these two classifications that are similar but have explanations with slightly different approaches in supplement to each other.

In several cases, it is the engineers who take many decisions with respect to the performance of their duty. But it is likely that the management, given the authority structure in business and governmental organizations, overstep their management role and make decisions that should be made by the engineers. Under this situation, a controversy comes into play. Harris explains that in order to justify their demand for compliance on the part of the engineers, the management brings in the term *loyalty* and says that the engineers must show loyalty to the organization. Harris illustrates the following case study in this connection.

> *Kermit Vandivier, an employee of the BF Goodrich plant in Troy, Ohio, was uncomfortable with the test practices on the brake component designed for the Air Force by Goodrich. As a result of his concern, he submitted his resignation, which was to take place after three weeks, but the chief engineer informed Vandivier that his resignation was to be accepted immediately because of Vandivier's disloyalty to the company.*

13.7.1 Uncritical Loyalty

Uncritical loyalty to an employer may be defined as placing the interests of the employer above any other consideration. These interests are as defined by the employer himself and hence may be binding on the employee to be obedient to his boss and do as the boss directs irrespective of the consequences of the decision. Hence, this is also called *blind loyalty*. Every design decision has to be approved by the management, every expenditure or every official action has to be approved by the management. The employees should ungrudgingly follow the directives to the word. An employee of Philips Petroleum Inc. will prefer to buy only Philips domestic appliances, or an employee of TISCO may consider himself loyal if he buys a Tata Indica car in case he has to buy a car, or an employee of Godrej Furniture may use only Godrej shaving cream.

Herbert Simon adds the following characteristics of employees with uncritical loyalty.

- The employees accept their superior's suggestions and orders without any critical review or consideration.
- Their reasoning would be aimed at anticipating commands by asking themselves how the employer would wish them to behave in a given situation.
- They will have limits to what extent they will obey their employers, but within these limits, they relax their critical faculties and permit their behavior to be guided by their employers, without independently examining the merits of that decision.

Arguments Favoring Uncritical Loyalty

1. Without uncritical loyalty, every engineer makes a decision and believes his to be the best, irrespective of what others feel. This results in chaos since there is no unification of individual ideas.
2. The employee discipline would be better and consequently the work discipline would be more prominent than in critical loyalty.
3. The centralized control and overall monitoring of a project is facilitated.
4. Efficiency and productivity is increased.

13.7.2 Critical Loyalty

By contrast, this type of loyalty makes the engineer analyze the management decision, which he has to implement with reference to the good or bad consequences of this decision, and enables him to put forward his viewpoint to his bosses, so that the decision can be modified to an optimal one. Here, the engineer is neither disobedient nor disloyal to his boss, but being a technical person is aware of the consequences of the decision to the safety and welfare of the community in general and does not want the overall reputation of the company to be effected.

A good display of critical loyalty is the main theme of the Hollywood movie Crimson Tide *starring Gene Hackman and Denzil Washington, the captain and vice captain respectively of a US submarine. This submarine is sent to Russian seas to assist the Russian army against a Russian rebel army. Enroute they receive an unfinished message from the US high command that the Russian rebels possess nuclear warfare, the instruction part of the message being warbled. The captain presumes missile attack by the rebels and readies to launch nuclear missiles against the rebel army. However, the second-in-command advises against the attack, until a clear message is received from the high command, since any hasty launch of nuclear warheads without knowing the true situation on shore could start a nuclear holocaust endangering thousands of lives on either side. When the war-itchy captain refuses to pay heed, and goes ahead with the preparation of the missiles, the latter defies his order and goes to the extent of arresting the captain and keeping him tied in a room. The major part of the movie is how he achieves his moral obligation to the society.*

Arguments Favoring Critical Loyalty

1. Though the discipline in case of uncritical loyalty is apparently better, excessive snooper vision over the engineers and restriction of their freedom of speech results in brewing of dissatisfaction and the act of complaining to the higher bosses or expressing their sincere concern to listeners, openly or unanimously. This act, called whistleblowing, dealt more in detail in Chapter 18, would become more a norm of the company rather than a last resort. This situation can be prevented if the engineers possess critical loyalty.
2. An engineer, if told that he does not have the right to protest the obvious wrongs but ‘do as you are told’, would feel frustrated enough to resign from the post. This will result in high turnover in the company, which contributes to the negative indication of the company’s public image.
3. Independent-thinking engineers are valuable to the company. They contribute their suggestions of how to make the company’s activities more socially and environmentally friendly. These steps

would increase the public image of the company, which can be used by the company for its benefit by increased publicity, etc.

4. Engineers must always keep in their mind, their professional obligations, while still being loyal employees, as explained above.

13.8 RESPONSIBLE ORGANIZATIONAL DISOBEDIENCE

Whenever there is a disagreement between the employees and the employers, more specifically the engineer and the manager, the former resorts to expression of his feeling by some means or other, sometimes not acceptable to the employer. Jim Otten terms it as *Organizational Disobedience* in the book *Ethical Problems in Engineering* edited by Albert Flores. This can take the following forms:

- *Disobedience by protest*, by leading strikes or mobilizing the colleagues against the management
- *Disobedience by non-participation*, by refusing to carry out the assigned tasks because of moral or professional objections
- *Disobedience by contrary action*, by engaging in activities contrary to the interest of the company like bringing political pressure
- *Whistle blowing*

13.9 RESPECT FOR AUTHORITY

With all said and done regarding the decision rights of the engineer as above, he does have certain obligations to respect the legitimate authority of his boss and the organization in which he is employed in order to fulfill the organizational goals. This means that vesting of authority for some people is inevitable and respecting it by some other is a must. Authority provides a method of identifying the areas of personal responsibility and accountability.

1. Institutional Authority

This is the authority that exists within the organization. It is the right of employers and managers to exercise control on employees and make them achieve the organizational goals. The *Oxford Dictionary* defines *institutional authority* as the power to give orders and make others obey.

- In order to enable the managers to perform tasks like allocation of resources properly, making policy decisions, giving recommendations, looking after the projects, issuing orders or directing the subordinates, they should be empowered with certain amount of authority. This will help in achieving the goals easily.

- At the same time, the authority vested should match with the competency and qualification of the individual to whom it is vested or otherwise the authority would be misused.
- Also, even if some engineers are vested with institutional authority, they may lack expert authority to inspire and encourage the employees to achieve the organizational goals.
- Nevertheless, they can motivate others to follow the advise of experts, an attitude highly useful for the organization.

2. Expert Authority

- In view of the last-mentioned difficulty faced due to institutional authority, the expert authority comes into picture. It is the possession of expertise, skill, or competence to perform a given task better than others, that vests this authority to individuals.
- For example, a doctor is an authority in his field of specialization, and even the chairperson of a large industry has to respect his authority.
- If the engineer is an expert in tower design, even his boss has to respect his authority, unless he himself is an expert in the same field.
- In general, staff engineers, consultants, expert advisers, etc. are vested with the expert authority, whereas the line managers are vested with institutional authority.

The *Oxford Dictionary* defines *expert authority* as the power to influence people because of having special knowledge, etc., inspiring respect.

13.10 AUTHORITY VS. POWER

Institutional authority shall also be distinguished from power. Institutional authority carries with it an allotment of resources needed to complete the task. Yet incompetent persons may not be able to summon the power their position allows them to exercise. For example, a manager who lacks the skill of leadership may not inspire and motivate employees; in the same way, a conductor may fail with his orchestra. Conversely, effective managers or engineers who are highly respected with proven integrity, may acquire power or influence over others that goes well beyond the institutional authority and often have influence beyond their domains of authority.

13.11 MORALLY JUSTIFIED AUTHORITY

Institutional rights and duties cannot be applied in the same sense as morally justified rights and duties. The institutional authority is morally justified only when the goals of the institution are morally permissible or morally desirable and the way in which the exercise does not violate other moral duties.

13.12 ACCEPTING AUTHORITY

Employees acknowledge their employer's authority by accepting the guidance and obeying the instructions given by the employer in their activities that are covered by the employer's institutional authority.

Whenever subordinates adjust their behavior as blindly guided by the decision of their boss, they may be said to accept authority. At the same time, they should not forget to analyse critically the consequences of the decision and behave ethically. They should be able to identify the zone of acceptance of the employer's authority from the moral point of view.

In any case, the engineer shall not forget his important obligation to protect the public health, safety and welfare, which should be given primary importance while following institutional authority.

13.13 COLLECTIVE BARGAINING

The industrial relations concept of collective bargaining has its essence in mutual trust and tolerance. The employer consults, discusses, negotiates the different aspects, and settles the issues with the representatives of the employees. The engineer as a responsible employee with a good understanding of the principles of collegiality has to have full knowledge of this concept as he has to deal with all the stakeholders.

The collective bargaining process requires

1. A clear goal and timebound programme
2. Open conduct and transparency

3. Clear communication
4. Respect for others' point of view
5. Patience
6. A win-win attitude
7. Tolerance and flexibility for changing for the benefit of all (most good for most people)

Question Bank

PART A

(Each question carries 2 marks which you are expected to answer in 3 minutes.)

1. Define collegiality.
2. Discuss the three elements of collegiality.
3. What do you understand by responsible organizational disobedience?
4. Expand the abbreviations PMD and PED.

PART B

(These are mostly 8-mark questions to be answered in 12 minutes, presuming that the time allotted for a 100-mark question paper is 3 hours. Some times the same question may be asked as a 16-mark question to be answered in 25 minutes.)

1. Discuss the need for collegiality for an engineer working in an organization.
2. Distinguish between agency loyalty and identification loyalty. How does this classification differ from that of critical and uncritical loyalty?
3. Explain in detail the points that favor critical loyalty.
4. Discuss and distinguish the functions of managers and engineers.
5. How does an engineer acquire authority by expertise? How does it differ from institutional authority?
6. Discuss the role of the engineer in collective bargaining.

PART C

(Objective-type Questions)

1. Fill in the blanks:

(i) Collegiality is the respect shown to the colleagues' … and _______________

(ii) The achievement of teamwork can be explained by the slogan T _______________ E _______________ A _______________ M _______________

(iii) _______________ loyalty and _______________ loyalty are the two types of loyalty.

(iv) In _______________ loyalty, an engineer acts as a spokesman of his employer.

(v) Uncritical loyalty promotes discipline. But excessive supervision in this case promotes whistle _______________

(vi) Agency loyalty : uncritical loyalty :: _______________ loyalty :: critical loyalty.

(vii) _______________ authority : his position in the company :: Expert authority : his expertise.

2. Answer if the following statements are true or false:

(i) Several professional associations have emphasized collegiality in their codes of ethics.

(ii) 'Remove your engineer's hat and put on your managers hat' is an ethical statement.

14

Rights and Responsibilities

- Professional Rights
- Rights for Recognition
- Rights for Professional Conscience
- Rights as an Employee
- Human Rights
- Positive and Negative Rights
- Professional Rights vs. Ethical Theories
- What is a Patent?
- What is a Trademark?
- What is a Copyright?
- What is a Trade Secret?
- Patented Information vs. know-how
- Types of Patents
- The Three conditions of Patents
- Purposes of IPRs
- General Procedure for Application for a Patent
- History of Patent Legislation
- Indian Patent Acts
- Salient features of Indian Patent Act 1970
- Powers of the Central Government
- IPR for SMS on ODIs
- Social Responsibility
- Categories of Social Responsibility
- Perspectives of the Social Responsibility
- ShareHolders and Stakeholders
- Needs for Social Involvement of an Organization (or points favouring the social responsibility perspective)
- Difficulties Faced in the Social Involvement of Organizations (or points in favor of efficiency perspective)
- Social Audit
- Audit Terminology
- Ethical Audit Procedure
- Ethical Audit Reviews
- Points to be Considered While Discussing on the Ethical Issues
- Seven Key Features of Social Audit
- CIET (Community Information, Empowerment, and Transparency)

Professional rights are those possessed by the engineer by virtue of his being a professional having special moral responsibilities. This chapter discusses the several types of rights and their ethical aspects.

Intellectual property rights, more popularly known as patents, have a wide range of social, economic, and political impacts. This chapter discusses several forms and types of IPR's and their importance to the engineers.

The moral obligations of the corporations in relating their policies to the society and environment so as to be mutually beneficial are discussed in this chapter. A highlight of this chapter is the concept of social audit.

Keywords: *Professional rights, rights for recognition, right for professional conscience, employee rights, human rights, positive and negative rights, rights vs. ethical theories, IPRs, WTO, TRIPS, GATT, patent office, trademark, copyright, trade secret, Indian Patent Act. Social responsibility, ethical responsibility, social responsibility perspectives, social involvement of the organization, social audit, ethical audit, audit terminology, audit reviews, CIET.*

14.1 PROFESSIONAL RIGHTS

Professional rights are those possessed by the engineer by virtue of his being a professional having special moral responsibilities. Professional rights and duties may not be identical with those of non-professionals but are similar and related. These rights include

- The right to form and express professional judgment,
- Right to refuse to participate in unethical activities,
- Right to warn public about dangers,
- Right to fair recognition for fair professional services,
- Right to talk publicly about the job within the confidentiality ethics, and
- Right to engage in the activities of professional societies.

These rights can basically be classified into four:

- Those related to recognition,
- Those related to professional conscience,
- Those acquired as a part of the contractual terms entered upon, and
- The basic rights as a human being.

14.2 RIGHTS FOR RECOGNITION

1. All employees have a right to professional recognition for their work and accomplishments.
2. The right for reasonable remuneration serves as a moral basis for the arguments against corporations that make excessive profits.
3. Nevertheless, the right for professional recognition is not sufficiently precise enough to pinpoint the amount of the reasonable salary or fair remuneration, which is left for mutual discussions and negotiations.
4. Without fair remuneration, engineers cannot concentrate on their jobs and cannot put forward their best efforts and energy. This results in an unhealthy situation.
5. Many times the right for professional recognition prevails over the remuneration, especially at higher levels. A senior engineer or a manager may have a better morale if his bosses are appreciative of his expertise, than when his bosses criticize his efficiency and grudgingly give him the due increments.
6. Rights are either stated formally in the contract or recognized conventionally.

14.3 RIGHTS FOR PROFESSIONAL CONSCIENCE

The right of professional consciousness is one of the most significant rights an engineer possesses in his capacity as a conscientious engineer, whose obligation to the society has been discussed in the previous chapters.

1. Engineers have a general obligation to protect the well being of the public. This is possible only if they are vested with the right to take decisions and implement actions that would protect the safety and well being of the public.
2. Even though such rights are not be stated specifically in the employment contract, they go by convention and awareness of the above-mentioned moral obligation of the engineer to protect the safety and well being of the related public.
3. Thus follows the right of the engineer for conscientious refusal, that is to refuse the command of his bosses, if he believes that such commands are unethical and against the well being of the public.
4. They also have the right to refuse to participate in activities that are directly and evidently unethical like forging documents, altering test results or giving false witness to protect the boss in a court case.

14.4 RIGHTS AS AN EMPLOYEE

1. Contractual rights that arise solely out of the contract terms like the right to receive the salary or the right to take certain privileged leave on full pay.
2. Non-contractual rights that exist even though not specified in the contract like the *right to choose outside activities*, as long as it does not trespass into the interest of the employer.

14.5 HUMAN RIGHTS

Apart from being a professional, an engineer is also a human being. Human rights are those possessed by the engineer by virtue of being a human and discussed more elaborately in Chapter 20. The most significant among these are

1. The right for privacy.
2. The right to freely pursue one's legitimate interests
3. The right to non-discriminatory treatment on the basis of race, sex, etc.
4. The right to freedom of speech and association.
5. The right to social security and work.

14.6 POSITIVE AND NEGATIVE RIGHTS

While exercising a right in taking a professional judgment and discharging one's duties in an ethical manner, the engineer can either be positive or negative in approach.

If he makes known his point in the exercise of his right and its justification to all his colleagues and makes them also feel obligated on their part for this exercise then it is called a positive right.

On the other hand, if the engineer exercises his rights for unethical purposes and in doing so becomes unpopular among his colleagues, they are called negative rights.

14.7 PROFESSIONAL RIGHTS VS. ETHICAL THEORIES

Professional rights of employees are indeed justified by the ethical theories detailed in Chapter 5.

- *Duty theory* propounds that a right for a person arises only for facilitating him to perform his duty to the society and others in general. The employers too have an obligation to the professionals not to use force that compromises personal moral integrity.
- *Rights theory* stresses the right of professional conscience from fundamental human rights to pursue legitimate interests and moral obligations.
- *Utilitarian theory* emphasizes that the greatest good is promoted by allowing engineers to pursue their moral obligations.

14.8 WHAT IS A PATENT?

A *patent* is a legal instrument for exclusive grant of property rights to the owner or initiator of an invention, to make, use, manufacture, and market the product, provided the invention satisfies certain specified conditions of the law enacted for this purpose as well as other relevant laws of the land related to food, health, safety, security, etc. The patent can also be gifted, assigned, inherited, leased, or sold to interested buyers. These rights would be available for a limited period of time, as indicated in section 14.13. The innovation can either be physical, like a device, or intellectual, like software. Formerly, the patents were generally issued for physical inventions and discoveries only. But subsequently, even innovation in the form of ideas, software, etc., have been included and the word *patent* is legally replaced by the word *intellectual property rights or IPRs*.

The patent rights are only territorial, that is limited to the country of issue. The patent issued in one country is not enforceable in another country, unless specific arrangements and agreements exist between countries like SAARC and EU. The World Trade Organization (WTO) established an international agreement called *Trade Related aspects of Intellectual Property Rights Systems (TRIPS)*, which was ratified by India in 1995. By TRIPS agreement, any invention can be patented if it is really innovative and suitable for industrial applications.

The term *patent* or *intellectual property rights* include

- Innovative ideas,
- Trademarks,
- Copyrights,
- Industrial designs,
- Layout designs of integrated circuits,
- Trade secrets,
- Geographical indications like Darjeeling Tea, Assam Tea and Aligarh locks,
- Books, etc.

But for all practical purposes, the word *patent* is still popular and even the government offices dealing with IPRs are called the *patent offices* the world over and the lawyers dealing with these issues are called *patent attorneys*.

14.9 WHAT IS A TRADEMARK?

A trademark is a word, symbol, phrase, or device which uniquely identifies a particular company, product, or an individual. An example is the word Coca Cola. Here, not only the logo, but also the shape of the bottle, the red imprint too can be considered a trademark, which no other soft-drink manufacturer can copy.

Another illustration is that while a photocopying machine is not a trademark, Xerox is a trademark and belongs to Rank Xerox Inc., a manufacturer of photocopying machines. Nevertheless, the word *Xerox* has become so popular that it now replaces the generic term of the original product. Other trademarks that have now become universal include coke (a short name for Coca Cola, that is meant for any brand of cola soft drink), Spartec (ceramic tiles), Jacuzzi, Band-Aid, Bermudas (short pants), Wellingtons (shoes), etc.

14.10 WHAT IS A COPYRIGHT?

A copyright is a specific and exclusive right for the reproduction of an original work, like films, music, aesthetic material, paintings, multimedia, sound recording, and literacy material like poetry and books. This does not need any registration but provides automatic right for protecting any original creation against

- copying the work,
- publishing or selling the copies commercially without approval,
- renting or lending the work in open market, and/or
- performing (especially drama scripts) or demonstrating the work in public.

14.11 WHAT IS A TRADE SECRET?

Trade secrets are that confidential information which are given limited legal protection against misuse or abuse by employees or contractors. These secrets may be about designs, technical processes, plant facilities, quality control methods, specialized equipment, list of customers, etc.

While USA held the record for the tallest building for a long time, in 1995 Malaysia secured the credit of having the tallest tower in Asia, the much advertised Petronas twin towers. Taiwan soon built the tallest building in Taipei. Perhaps it was originally shorter, but just to achieve the record, they might have increased the height. In this international race for constructing the tallest building of the world, for world-record purposes, Dubai planned to construct a much taller building called Burz Dubai, which was completed in 2008. However they have not indicated and decided not to publicize it till the later part of completing the construction. This is a trade secret, the purpose being to prevent other planners of the world to plan for a taller building than Burz Dubai. Maybe the world record of having the tallest building was short-lived for Malaysia and Taipei because they could not maintain their trade secret of the height of their buildings.

The above is an illustration of a trade secret and its purpose. A *trade secret* can be defined as an information that is kept secret by the owner, so as to provide him (or the nation as the above illustration indicates) an advantage over competitors. Unlike a patent, this trade secret is fundamentally a do-it-yourself form of protection. Trade secretes may include a formula or a program or a new method or process or a system of data collection. Trade secrets are generally not registered or patented. They are simply kept confidential by the owner or those employees to whom it is divulged under oath or promise of secrecy. If there is any improper user or disclosure of the trade secret and if there is a proof of the original ownership of the trade secret then the owner can legally take action on the divulging person and recover damages if the trade secret is made use of illegally. If the owner wantedly makes the secret public then the protection for the trade secret ends.

14.12 PATENTED INFORMATION VS. KNOW-HOW

Generally, the information disclosed in the patent application is not sufficient for commercial application of the invention. Further development and synthesis, as necessary, may have to be made for the commercialization of this information into production. On the other hand, know-how covers all the information necessary to commercialize the invention like the setting up of the production plant, details of the production processes, the optimal equipment, design drawings, etc. In short, the patent information is only the basis from which the know-how has to be developed.

14.13 TYPES OF PATENTS

There are basically three categories of patents.

Utility patents which are granted for those inventions or discoveries that are new and useful for the manufacturing process or new chemical compositions including new materials useful to the general public. Here, chemical compositions include mixtures of ingredients and new chemical compounds. This patent is valid for 20 years.

Design patents which are granted for new and original ornamental designs or patterns (that is the appearance) for an article of manufacture. This patent is valid for 14 years.

Plant patents which are granted for those who discover and asexually reproduce a new variety of plant. This patent is valid for 20 years.

14.14 THE THREE CONDITIONS OF PATENTS

An invention can be patented if it satisfies the following conditions:

- Novelty,
- Inventiveness, and
- Usefulness.

14.15 PURPOSES OF IPRs

1. Encouraging development of new processes and products, thereby the technical advancement of a country.
2. Dissipating the unique knowledge possessed by individuals to public domain with useful industrial applications
3. Identifying the trends of the market
4. Evaluating the strength of competitors
5. Identifying unexplored areas for R&D work
6. Identifying unprotected areas to avoid infringement
7. Prevent misuse and plagiarism of someone else's hard work and intelligence
8. Prevent others using a novelty for commercial gains
9. Support income-generating capacity for the inventor as well as the society.

14.16 GENERAL PROCEDURE FOR APPLICATION FOR A PATENT

1. Generation of the idea, physical or documented.
2. Submission to the patent office defining clearly the invention and disclosing all the necessary information like
   - Description of the invention,
   - Bibliographical information,
   - Summary,
   - Training needs, and
   - Claims.

3. After preliminary scrutiny, the patent office releases an advertisement in the paper about the title of the patent application.
4. If no comments or objections are received from anyone before the deadline specified in the advertising, a registered number is given and is passed on to the patent committee.
5. The application is discussed by the patent committee with reference to the originality and other merits of the ideation.
6. The application is filed open for public.
7. It is published in the official gazette giving all details and is given for general circulation and sale.
8. After the mandatory period, the patent is granted.

14.17 HISTORY OF PATENT LEGISLATION

The first recorded discussions on patents was during the Paris Convention of 1883, where basically USA and European countries met to discuss the protection of patents with reference to industrial manufacture. Such conventions were repeated later in 1900 (Brussels), 1911 (Washington), 1925 (the Hague), 1934 (London), 1958 (Lisbon), 1967 (Stockholm), etc. India became a member of this union in 1998. The Uruguay Round in 1994 had initiated international trade between the individual countries, giving birth to *GATT (The General Agreement on Tariffs and Trade)*, which had a significant impact on the individual patent laws of the world.

14.18 INDIAN PATENT ACTS

Some of the patent-related legislations enacted in India are

- The Contract Act (for protection of undisclosed information) 1872
- The Designs Act in 1911 incorporating mostly the British systems
- The Copyright Act of 1957
- The Trade and Merchandise Marks Act of 1958
- The Patent Act of 1970, amended in 1999 and in 2003
- The Geographical Indication of Goods (Registration and Protection) Act 1999
- Semiconductor Layout Design Act of 2000.

14.19 SALIENT FEATURES OF INDIAN PATENT ACT 1970

1. The basic object of the Act is to encourage research and grant exclusive privileges to the inventors.
2. It codifies inventions that are not patentable.
3. It provides for endorsement of a patent with the words 'license of right'.
4. It provides for compulsory licensing on some other specified situations as well.
5. It provides for the invention for the purpose of the government and acquisition of the invention by the Central Government.
6. It provides revocation patents in public interest.

It will be a matter of interest that the UNCTAD had commended the Indian Patent Act 1970 as the most progressive of the patent laws in the world. The Act strives to strike a balance between the interests of the inventor and the consumer. An international website appreciates the patent laws of India to be the best among many countries and reports as follows:

> *India has made real strides on the patent front by making substantial changes to bring its patent laws into full TRIPS compliance. This happened at a very interesting time as the pharmaceutical industry in India is currently shifting from a copying-based industry to an R&D based industry. Over time, this should increase the need for strong intellectual properties. Once India has homegrown reason for being serious about intellectual property, real reforms should follow.*

14.20 POWERS OF THE CENTRAL GOVERNMENT

Section 159 of the Indian Patent Act 2003, specifies the powers of the Central Government which are reproduced as under:

The Central Government may by notification in the official gazette, make rules for carrying out the purposes of the Act. Without prejudice to the generality of the foregoing power, the Central Government may provide guidelines to provide for all or any of the following matters, namely the following:

1. The form and manner in which any application for a patent, any specification or drawings and any other application or document may be filed in the patent office

2. The time limit within which any act or thing may be done under this Act, including the manner in which and the time within which any matter may be advertised under this Act
3. The fees which may be payable under this Act and the manner of payment of such fees
4. The matters in respect of which the examiner may make a report to the Controller
5. The form of request for the sealing of the patent
6. The form and manner in which and the time within which any notice may be given under this Act
7. The provisions which may be inserted in an order for restoration of a patent for the protection of persons who may have availed themselves of the subject matter of the patent after the patent has ceased
8. The establishment of the branch offices of the Patent Office and the regulation generally of the business of the Patent Office, including its branch offices
9. The maintenance of the register of patents and the matters to be entered therein
10. The matters in respect of which the Controller shall have the powers of a civil court
11. The time when, and the manner in which the register and any other document open to inspection may be inspected under this Act
12. The qualification of, and preparation of the roll of specific advisers for the purpose of Section 115
13. The manner in which the compensation for acquisition by Government of an invention may be paid
14. The manner in which the register of the patent agents may be maintained, and conduct of qualifying examinations for patent agents, and matters connected with their practice and conduct, including taking of disciplinary proceedings against patent agent for misconduct
15. The regulations of the making, printing, publishing, and selling of indexes and abridgments of specifications and other documents in the Patent Office, and the inspection of indexes and abridgements and other documents
16. Any other matter which has to be or may be prescribed

14.21 IPR FOR SMS ON ODIs

A peculiar case of IPR litigation has surfaced as late as February 2006. Normally, the mobile service providers periodically keep their clients informed about the score details of the cricket test matches or ODIs or other popular games, by sending SMS messages. On a civil suit filed by a Chennai-based company, which has the exclusive global rights for SMS services for the current cricket series between India and Pakistan being played in Pakistan, the Madras High Court had on 7 February 2006, restrained 18 major telecom service providers from sending SMSs relating to scores, match alerts and updates of India-Pakistan ODI cricket matches. These restrained companies include the Central Government owned Bharat Sanchar Nigam Limited!

14.22 SOCIAL RESPONSIBILITY OF CORPORATIONS

Social responsibility of an organization is the development of the moral obligation of the organization to relate its operation and policies to the social environment in ways and means mutually beneficial to the organization and the society. This concept includes enterprises other than business organizations and relationships within the organization. The term *social responsiveness* implies the 'ways and means' and the 'how' of the organizations' response to the above responsibilities.

14.23 CATEGORIES OF SOCIAL RESPONSIBILITY

1. Economic responsibility that is their obligation to the investors to run the organization in a cost-effective manner and make profits.

2. Legal responsibility that is their obligations to follow the law of the land and ensure that all activities are open and perfectly legal.

3. Ethical responsibility is their obligation to ensue that no immoral or unethical activities take place in the organization and any such activity is immediately amended.

4. Discretionary responsibility is their obligation to take ethical decision in case of moral dilemmas in an ethical manner, applying their expertise as managers.

14.24 PERSPECTIVES OF THE SOCIAL RESPONSIBILITY

It is undisputed that organizations are also obliged to make profits to satisfy the investors that are to fulfill their economic responsibility. The purpose of the management is to maximize profits to the benefit of the investor and at the same time, being socially conscious and satisfying the conflicting requirements of the owner's interests on one hand and the employees' interests, societies requirements, environment friendliness, and customer satisfaction, etc., on the other. In this context, to what extent the mix of economic and social factors are taken into consideration depends upon the size of the industry. The policy is to combine the different responsibilities in policy making. Providing good pay, working conditions, and a measure of security to the employees as well as selection of environment-friendly processes are some examples of judicious combination of satisfying several responsibilities of the organization. These examples fall into two basic perspectives of the ethical nature of management.

1. Efficiency Perspective

The approach to the organizational responsibility of the managers is to concentrate on the optimization of production and maximization of profits for shareholders and leave the social obligations to the government and other organizations. Here, the three manager act either as the owner (entrepreneur) or the agent of the shareholders (employee). In this perspective, if the manager pursues actions that benefit the society but not the shareholder then he is only exercising the political power and not managerial responsibility.

2. Social Responsibility Perspective

This approach is based on the argument that it is the society that grants and permits the very existence of the organization which hence has the obligations to the society as a whole and not just to the shareholders.

14.25 SHAREHOLDERS AND STAKEHOLDERS

It should be noted here that the term *shareholders* includes the shareholders and other investors, whereas the term *stakeholders* includes all those that have interest in the functioning of the organization like the shareholders, financers, employees, customers, suppliers, communities, and society at large.

14.26 NEEDS FOR SOCIAL INVOLVEMENT OF AN ORGANIZATION (OR POINTS FAVOURING THE SOCIAL RESPONSIBILITY PERSPECTIVE)

1. Social involvement creates a favorable public image, which attracts customers.
2. This is also in the interest of the employees and the shareholders.
3. Society gains through better neighborhoods and employment opportunities, while the organization benefits from a better community, which is the main source of the workforce and the consumer of its products.
4. Public needs have changed leading to changed expectations from consumers. The industry/business receives its very existence from the society and has to respond to the needs of the society.
5. The company's social involvement discourages excessive regulation or intervention from the Government or statutory bodies, and hence gives greater freedom and flexibility in decision-making.
6. The internal activities of the organization have an impact on the external environment, since the society is an interdependent system.
7. A business organization has a great deal of power and money and should be accompanied by an equal amount of responsibility. In other words, there should be a balance between authority and responsibility.
8. Problems can become profits. Items once considered as waste can be profitably used again. This also encourages recycling wastes.
9. Good utilization of resources, not only of the materials but also of the personnel like its talented managers in solving social problems.
10. The good public image secured by one organization by its social responsiveness encourages other organizations in the neighborhood or in the professional group to adapt themselves to achieve their social responsiveness.
11. This atmosphere of social responsiveness encourages cooperative attitude between groups of companies. One company can advise or solve social problems other organizations could not solve.
12. It is easier to address the grievances of employees and the unemployed rather than to cope with social unrest. In other words, it is better to prevent social problems through social responsiveness than to cure them.

14.27 DIFFICULTIES FACED IN THE SOCIAL INVOLVEMENT OF ORGANIZATIONS (OR POINTS IN FAVOR OF EFFICIENCY PERSPECTIVE)

1. Social involvement could reduce economic efficiency since the primary task of the business is to maximize profits.
2. Social involvement could create excessive costs for business that cannot commit its resources for social actions.
3. Social involvement can weaken the international balance of payments.
4. Social involvement of the organizations, when motivated for political and unethical causes, would encourage certain organizations trying to wield power over others and increase the tendency of monopolistic trade practices.
5. Not all organizations possess the social skills pertinent to social problems and this situation leads to a confused state of affairs.
6. Unless accountability is established, social involvement would result in disputed claims, which will lead to friction and more social problems.

14.28 SOCIAL AUDIT

Audit is defined as the official examination of the accounts or procedures to ensure that they are as per the set standards. This definition can be extended to quality audits, environment audit, etc., depending upon the system that is audited.

By audit, we normally mean checking whether the systems, procedures, and documentation followed is as per the established policies and standards are met by meticulously going through each and every document and questioning and discussing with each and every concerned person.

A social audit can similarly be defined as a systematic assessment and reporting on some meaningful definable activities and policies of an organization that have social impact.

There may be three types of social audits:

1. *As required by the Government or statutory bodies*, like pollution control, safety requirement, equal employment status.
2. *As required for voluntary social programmes* audited and reported by voluntary organizations or newspapers to create awareness among the public

3. *Internal auditing and reporting* by an organization to highlight their social responsiveness would uplift their public image and they could use the same as an advertisement

The significance of social audit can be better understood by the following newspaper report of July 2005.

> *Ms. Kiran Bedi, the best known woman of the Indian Police Force, said what India required was an independent system of external social audit for the government where each person in power would have to account for what he or she has done with the post and powers.*
>
> *Ms. Bedi said everyone was precise when it came to financial auditing, spending within the budget. But no one is accounted for what this money is used for. "As long as your finances are in order, you are fine. But who judges what I did with what I got?' she said. She suggested an independent organization that would objectively audit the accomplishment of different departments in the public sector.*

14.29 AUDIT TERMINOLOGY

In the definition given earlier, some of the keywords in audit are,

Verification To evaluate compliance to the requirements

Systematic Carried out in accordance with set protocols

Periodic Conducted to established schedules

Objective The goal of identifying non-compliance is basically to bring it to the notice of the concerned personnel and encourage them to comply

Documentation Preparation of reports and statements together with recommendations, to aid future reference and monitoring, where necessary.

The other terminology involved is

- *Audit Cycle* Period over which all aspects of the organization or the project are audited for ethics
- *Audit Programme* A timetable within the audit cycle, showing what is to be audited, when and by whom
- *Audit Protocol* or procedure including
  - Audit scope
  - Audit frequency

- Audit methodology
- Auditor qualifications and experience
- Documentation required
- Reporting and distribution of documents

14.30 ETHICAL AUDIT PROCEDURE

In the execution of any project, the contractual agreement between the partners is somewhat different form the ethical duties of each. The project contract normally sets out the aims and constraints of the project, the quality of products and services expected and also the obligations and duties of the parties. Both the formal and informal relationships between the contracting parties should continue during the lifetime of the project. Thus, the inclusion of an ethical section in every project contract will help reduce future conflicts and ruptures that are likely to arise under pressure during project execution, especially when things go wrong. Such ethical reviews should be made a formal part of the project procedures. These reviews are similar to the audit as described earlier.

14.31 ETHICAL AUDIT REVIEWS

Periodically, ethical audit review meetings are to be held, convened by a superior officer and participated by the two parties. These meetings are basically to discuss on

- a review of the present situation, and
- the ethical implications of future activities.

The objective of these meetings is to identify the possible issues of ethical conflicts of the future and to eliminate them where possible. The discussions shall generally cover the following issues:

1. Identification and Role Specification of Each of the Parties Concerned

This includes the names, addresses, and management structures of each organization and the names of the persons representing the organization. The roles, responsibilities, and reporting hierarchy of each key person shall be defined, whether he is a client or a manager or a consultant or a supplier or a statutory officer. This schedule should also include the details of the subcontractors and their contractual relationship with the main contractors.

2. Summary of the Contents of the Contract and Terms and Regulations

This includes the programme limitations, summary of all sections of the contract. Special note is to be made of any particular performance specifications and of any special constraints like safety standards, security and confidentiality. Quality management procedures need to be set out with definitions of the responsibilities and authorities of those concerned with the monitoring of the quality.

3. Ethical Context

The full description of the site and the neighbourhood that are likely to be affected by the project with special reference to the communities in those areas. The description shall include full details of any environmental impact assessment that has already been carried out and the recommendation therein. All special requirements concerning the working conditions, health, safety security, pollution, communications, traffic management, restrictions, social welfare, etc., shall be specified. The names and duties of those monitoring the above shall also be specified.

4. Statutory and Legal Requirements

In the specification as detailed in the above paragraph, statutory and legal requirement of the contract also shall be noted with definitions of any national or international standards. Relationships with the approving bodies like Pollution Control Board shall also be defined.

5. The Design

Any special requirement for the sustainability, energy conservation shall be noted. All detailed specifications, processes, and control procedures shall be specified. Provision shall be made for variations of design during the construction or execution stage.

6. Implementation

The items covering the relationships with local communities and execution aspects of the project shall be noted and reviewed regularly at periodical meetings.

14.32 POINTS TO BE CONSIDERED WHILE DISCUSSING ON THE ETHICAL ISSUES

With a clear statement of values and objectives, all parties can carry out their individual duties with responsibilities. For a successful contract document, the following points are to be considered to cover all ethical issues that may arise in future.

- Early agreement required on the broad parameters for the commercial viability of the project
- Flexible approaches required for incorporating the client changes during the design stage
- Open-book approach to negotiations for process of construction work, particularly for estimates of the cost variations
- Agreement on detailed specifications before the start of the project execution
- Consideration for the matter of standardization to ease executability of the project
- Use of independent professional project management, using experienced professionals
- Structured utilization of total quality management, quality assurance, etc.
- Good working relationships between parties and good communication systems

14.33 SEVEN KEY FEATURES OF SOCIAL AUDIT

1. Getting the Evidence Hard data from the households, schools and communities as well as from the service itself, are gathered systematically to guide planning and action.

2. Community Participation Communities not only co-produce the data but also through focus groups and workshops involving community representatives, help design local and national solutions.

3. Impartiality Community-based audit by a neutral third party can help build a culture of transparency and strength service credibility.

4. Stakeholder buy-in All those who have significant stake in a serve delivery are actively involved throughout the audit, from the initial stages of design to the implementing of community-led solutions.

5. No Finger-pointing A special audit is intended to focus on system flaws and program content, rather than on individuals or organizations. Even negative findings can be framed as a starting point for improvement.

6. Repeat Audits Several audit cycles are usually needed to measure the impact and progress over time and to focus planning efforts where they can be most effective.

7. Dissemination of Results A communication strategy, including feedback to communities, mapping out and media dissemination is a part of every social audit design.

14.34 CIET (COMMUNITY INFORMATION, EMPOWERMENT, AND TRANSPARENCY)

CIET was originally started in Mexico City in 1994 as *Centro de Investigation de Enformendates Tropicales (Tropical Decease Research Centre)*, for the assessment of losses to the society due to environmental pollution. With its expertise in data collection and analysis, it has spread its activities into ethical issues in the corporate sector. Accordingly, it had come to be known as *Community Information and Epidemiological Technologies in USA* and as *Community Information, Empowerment and Transparency in Europe*. Starting from 2002, with the support from *Organization for Economic Cooperation and Development (OECD)*, it has done social audits in several countries like Baltic States, Bolivia, Mali, Bangladesh, Pakistan, South Africa, Tanzania, and Uganda.

Question Bank

PART A

(Each question carries 2 marks which you are expected to answer in 3 minutes.)

1. What do you understand by professional rights of an engineer?
2. What are the rights of an engineer by virtue of his profession?
3. What is the meaning of professional conscience?
4. Explain positive and negative rights.
5. How does the utilitarian theory explain the limitations of professional rights?
6. What is a patent? What are the types of ideas that can be patented?

7. Explain the relationship between WTO and TRIPS.
8. What its the difference between trademarks and trade secrets?
9. What are copyrights?
10. Distinguish between patented information and know-how.
11. Illustrate the three basic types of patents.
12. What are the three basic requirements for getting a patent?
13. Why should organizations have social responsibility?
14. What is social audit?
15. Name the seven key features of social audit.
16. What is CIET?

PART B

(These are mostly 8-mark questions to be answered in 12 minutes, presuming that the time allotted for a 100-mark question paper is 3 hours. Some times the same question may be asked as a 16-mark question to be answered in 25 minutes.)

1. Discuss and explain the four broad classifications of professional rights with illustrations.
2. Justify the statement that the engineer is justified for the right of conscientious refusal.
3. Justify the statement that the engineer has the right for recognition for his excellence and achievements in his service.
4. How do each of the ethical theories justify the professional rights of an engineer?
5. Discuss the general procedure for obtaining a patent.
6. Discuss the significance of the Indian Patent Act 1970.
7. Discuss the purposes of IPRs.
8. Cite the Indian Patent legislations.
9. What are the powers of the Central Government with regard to patents?
10. Discuss the perspectives and categories of the social responsibilities of organizations.
11. What is social audit? Discuss the procedure and terminology involved.
12. Discuss the objectives and scope of ethical audit review.

PART C

(Objective-type Questions)

1. Fill in the blanks:

(i) WTO stands for ____________ ____________ ____________

(ii) TRIPS stands for __________ __________ __________ __________

(iii) GATT stands for ____________ ____________ ____________

2. Answer if the following statements are true or false:

(i) Patents are internationally valid.

(ii) A new mathematical equation can be patented.

(iii) Issuance of patents is a State government function.

(iv) After preliminary scrutiny of the patent application, the patent office releases an advertisement in the paper about the title of the patent application.

(v) Development of new software cannot be patented.

3. Match the following:

(i) Innovative ideas	(a) Books
(ii) Trademarks	(b) A novel method of operation
(iii) Copyrights	(c) New equipment
(iv) Industrial designs	(d) Logos
(v) Layout designs	(e) AutoCAD design
(vi) Trade secrets	(f) Integrated circuits

15

Confidentiality

- Confidential Information and the Professional
- Justification for Confidentiality in the Engineering Profession
- Levels of Confidentiality
- Types of Confidential Information
- Ethical Theories vs. Confidentiality
- Conflicting Interests in Maintenance of Confidentiality

A significant requirement of an engineer is to keep certain professional information confidential. This chapter discusses the several forms of confidential information and the engineer's role in maintaining their confidentiality.

Keywords: *Confidentiality, levels of confidentiality, privileged information, proprietary information, trade secrets, consultancy, part-time jobs, moonlighting, conflicting interests.*

15.1 CONFIDENTIAL INFORMATION AND THE PROFESSIONAL

Confidential information is defined as the information the employer or the client would like to keep secret in order to compete effectively against competitors.

A significant requirement of a professional is his obligation in keeping certain professional information confidentially as long as it is required to be kept confidential. This is acknowledged as a duty in most of the ethical codes of any profession, be it medical or legal or engineering.

In the legal profession, it is a necessary principle that the defense lawyers must keep their client's information confidential without which the opponent party is likely to get hold of the weak points and win the cases. Even in the medical profession, the patient's medical information must be kept a secret from the patient himself lest his condition may worsen due to his worrying about it. This information may be divulged and discussed with the near relatives freely, when their decision is important. Teachers are expected to keep personal information about their students confidential.

In case of the engineering profession, the engineers have an obligation to keep the proprietary information of their companies and their clients confidential. Most of the information can directly affect the company's ability to compete in the market place such as how a business is turning out its products, its customers and suppliers. A competitor to capture the market may unethically use this information. Such kinds of information should be kept confidential in the good interest of the company to the possible extent.

15.2 JUSTIFICATION FOR CONFIDENTIALITY IN THE ENGINEERING PROFESSION

The engineer's obligation for maintaining secrecy is focused on three moral considerations:

1. Respect for autonomy or the freedom of privacy and self-determination of an individual or a company so as to retain their control over such information or process which they had developed after substantial hard work.

2. Respect for promises Some of the promises made by the employers to their employees are specific and different from other employers.

Disclosure of these special promises to others would only cause embarrassment. Promises are to be and normally would be kept up by the employers. But this sort of disclosures and the resulting embarrassment to the employers would only force the employers to back out of these promises.

3. Respect for Social Well Being A lawyer not revealing the confidential nature of his argument until before the judge or the doctor keeping the condition of his patient secret as long as it is required to, would only help the clients get more confidence in their consultant (lawyer or the doctor) making them discuss their personal problems more freely. Again, by maintaining the company secrets about their products, the company can not only compete freely in the market, the economic benefits can be accrued to all stakeholders.

15.3 LEVELS OF CONFIDENTIALITY

There can be two levels of the nature of the confidentiality of information:

1. Information of higher level of confidentiality like test results, information about the unreleased products, processes, designs, formulae and other data are under development or experimentation.

2. Information of lesser level of confidentiality basically normal and routine business information like number of employees working in the project, plant capacity, operating capacity, product brochures, identity of suppliers, production costs, etc.

15.4 TYPES OF CONFIDENTIAL INFORMATION

Confidential information, the justification of which has been discussed earlier can be of several types:

1. Privileged Information

This is the type of information where the access is available to only certain category of employees connected with specific assignments.

2. Proprietary Information

This information is considered as owned by a company or an individual. It refers to a new knowledge established within the organization like an invention or process development that is under experimentation stage and can be legally protected from use by others.

3. Trade Secrets

A reference may be made to Para 4 of chapter no. 16 on confidentiality wherefrom the case study can be reproduced as under

> *While USA held the record for the tallest building for a long time, in 1995 Malaysia secured the credit of having the tallest tower in Asia, the much advertised Petronas twin towers. Taiwan soon built the tallest building in Taipei. Perhaps it was originally shorter, but just to achieve the record, they might have increased the height. In this international race for constructing the tallest building of the world, for the world-record purposes, Dubai planned to construct a much taller building called Burz Dubai, completed by 2008. However, they did not indicate and decide not to publicize the actual height till the later part of completing the construction. This is a trade secret, the purpose being to prevent other planners of the world to plan a taller building than Burz Dubai. May be, the world record of having the tallest building is short lived for Taipei because it could not maintain its trade secret of the height of its building.*

4. Patents

In chapter 14, we discussed patents in detail and stated that patents legally protect some specific products from being manufactured and sold by other competitors without any written permission of the patent holder. Thus, a patent holder has a legally protected monopoly power. Patents differ from trade secrets to the effect that the legal protection is limited to keeping relationships of confidentiality and trust, and as such full legal protection does not exist in the case of trade secrets. More details of the patents are discussed in the chapter on intellectual property rights.

15.5 ETHICAL THEORIES VS. CONFIDENTIALITY

Ethical theories add some dimensions to confidentiality. The engineer has a moral and institutional right to take decisions on deciding what type of information shall be kept secret and which type of information shall be made public. He can apply different ethical theories in making his decisions.

Rights-based ethical theories justify the engineer's obligations for confidentiality in terms of his basic human rights. He can either refuse to divulge information regarding the intellectual property of the corporations. However, if he feels withholding some information may cause public hazards then he can openly warn people against the spirit of confidentiality, and this is called whistleblowing which is discussed more in detail in Chapter 20.

Duty-based ethical theories stress the basic obligation of the engineer to keep the trust placed on him by the employer and to keep all confidential matters within himself, in deference to any agreement that exists. This theory also makes the engineer obliged not to trespass or abuse the proprietary rights of others.

Utilitarian theories justify the rules of confidentiality when such rules produce most good for most people or in general to the public.

15.6 CONFLICTING INTERESTS IN MAINTENANCE OF CONFIDENTIALITY

The engineer who has been given access to some highly confidential information during the course of his employment, continues to be obliged to maintain this secrecy even when he leaves the employment and takes up his employment elsewhere, especially if the latter employer happens to be a competitor to his first employer. The moral obligations for such an engineer can be in two forms:

1. When he joins a company which has an entirely different line of manufacture, when the probability of the disclosures are less as neither the employee nor the new employer benefits by the secrets of the former company being disclosed.
2. However, if he joins a competitor company, there is a good chance that he makes use of that information wittingly (use the information that adversely effects the interests of the former company) or unwittingly (using the knowledge and experience gained by him not only in that specific former company in all his earlier employments in making decisions like selection of materials and optimal processes). After all, the very concept of 'experience' means the skills acquired by an engineer by way of his earlier employments.
3. The consultants who simultaneously work at two or more companies at the same time have more opportunities to pass on confidential information. It is only their ethics and perhaps the

carefulness of the client in screening the information given to the consultant that may protect the confidentiality to some extent.

4. A similar situation occurs when the employee also accepts part-time jobs during the evening hours, in addition to his regular full-time job. This is called *moonlighting* and is discussed more in the next chapter. The ethics of the engineer in not disclosing his daytime employer's secrets is similar to the above situation.

These conflicts of interests get compounded with the under-mentioned fundamental rights of the employee as well as the employer which are

(i) The employees right to seek a further career of his choice
(ii) The employer's right to keep information away from the competitors

Under these conflicts, since the employer could do little in protecting the secrets, it is the employee's ethics that makes him obliged to maintain the secrets of his former employer.

Question Bank

PART A

(Each question carries 2 marks that you are expected to answer in 3 minutes.)

1. What do you understand by confidentiality?
2. Why should engineering information be kept confidential?
3. Give some illustrations of confidentiality in medical and legal fields.
4. What are the two levels of confidentiality?
5. What is the difference between privileged information and proprietary information?
6. What is moonlighting? What are the engineer's obligations in that case?

PART B

(*These are mostly 8-mark questions to be answered in 12 minutes, presuming that the time allotted for a 100-mark question paper is 3 hours. Some times the same question may be asked as a 16-mark question to be answered in 25 minutes.)*

1. Discuss the different types of confidential information.
2. Discuss the justification and limits for confidentiality.

3. Discuss confidentiality with respect to the ethical theories.
4. Discuss the conflicting interests in maintaining confidentiality.

PART C

(Objective-type Questions)

1. Fill in the blanks:

(i) Respect for autonomy : Respect for social well being :: Agency loyalty : ______________

(ii) Information of higher level of confidentiality include _________, _________ etc.

(iii) Information of lesser level of confidentiality include _________, _________ etc.

2. Answer if the following statements are true or false:

(i) There is no point in maintaining the information on the number of workers in a factory as strictly confidential.

(ii) Whistleblowing is an example of respect for promises.

3. Match the following:

(i) Privileged information	(a) IPRs
(ii) Proprietary information	(b) Immersions time of plating to get extra gloss
(iii) Trade secret	(c) Information owned by an individual
(iv) Patents	(d) Information given to consultants

16

Conflicts of Interests

- What is a Conflict of Interest?
- Types of Conflicts of Interest
- Moonlighting
- Corporate Conflicts of Interest
- Codes of Ethics on Conflicts of Interest
- Points to be Kept in Mind
- On the Lighter Side

Conflict of interest is a major contributor for moral dilemmas faced by an engineer. A conflict of interest exists for a professional when he or she is subjected to influences, loyalties, temptations, etc., in making his or her professional judgments. This chapter deals with this aspect critically with illustrations. Some of the relevant codes of professional associations are cited.

Keywords: *Professional judgment, professional conflicts of interest, actual, potential, and apparent conflicts of interest, moonlighting, codes of ethics.*

16.1 WHAT IS A CONFLICT OF INTEREST?

In Chapter 6, we had suggested that conflict of interest is a major contributor for moral dilemmas faced by an engineer. Let us now examine this issue in detail.

A conflict of interest occurs when the employee pursues an interest other than his regular employment. Sometimes such an interest involves in serving some other professional role, like an engineer working in a company and also acting as a consultant to a competitor's company. In this case, he may not be able to meet fully the obligations of his regular employer or sometimes not even to the client. This is termed as *professional conflict of interest*.

The other instances of conflicts of interest may occur when the employee

- Invests his money in a competitor's company. In this case, he would tend to be more loyal to the competitor's company than the one that pays him regular salary.
- Invests in a company that may not be a direct competitor to his parent company, but is one of the companies that are vying with each other in supplying goods or otherwise. The concerned engineer might either have invested money in this latter company or has his brother-in-law or any other close relations or friends as the proprietor or a beneficiary of that company.

For example, a purchase engineer has a financial interest in a supplier company and if there are quite a few other suppliers, then he will face a conflict of interest in selecting the supplier.

16.2 TYPES OF CONFLICTS OF INTEREST

Mike Martin et al. categorizes the conflicts of interests into three.

1. Actual Conflicts of Interests

These are those explained above and are based on weak judgment and service. It is the loss of objectivity in decision-making and inability to faithfully discharge one's professional duties to the employer. If the engineer has outside interests as explained in the earlier paragraph, conflicts of interest are bound to appear. Whether any such interest influences his professional judgment, is a clear test on his mortal ethics. Consider the following illustration:

Ramanadh is participating in a design project for M/s ABC Co. that requires a large quantity of bolts. He has a choice between two or three types of bolts, of which only M/s PQR Co., owned by Ramanadh's father-in-law, manufactures one type. He presents his design in such a way that the order can be placed only to the latter company.

2. Potential Conflicts of Interest

They arise when there are no preset outside interests for the engineer as illustrated above, but still he is generally motivated by gifts or bribes to influence his professional judgment. This is called *potential* since the judgment is based on the receipt of the bribe. We have already seen in Chapter 6, how to distinguish between a gift and a bribe. An old friend suddenly turning out to be a supplier and then if your decision to place purchase orders is influenced by this then too it can be a potential conflict of interest. Several professional associations have spelt clearly the act of accepting bribes in their ethical codes. Some of them are cited in the subsequent paragraphs.

Potential conflicts of interest can also be caused by the following situation.

When an engineer, especially as a consultant, is paid on the length or the cost of the project, say design project or turnkey construction project, and if he is given no incentive to cut down the costs, an unethical engineer would try to inflate the cost to get more commission or remuneration, which may generally be a percentage of the cost.

3. Apparent Conflicts of Interest

These may happen when the engineer's professional judgment is fully ethical but the public has already formed a negative opinion about him in view of certain developments. This is illustrated in the following paragraph. Apparent conflict of interest decreases the confidence of the public in the objectivity and trustfulness of the professional services.

In the above illustration, Ramanadh gets divorced from his wife. But still as he believes that the bolts manufactured by his ex-father-in-law are the best in the market, he specifies them even though he does not like the order to go to them. The boss of Ramanadh accuses him of conflict of interest, without knowing that he was divorced.

16.3 MOONLIGHTING

Moonlighting is another situation that may cause the first type, that is the actual conflict of interest. Moonlighting refers to a person working in another company apart form his parent company. The second one may be on part-time during the evenings. The fact that the person returns home from his second employment during late-night hours, it is called moonlighting. This is very common in teachers or professional engineers teaching in institutions conducting evening courses, and sometimes in other companies as part time accountants, auditors, etc. This type of moonlighting is not immoral as long as the part-time function does not involve in working with competitors or in tasks that are detrimental to the full-time employer. It is also said that moonlighting makes a person exhausted, in general, and he may not perform his full-time job efficiently.

16.4 CORPORATE CONFLICTS OF INTEREST

An interesting case is recorded by the *Journal Materials* evaluation of USA as early as July 1964.

> *Today it is not uncommon for an otherwise reputable company to request a test equipment manufacturer to invest time and money for preliminary designs and estimates implying that the test equipment manufacturer would be awarded the orders after necessary changes and fair price fixation. Nevertheless, they find that the company deliberately hands over the designs and suggestions to a competitor who can supply them at lower prices because they need not spend anything on the design and development costs.*
>
> *(Source: "Productivity" Journal of NPC, of 1964)*

16.5 CODES OF ETHICS ON CONFLICTS OF INTEREST

Several professional associations have specified clearly in their codes of ethics forbidding the act of accepting bribes. Some of them are cited below.

Institution of Engineers (India) *A corporate member shall not accept any unauthorized commission, discount, allowance or profit, directly* *or indirectly, in connection with any work under his charge or for any professional business undertaken by him.*

Indian Institute of Materials Management *To subscribe and work for honesty and truth in buying and selling, to denounce all forms of manifestations and commercial bribery and to eschew unsocial practices.*

Institute of Electrical and Electronic Engineers *We, the members of IEEE, do hereby commit ourselves to the highest ethical and professional conduct and agree to reject bribery in all its forms.*

National Society of Professional Engineers

- *Engineers shall not be influenced in their professional duties by conflicting interests.*
- *Engineers shall not accept commissions or allowances, directly or indirectly, from contractors or other parties, dealing with the client or employers in connection with the work for which the engineer is responsible.*
- *Engineers shall disclose all known or potential conflicts of interest to their employer or clients by promptly informing them of any business association, interest, or other circumstances which could influence or appear to influence their judgment or the quality.*

16.6 POINTS TO BE KEPT IN MIND

In considering the prohibitions and conflicts of interest, the following points shall be kept in mind:

1. A conflict of interest is like dirt in a sensitive gage. It not only spoils one's personal career but also taints the profession. So all professional engineers must be ever alert for signs of conflicts of interest. There have been several cases that show how easily individuals, companies, and even professional societies can find themselves in expensive legal battles.
2. The extent of the conflict of interest varies from case to case. Professional conflicts of interests should be distinguished from personal ones, which do not form ethical issues. An engineer may like tennis and swimming and cannot decide which interest is more important to him. This does not involve a conflict that is likely to influence professional judgment and ethics.

3. The interests of the client, employer, and public are restricted to those that are morally legitimate. If the employer or the client has fraudulent or anti-society interests then the engineer has no professional duty to protect such interests. On the other hand, he has a duty to blow the whistle to external authorities.
4. We must distinguish between the three types of conflicts, as stated above—the actual, potential and apparent—and then decide on the extent or severity. In case of the apparent conflict, the engineer should reveal its existence much before the public or the customer find out about it on his or her own and misinterpret it as illustrated above.
5. Even though, it is best to avoid conflicts of interests, because conflicts of interests threaten the fulfillment of one's professional duties.

16.7 ON THE LIGHTER SIDE

> A conflict of interest arises when your undertaker is also your life insurance agent.

Question Bank

PART A

(Each question carries 2 marks which you are expected to answer in 3 minutes.)

1. What is a conflict of interest?
2. Distinguish between an actual and potential conflict of interest.
3. What is moonlighting?
4. Why does receiving bribes cause conflicts of interest?
5. Why should you inform your boss about the existence of any conflicts of interest?

PART B

(These are mostly 8-mark questions to be answered in 12 minutes, presuming that the time allotted for a 100-mark question paper is 3 hours. Some times the same question may be asked as a 16-mark question to be answered in 25 minutes.)

1. Discuss the situations under which conflicts of interest occur.

2. Discuss the three types of conflicts of interest.
3. Illustrate some of the codes drawn by professional associations with reference to conflicts of interest.
4. Discuss the points to be kept in mind while determining the extent of the conflicts of interest

PART C

(Objective-type Questions)

1. Fill in the blanks:

(i) A ______________ occurs when an employee has invested in a competitor's company. (conflict of interest/moonlighting)

(ii) Teachers or professional engineers teaching in institutions conducting evening courses constitutes _______________ (conflict of interest/moonlighting)

2. Answer if the following statements are true or false:

(i) The conflict of interest is a major contributor for moral dilemmas faced by an engineer.

(ii) A conflict of interest occurs when the employee pursues an interest other than his regular employment.

(iii) Moonlighting does not always cause conflicts of interest.

(iv) Engineers should not be influenced in their professional duties by conflicting interests.

17

Occupational Crimes

- What is a Crime?
- Occupational Crimes
- Nature of White-collar Criminals
- Why do they Commit Crimes?
- Nature of Organizations Committing Organizational Crimes
- Case Studies in White Collared Crimes

Any professional associated with an organization either on full-time or part-time basis has substantial exposure and opportunities to commit occupational crimes. In this context, this chapter explains the various forms of crimes and creates awareness for the professional to apply ethical codes in shunning these crimes.

Keywords: *Professional crimes, victimless crimes, hate crimes, white-collared crimes, petty thievery, industrial espionage, price fixing, embezzlement, reverse engineering, computer crimes, international crimes.*

17.1 WHAT IS A CRIME?

A crime is defined as an illegal act for which one may be punished. There are several types of crimes.

Domestic crimes are non-accidental deliberate crimes done by the members of a family, like children thieving cash from cupboards, brothers cheating one another in case of property distribution, sibling feuds resulting in murder, etc.

Professional crimes under unlawful employment also called street crimes or blue-collared crimes, like that of robbers, kidnappers, thieves, pickpockets, etc.

Professional crimes under lawful employment also called occupational crimes, described more in detail below.

Victimless crimes like persons committing crimes on themselves like suicides, or deliberate attempt on body infliction for manipulation of car accidents for wrongful claims of insurance.

Hate crimes like communal clashes, racial disturbance, resulting in arson and damage to public property.

Computer crimes detailed more in Chapter 22.

17.2 OCCUPATIONAL CRIMES

Occupational crimes are the illegal actions committed by employees of an organization taking advantage of their lawful employment. It is a violation of the rules of the company. They are motivated by personal greed, corporate ambitions, egoism, misguided company loyalty, and more prominently by corruption. They are also called white-collared crimes since they are generally carried out by office workers and professionals, There can be several forms of occupational crimes.

1. Petty Thievery

The management of a large manufacturing organization in Bombay wanted to have a photograph of all their 1000 plus employees in a single glimpse for releasing a publicity advertisement. As there was no time to inform the employees, the exit gates were closed just as the closing siren rang, to collect a large group near the exit. When the workers gathered at the gate, they did not know the reason for the gate closure, and there *was a rumor that there would be an intensive individual security check. When the group dispersed after half an hour, the management and the security were shocked to find a treasure of small items and tools like screw drivers, pliers and spanners around the crevices and corners near the exit gate.*

Obviously, the employees thought the gates were closed for individual check and dropped whatever they had in their pockets. This is an indication of how much large organizations are losing everyday by petty thievery. The action may either be deliberate or unwittingly done due to kleptomania. Such thievery is done not only by blue-collared workers but also by white-collared workers like office staff, who carry away small stationery items.

2. Industrial Espionage

Industrial espionage means industrial spying. This is also called workplace crime. An individual or a group illegally uses their professional capacity for getting something of value. This crime is mostly done at the instant of some outsider, trying to get some secret information from the company by bribing and using illegal services of few employees who have access to those confidential files. Nowadays, such espionage has become easier due to the easy availability of floppies, CDs and even computer chips, etc., because of their small size compared to the information stored in them. By nature, the computer chips are very small and can be carried off easily. These crimes can also be done by physically passing on certain products or designs for easy duplication by competitors. Employees of the original company involved in these activities may pass on the information through agents.

3. Price Fixing

Any standard-sized company makes several lakhs of purchases at any time. Each of the items purchased may have more than one supplier, and each may quote their own prices which may differ from each other by over 20%. Some persons responsible for purchases may take advantage of this and enter into an immoral agreement with any one of the suppliers letting him quote a price much higher than his actual price but lower than the highest price and recommend this supplier for the purchase. After the supplier collects the payment from the company, he may pay a commission to the person as per the secret deal. This crime of price fixing may be controlled to some extent.

- If sealed tenders are invited and they are opened in the presence of other suppliers.

- When the purchase analysis and recommendation is done by a committee of two or more middle-level or higher-level officers of different departments.
- More reliable and trustworthy officers are given the charge of purchasing.
- Senior management is vigilant and checks the procedures constantly.
- Audit of accounts and purchase procedures is more meticulous and sincere.

4. Embezzlement or Manipulation of Accounts

Officers in charge of the finances of the company have the opportunity to commit such a crime. Unless the employer takes sufficient interest and effort to check the accounts regularly and question each suspicious-looking expenditure, this type of manipulation would continue. A perfect auditing system would expose such embezzlements.

5. Bootlegging

Bootlegging is making, transporting, or selling something which is illegal or not authorized. It also means working on unauthorized projects, may be for profit, or selling to a client or some other group.

6. Reverse Engineering

The development of computer chips is extremely competitive and fast moving. The products are often outdated within two years because of the introduction of new chips. Profits can be made in months depending upon the development of new products.

However, the manufacture of computer chips is very expensive and hence the reverse engineering is adapted. The competitor's product is identified and purchased from the open market. Then it is broken down physically or mentally or by tests to identify the circuit diagrams and other components. The details of the manufacturing process and technical specifications are developed and designed accordingly. This process may be immoral but not illegal unless the duplicated product is given the original brand name and the patent rights are violated. However, some industries, in order to avoid even the cost and labor of this reverse engineering, simply try to procure the designs of leading industries by illegal and criminal means as detailed above.

7. Cyber Crimes

Cyber crimes are computer-related crimes. While the general computer crimes are indicated in Chapter 26 on Computer Ethics, this case study as reported in the newspapers of 22 June 2005, is illustrated to highlight the criminal nature:

> *The Cyber Crime wing of the Central Crime Branch police arrested a 28-year-old engineer on Monday on charges of stealing a software design used for setting up telecommunication towers. According to the police, the arrested person joined an Indo-Belgian company supplying software designs for setting up telecommunication towers. During his one-year service, the engineer was entrusted with the work of processing and development work of plug-in tools and scripts for a particular program. After resigning from the company the engineer sent e-mail to a company abroad that he had developed a software design that could be used to automate the drawing work. Cases under sections 66 of the IT Act (hacking) and 408 (breach of trust) were booked against him.*

8. Organizational Crimes

When the above-mentioned crimes are committed by not one single person or a group, but by the owner himself through his organization, it is called organizational crime. A majority of these crimes are for evading taxes or for wrong claim of insurance.

Many a times some organizations deliberately take immoral decisions in matters relating to safety of public whether to gain profits or to satisfy their ego. The Challenger crash is a typical illustration.

Other types of organizational crimes committed in recent times by chit fund companies are offering high interest rates and all of a sudden closing their offices to abscond with the deposit money. Similar is the case with some manpower recruitment companies who collect deposits from unsuspecting job hunters. Case studies from Chennai City Police that appeared in newspapers is discussed below in Section 17.6.

9. International Crimes Committed by Nations

During the eighties, the United States Army made several attempts to dump their nuclear waste in the Pacific Ocean. The Green Peace Movement opposed these attempts but for which a majority of the population in the neighborhood of Pacific Ocean would have perished or would have had permanent disabilities. Even the case of the United States trying to destroy Iraq in the guise of exterminating Saddam Hussein and his followers is another example of international crime.

A survey conducted by AP Ipsos reported that 53% of Americans said the Iraq war was a mistake and disapproved Bush's administration in the conduct of war. The World Tribunal on Iraq (WTI) had in June 2005 declared US President George Bush and British Prime Minister Tony Blair as guilty and recommended an exhaustive investigation of those responsible for crimes of aggression and crimes against humanity in Iraq. (vide newspaper report of 28th June 2005)

The above are illustrations of international crimes, when one or few individual countries try to commit crimes on a foreign land. However, we can also cite some contrasting illustrations which exhibit international cooperation.

A Russian submarine which got entangled in a steel net at 190 meters below the sea off Kamatchaka peninsula in August 2005 was resurfaced by the British Royal Navy's Scorpio submersible robot which cut open the steel mesh with heavy-duty drills and rescued all the crew. Surprisingly, the steel mesh had been a part of the undersea coastal surveillance antenna system. The figures below show how the submarine got entangled and a view of the Scorpio underwater robot.

17.3 NATURE OF WHITE-COLLAR CRIMINALS

- They are people without firm ethical principles.
- They are physically normal.
- They usually have medium and high levels of education.
- They come from non-criminal family backgrounds.
- They have no involvement in street crimes, not even addiction to drugs or alcohol.
- They generally have a trouble-free childhood and student career.
- Most offenders generally prefer to work alone unless when cooperation is needed.

17.4 WHY DO THEY COMMIT CRIMES?

(a) Though the impact of the crime to the society in general is high, the cost to the criminal is low.

(b) Lack of accountability.

(c) The employees involved in leakage of secrets or pilferage of chips, etc., may not do transfer directly but sell through some agents.

(d) They assume that the probability of discovery is low. For example, in the US, though 30000 cases of white-collared crimes are reported annually, only 10% of these get convicted and still a smaller number go to jail. In comparison, over 80% of the blue-collared criminals go to jail.

(e) They presume that even if discovered, the loopholes in the law shall protect them.

(f) Even if convicted, the punishment is low compared to the gains in the crime.

(g) Protection to offenders from politicians.

(h) Those responsible, or the criminal justice and the police, are afraid to enforce the law due to the status of the offender.

(i) Corruption and bribery.

17.5 NATURE OF ORGANIZATIONS COMMITTING ORGANIZATIONAL CRIMES

- Firms with declining profitability
- Firms in a highly regulated and volatile markets
- Loopholes in Government regulations

17.6 CASE STUDIES IN WHITE-COLLARED CRIMES

1. White-collared Crimes in Chennai

White-collared crimes in Chennai, including job rackets and forging of credit cards, are keeping the Greater Chennai city Police busy.

If crimes need general investigation skills, white-collared offences call for special talent among crimebusters. With the spurt of white-collared crimes, be it job rackets, falsification of documents, forging of credit cards or any other con jobs, investigators and top police administrators have now started gearing up the police machinery to trace the challenge.

Earlier, an Assistant Commissioner ranked officer was entrusted with the investigation of the offences randomly; the city police have now reorganized the Central Crime Branch set-up by allocating specific subjects to each of four

Assistant Commissioners. Each Assistant Commissioner has teams headed by Inspectors of Police. The four ACPs are the following:

- *The first Assistant Commissioner has 5 teams reporting to him and investigating into the routine cases like cheating, narcotics offences, etc.*
- *The second Assistant Commissioner has been entrusted with investigations related to forgery, counterfeit, and video piracy.*
- *The third Assistant Commissioner deals with cases relating to usury and credit card related offences.*
- *The fourth Assistant Commissioner has been posted to head a 'Cyber Cell' to deal with cyber crimes, banking complaints, and job racket.*

Training for the police force: *A four-module training, investigation of specialized offences, bodily offences, white-collared offences and crimes related to Information Technology Act and Immoral Trafficking Act, is provided to the personnel at the Police Training College before they join the special units.*

An illustration of the above is the recent recovery of ₹2 crore from a private manpower agency that promised overseas jobs to people after collecting 'deposits'. When the case was referred to the police, the team arrested the kingpin behind the operations and recovered the entire hard cash collected and returned the money to the victims (based on a news item dated 7 May, 2005).

2. White Collared Crimes in Industry

Another case study reports that the computer industries located in an industrial estate are engaged in the production of integrated-circuits microprocessors or computer chips. This area has a large number of creative engineers and entrepreneurs, but is infested with a large number of industrial espionage. The reasons for this can be listed as follows:

- The development of computer chips is extremely competitive and fast moving.
- The products are often outdated within two years because of the introduction of new chips.
- Profits can be made in months depending upon the development of new products.

- Manufacture of computer chips is very expensive.
- Some duplicators adapt reverse engineering, which may be immoral but not illegal as discussed earlier.
- But some duplicators follow the easy method in order to avoid even the cost and labor of this reverse engineering. They simply try to procure the designs of leading industries by illegal and criminal means by bribing some internal employees.

Question Bank

PART A

(Each question carries 2 marks which you are expected to answer in 3 minutes.)

1. What is a crime? Illustrate the several types of crimes.
2. What is an occupational crime? Why is it known as a white-collared crime?
3. Distinguish between price fixing and account embezzlement.
4. Illustrate petty thievery. Who is a kleptomaniac?
5. Why are computer components subjected to petty thievery?
6. What is bootlegging?

PART B

(These are mostly 8-mark questions to be answered in 12 minutes, presuming that the time allotted for a 100-mark question paper is 3 hours. Sometimes the same question may be asked as a 16-mark question to be answered in 25 minutes.)

1. Discuss the several types of occupational crimes.
2. Discuss and illustrate organizational crimes and international crimes.
3. Analyze why individuals and organizations commit white-collared crimes.

PART C

(Objective-type Questions)

1. Fill in the blanks:

(i) Making your own friend work in your competitor's company and stealing secrets through him is called ______________

(ii) The Green Peace Movement ___________ (opposed/encouraged) dumping of nuclear waste mid-ocean.

(iii) The World Tribunal on Iraq declared US and UK as _________ (heroes/guilty) of Iraq War..

2. Answer if the following statements are true or false:

1. One of the ways to prevent price fixing is to invite sealed tenders and open them in the presence of the tenderers.

2. Auditing of accounts has no possibility of identifying financial embezzlements.

3. Milling machines can be pinched by petty thievery.

3. ***(a) Match the following:***

(i)	Domestic crimes	: Phishing
(ii)	Lawful employment crimes	: Riots
(iii)	Unlawful employment crimes	: Price fixing
(iv)	Victimless crimes	: Inflated insurance claims
(v)	Hate crimes	: Kidnapping
(vi)	Computer crimes	: Sibling feuds

(b) Match the following:

(i)	Petty thievery	: Manufacture of spurious goods
(ii)	Industrial espionage	: Mafia operations
(iii)	Price fixing	: Pinching
(iv)	Embezzlement	: Getting secret information
(v)	Reverse engineering	: Manipulating accounts
(vi)	Organizational crimes	: Kickbacks

18

Whistleblowing

- Introduction
- Whistleblowing—Other Definitions
- Internal vs External Whistleblowing
- Open and Anonymous Whistleblowing
- The Six Elements of Whistleblowing
- When should Whistleblowing be Attempted?
- When is it Ethical to Whistleblow?
- Guidelines for Ethical Whistleblowing
- Whistleblowing Situations
- Whistleblowing vs Currying Favor
- Protecting Whistleblowers
- How Corporations can Prevent Unwanted Whistleblowing
- The Indian Scenario for Whistleblowing
- On the Lighter Side of Whistleblowing
- Further Reference

Whistleblowing is an accepted and protected form of informing the superiors of any immoral or dangerous action that is taking place. This chapter shows whistleblowing in a new light. It dispels the popular public concept that links whistleblowing to currying favor. Major landmarks like National Whistleblowing Centre, Sarbanes Oxley Act, special reports by British Computer Society, Birmingham City Council, etc., are cited. Special references are given to the websites available on this topic.

Keywords: *Whistleblowing, National Whistleblowing Centre, currying favor, ethical whistleblowing, topic, agent, recipient, Whistleblowing Policy Document, Sarbanes Oxley Act, protecting whistle blowers.*

18.1 INTRODUCTION

Whistleblowing occurs when an employee or former employee conveys information about a significant moral problem outside approved organizational channels (or against strong pressure) to someone who is in a position to take action on the problem. For ages, this process was treated with disdain, perceiving that it is done only due to jealousy or currying favor nature of the informer, and as an act of infringement into the private lives of the misdoers, even though such misdoing adversely effects the organization or other public. In recent times, however, the good effects of such whistleblowing have created global awareness that whistleblowing is indeed a significant and positive process of Professional Ethics and must be encouraged instead of penalizing. In UK, USA, and most European countries, professional bodies under the patronage of the Government have been promoted like PCAW (Public Concern at Work) in UK and the National Whistleblowing Center of USA. These, together with the British Computer Society, Birmingham City Council, etc., have submitted reports running to several pages detailing the legal protection required for ethical whistleblowers. A notable promotion of this whistleblowing is the Sarbanes Oxley Act (SOX) of 2002 of USA (recognized by the US Department of Labor) where several clauses for the legal protection for corporate whistleblowers has been formed, including prevention against wrongful termination or discrimination in employment for whistleblowers. In India, this level of awareness and legal protection is yet to be realized. Under this scenario, this chapter discusses the several aspects of whistleblowing and tries to distinguish ethical whistleblowing from currying favor. It is hoped that Indian industry and society also recognizes and promotes the positive aspects of whistleblowing as is done elsewhere.

The principle of whistleblowing is reflected as one of the oaths suggested by this author to be administered on young engineering graduates (vide annexure).

'I will speak out against evil and unjust practices whenever and wherever I encounter it.'

18.2 WHISTLEBLOWING—OTHER DEFINITIONS

Whistleblowing is the exposure of fraud and abuse by an employee *(The Columbia Encyclopaedia—2001)*

A *whistleblower* is a person who takes a concern, such as a concern about safety, financial fraud, or mistreatment of (research animals, etc.) and complains it outside the organisation in which the abuse is occurring and with which the whistleblower is affiliated (*Glossary of ethical terms—Online ethics centre).*

18.3 INTERNAL VS EXTERNAL WHISTLEBLOWING

Whistleblowing can either be

Internal Like an employee or a former employee or a person attached closely with the organisation, or

Internal (Cross) Involving employees informing outside agencies directly about the immoral acts that are taking place in their organisation, or

External Like outsiders, generally the journalists, politicians, and consumer groups, by publishing articles or informing regulatory agencies. They may get the information through the internal (cross) whistleblowers or through their own investigation about the immoral acts that are taking place in an organisation.

Internal whistleblowing can be through proper channel like informing the immediate boss who reports to his boss, the information reaching the top person by such hierarchy. But more common is to blow the whistle directly to the chief executive bypassing the immediate bosses.

18.4 OPEN AND ANONYMOUS WHISTLEBLOWING

- In *open whistleblowing*, individuals openly reveal their identity as they convey the information.
- In *anonymous whistleblowing*, by contrast, they conceal their identity.
- *Partly open and partly anonymous* are overlapping cases such as when individuals acknowledge their identities to a journalist but insist their names be withheld from anyone else.
- In *public interest whistleblowing*, the agent's public interest overrides the interest of the organisation he serves, and he publicly "blows the whistle" if the organisation is involved in corrupt, illegal, fraudulent, or harmful activity.

18.5 THE SIX ELEMENTS OF WHISTLEBLOWING

1. Disclosure The act of blowing the whistle

2. Topic *A* significant moral problem for the organisation like
- — criminal behaviour
- — unethical policies or practices
- — injustices to workers within the organisation
- — serious threats to public safety and well-being

3. Agent Internal or external whistleblower

4. Recipient A person or organisation in a position to act on the problem

5. Investigation The process of consulting with associates or other colleagues to discuss and investigate into the allegation

6. Action Action taken if the above found to be correct and serious

18.6 WHEN SHOULD WHISTLEBLOWING BE ATTEMPTED?

1. When you have the need,
2. When you have full knowledge of the situation,
3. When you are in the proximity,
4. When you have the capability to attract attention,
5. When you have the clear definition of targets, and
6. When you think it is a last resort.

18.7 WHEN IS IT ETHICAL TO WHISTLEBLOW?

1. If the harm that will be done by the product to the public is serious and considerable.
2. If they make their concerns known to their superiors.
3. If getting no satisfaction from their immediate superiors, they exhaust the channels available within the corporation, including going to the board of directors.
4. In order for the whistleblowing to be morally obligatory, however, De George gives two further conditions.
   - He must have documented evidence that would convince a reasonable, impartial observer that his view of the situation is correct and the company policy wrong.

- There must be strong evidence that making the information public will in fact prevent the threatened serious harm.

5. When he is sure that blowing the whistle openly could result not only in the loss of one's job but also in being blacklisted within the profession.

18.8 GUIDELINES FOR ETHICAL WHISTLEBLOWING

1. Follow normal organizational channels except for extremely rare emergencies.
2. Get to know both the formal and informal rules for making appeals within the organization.
3. Be prompt in expressing objections. Waiting too long may create the appearance of plotting for your advantage and seeking to embarrass a supervisor.
4. Proceed in a tactful, low-key manner.
5. Be considerate of the feelings of others involved.
6. Always keep focused on the issues themselves avoiding any personal criticisms that might create antagonism and deflect attention from solving those issues.
7. As much as possible, keep supervisors informed of your actions, through informal discussion or formal memorandums.
8. Be accurate in your observations and claims, and keep formal records documenting relevant events.
9. Consult colleagues for advice—avoid isolation.
10. Before going outside the organization, consult the ethics committee of your professional society.
11. Consult a lawyer concerning potential legal liabilities.

18.9 WHISTLEBLOWING SITUATIONS

The Birmingham City Council, in its Whistleblowing Policy Document, had cited the following situations when whistleblowing could be attempted.

1. A criminal offence like fraud, corruption, or theft has been or is likely to be committed
2. A miscarriage of justice has been or is likely to occur
3. The health or safety of any individual has been or is likely to be endangered
4. The environment has been or is to be damaged

5. Public funds are being used in an unauthorized manner
6. The council's constitution, including standing orders, financial regulations, etc., are not being observed or being breached by the members and/or officers
7. Sexual or physical abuse of any member of staff or service recipient is taking place
8. Discrimination is occurring to any member or service recipient on grounds of sex, race, or disability
9. Any other form of improper action is taking place
10. Information relating to any of the above is being deliberately concealed or attempts are being made to conceal the same

18.10 WHISTLEBLOWING VS CURRYING FAVOR

We had in the introduction distinguished whistleblowing from currying favor. International recognition and legalized protection is given to this former act from this point of view, that is considering whistleblowing as different from the act of currying favor.

In the modern world of cut-throat competition of advancement of individuals, it cannot be denied that some people use this platform of whistleblowing unethically with the sole purpose of winning the favor of the boss by talking ill of another. The latter act is called *currying favor*.

It is, hence, the explicit duty of the boss to distinguish this attitude by independently inquiring into the issue and draw his own conclusion with fair judgment.

Very obviously, the boss should discuss this issue directly with the affected person and find out the extent of truth or exaggeration made by the whistleblower.

It is repeated here that the boss, under no circumstances, shall be guided by the whistleblower, unless he discusses it with the affected person.

18.11 PROTECTING WHISTLEBLOWERS

Whistleblowing, as distinct from currying favour, is lonely, unrewarded, and has a risk of retaliation which is difficult and expensive. But the vital service to the public provided by genuine whistleblowers has led increasingly to public awareness of a need to protect them against retaliation by employers.

- Federal laws related to environmental protection and safety
- False Claim Act of 1863 revised in 1986 to give more leverage to ethical whistleblowers
- Whistleblowing Policy drawn by Birmingham City Council
- Setting up of an exclusive Body, the National Whistleblowing Centre in USA
- Encouraging every corporate to set up an ethics department with the sole purpose of creating an awareness among the employees and promoting genuine whistleblowing
- The Civil Service Reform Act of 1978
- Those covering coalmine safety
- Control of water and air pollution
- Disposal laws for toxic substances
- Occupational Safety and Health Association (OSHA)
- Statutes forbidding firing or harassing of whistleblowers in the private sector
- Role played by professional societies
- Publishing in professional journals, the names of companies who take unjust reprisals against whistleblowers

The British Computer Society's Ethics Expert Panel submitted a 10-page report on Whistleblowing. The IEEE has established awards and other forms of honorary recognition for whistleblowers who act according to its ethical code).

18.12 HOW CORPORATIONS CAN PREVENT UNWANTED WHISTLEBLOWING

1. A strong corporate ethic structure,
2. Defined commitment to ethical behaviour right from top to bottom
3. Clear lines of communication
4. Openness and transparency of rules understood by all employees
5. Empowerment given to the employees
6. All employees having meaningful access to the top management
7. Rewarding of really eye opening whistleblowing
8. A sense of job security
9. Willingness of management to admit mistakes
10. High employee morale

18.13 THE INDIAN SCENARIO FOR WHISTLEBLOWING

During the several lectures addressed by this author on whistleblowing at technical meetings of several professional associations, the general response from the members was positive and wished for a greater awareness of this vital ethical process in the Indian corporate sector.

> *It is interesting to note that the Reserve Bank of India had announced on 25 January 2006, a scheme for protection of whistleblowers in all private-sector banks and foreign banks. It asked the Board of Directors of these banks to frame a 'Protected Disclosure Scheme' laying down norms for protection of identity of employees making disclosures of wrongdoing and safeguarding them from any adverse personnel action. Under this scheme, employees of the banks concerned, customers, stakeholders and non-government organizations can lodge complaints. However, anonymous or pseudonymous complaints will not be entertained under this scheme.*

18.14 ON THE LIGHTER SIDE OF WHISTLEBLOWING

The manager and his assistant are inspecting a lot of whistles just received.
The Assistant says "You were robbed. None of these whistles work!"
The manager replies "I know. I bought them for the whistleblowers in our company."

18.15 FURTHER REFERENCE

In view of the interesting and ethical nature of the concept of whistleblowing, and since this concept is not fully understood or appreciated in India, readers are advised to look for further reference to the following books, papers, and websites.

1. *Ethics in Engineering* by Mike Martin and Roland Schinzinger, McGraw Hill, 1966
2. *Engineering Ethics* by Charles Fledderman, Prentice Hall, 1999
3. *How Could You Do That* by Laura Schlesinger, Harper Collins, 1996

4. *Whistleblowing*, a PP presentation by Prof. D.R. Kiran to the teaching staff of GKM CET, Nov. 2004. Also to the members of IIPE in April 2005
5. *On Line Ethics Center—Glossary of Ethical Terms* (from www.onlineethicas.org)
6. *Whistleblowing—The Columbia Encyclopedia*, 6th Ed., 2001 (from www.bartleby.com)
7. *National Whistleblowing Center*—full website—(from www.whistleblower.org)
8. *Whistleblowing* (from www.discriminationattorney.com)
9. *Environmental Whistleblowing* (from www.csmonitor.com)
10. *Whistleblowing*, *International Association of Lawyers against Nuclear Arms (IALANA)* (from www.ialana.org)
11. *Whistleblowing Policy of Birmingham City Council* (7 pages) (from www.birmingham.gov.uk)
12. *Whistleblowing Report* by Ethics Expert Panel of British Computer Society (13 pages) (from www.bcs.org)
13. *The Sorbanes Oxley Act (SOX)—Legal Protection for Corporate Whistleblowers* by Stephen M. Kohn (from www.whistleblowers.org)
14. *Whistleblowing Said to be a Factor in FBI Firing* by Eric Lichbau, Washington, July 2004 (from www.nytimes.com)

Question Bank

PART A

(Each question carries 2 marks which you are expected to answer in 3 minutes.)

1. What is the significance of whistleblowing?
2. Define ‘whistleblower’.
3. Distinguish between internal and external whistlebowing.
4. Distinguish between open and unanimous whistleblowing.
5. Explain the six elements of whistleblowing.
6. Illustrate the statement ‘*Attempt whistleblowing only when you feel it is the last resort*’.
7. State some of the situations when whistleblowing may be resorted to.
8. What is the role of professional associations in protecting genuine whistleblowers?
9. What is SOX?

PART B

(*These are mostly 8-mark questions to be answered in 12 minutes, presuming that the time allotted for a 100-mark question paper is 3 hours. Sometimes the same question may be asked as a 16-mark question to be answered in 25 minutes.)*

1. Explain the guidelines for ethical whistleblowing.
2. What is currying favor? Explain how you distinguish it from ethical whistleblowing, emphasizing the role of the recipient.
3. Discuss how corporations can prevent unwanted whistleblowing in their organizations.
4. Examine the following illustration and see if it is the right situation for whistleblowing.

   A young engineer felt that the level of pollutants pouring into the nearby stream from his factory were dangerously high, considering the fact that children were swimming down the stream. On informing this to his boss, he was told that his fears were baseless as there had been no complaint from any quarter in the past. What should the engineer do at this stage?

PART C

(Objective-type Questions)

1. Fill in the blanks:

(i) National Whistleblowing Centre was set up in ______ (US/UK /India/Germany)

(ii) Whistling : whistleblowing :: attracting attention : ________________

(iii) The person who blows the whistle is called the ______ of the disclosure.

2. Answer if the following statements are true or false:

(i) Whistleblowing is abetting a person who does a fraud.

(ii) You should blow the whistle only after ascertaining yourself fully about the act.

(iii) Unethical whistleblowing is done with an intention of currying favor.

(iv) High employee morale results in more cases of whistleblowing.

19

Discrimination and Harassment

- Discrimination
- Reasons for Discrimination
- Instances of Discrimination
- Preferential Treatment
- Sex Discrimination
- Discrimination Based on Marriage
- Age Discrimination
- Wrongful Termination
- Sexual Harassment
- Quid-pro-quo Tactics
- Sexual Harassment From Point of View of Ethical Theories
- Legal Protection Against Discrimination

Discrimination and harassment of employees has been a major social evil leading to low employee morale, both in the corporate and the academic sectors. This chapter discusses the various forms and effects of discrimination and harassment and also the legal protection provided for such evils.

Keywords: *Discrimination, an equal-opportunity employer, ill treatment, sex discrimination, age discrimination, Federal ADE Act, weak preferential treatment, strong preferential treatment, BPOs, disparate treatment, disparate impact, wrongful termination, sexual harassment, quid-pro-quo tactics, Sarbanes Oxley Act.*

19.1 DISCRIMINATION

Discrimination is defined as making unfair and morally unjustified differentiation in one's treatment to people. The term 'discrimination' is somewhat an antonym to the word *impartiality*. Discrimination may be based on

- Gender
- Age
- Race
- Religion
- Nationality
- Language
- Community
- Disability
- Other factors

19.2 REASONS FOR DISCRIMINATION

The reasons for discrimination are generally due to

- Individual bias
- Personal grudge
- Outside relationship
- Family feuds
- Whistleblowing by the subordinates
- Pressure from outside
- Other factors

19.3 INSTANCES OF DISCRIMINATION

Discrimination may exist either in selection of an employee during recruitment process or in fixing up the salary. Even after the employee joins the company, the discrimination may continue by way of ill-treating him in comparison to others in his day-to-day working.

Discrimination reduces the morale and kills the initiativeness and creativity of the employee and also gives a bad reputation to the company. If one manager is known to be discriminative, everyone looks at the whole company in suspicion. That is the reason why several companies nowadays add '*An equal-opportunity employer*' in their advertisements for job recruitment.

The following instances can be cited as discriminative behavior:

- During job interviews, selecting candidates only from a certain gender, community, or race
- Fixing different salary structures or perquisites of employees based on their community
- Fixing lesser salary for women employees selected under the same job specifications
- Provision of differential work atmosphere
- Wrongful termination
- Sexual harassment
- Ill-treatment during the work
- Being harsh to one person in contrast to being kind to others
- Belittling a subordinate in front of others
- Not passing the leave applications or medical bills of a particular subordinate
- Dismissing employees who are at the verge of their retirement
- When the company is forced to reduce the number of staff due to economic reasons, selecting only those from specific communities or gender for dismissal

In September 2006, a news item on class discrimination appeared in an Indian newspapers, as summarized below:

> *In Brazil, there was an international conference in August 2006 on the impact of privatization on wastepickers worldwide. Chintan, a Delhi-based NGO, sponsored one of the ragpickers for the same. As economy-class tickets were not available, they were generous enough to buy a business-class ticket for him. His tickets, visa, passport, and other documents were perfect and valid, but while checking in, the Indian officials of the foreign airlines prevented him from boarding saying that he could not board the business class just because he did not look like a businessman. They refused to listen to his plea of checking up with the NGO, but simply forced him out at that odd hour.*

19.4 PREFERENTIAL TREATMENT

In between the two extreme cases of discrimination and partiality, there can be a socially acceptable form of preferential treatment, especially given to minorities and women and other categories described in Section 19.1. There can be two kinds of preferential treatment.

Weak Preferential Treatment When preference is given to the members of traditionally discriminated people, including women and minority groups, against other persons who are equally qualified.

Strong Preferential Treatment When preference is given to the members of traditionally discriminated people, including women and minority group applicants against better qualified applicants from other groups.

Arguments in Favor of Strong Preferential Treatment

- Preference can be given to the underprivileged now, as long as they are not treated by the society equally. This was propounded by Dr. Babasaheb Ambedkar during the early days of the Indian Constitution to provide reservations to underprivileged people, till they come up in their social living status.

Arguments Against Strong Preferential Treatment

- The equal-opportunity concept is defeated. This is also against the rights and utilitarian ethics discussed in the earlier chapters.
- This reservation principle tends to continue even beyond the expressed time limit and after the socially underprivileged persons ascend to the social and financial status of the privileged.
- The benefits of the reservation could be misused when even those who are socially and economically elite, could corner the benefits in view of their community.

19.5 SEX DISCRIMINATION

Sex discrimination is treating an employee or employees differently on the basis of their gender. This may normally be not illegal, but when it effects the terms of condition of employment like pay, position, title, vacation, etc., it becomes illegal.

> *During the 1960s, the airhostesses of Indian Airlines were expected to be unmarried. The moment they got married they had to resign, or face dismissal. Consequently, there were cases when the airhostesses married secretly and underwent a lot of tension in keeping it a secret in office.*

There are two types of sex discrimination.

Disparate Treatment It is straightforward discrimination, treating a person differently just because of his/her gender.

Disparate Impact It is when a certain company policy bars certain types of people from certain categories of jobs, for example, women are not employed for firefighting jobs. But such policy decisions were drawn when no woman preferred such a job in view of its complexity. However today, when women get chosen to undergo firefighter's courses and get qualified, still applying that policy and not employing such qualified women is indeed discriminating. Here, it is not the department that is discriminating, but it is the impact of the policy drawn long ago and which was not optimally job-related.

However, not employing women for jobs requiring night-shift work cannot be termed as discrimination.

> *The demand for business process outsourcing has grown tremendously in the recent years. This job requires night-shift working to suit the working hours of USA corporations and several female engineers have been employed for this without discrimination. Nevertheless, there was at least one incident when a girl employee was raped by one of the drivers of the company's transport. This called for reorientation of the policy of employing women in BPO call centers.*

19.6 DISCRIMINATION BASED ON MARRIAGE

Frequently, women are not employed if they have small children since they have to take care of them. In the early days of airline services, married women were not selected as airhostesses whereas men did not have such bars to be selected as stewards, even though technically marriage has nothing to do with performing such jobs.

19.7 AGE DISCRIMINATION

Normally, discriminating on the basis of age is illegal. Yet there have been cases when the employers refused to select men with equal or higher qualifications and experience just because they were above forty and considered too old. It may be of interest to know that the Federal Government of US has enacted a law called *Federal Age Discrimination in Employment Act (ADEA)*.

Sometimes employers offer a golden handshake with special attractive packages to employees to downsize the staff strength and this is not discrimination, unless the purpose is to get rid of the old people and then replace them with young people. It is also illegal to replace any person over 40 years by a new employee under 40, if age is the reason.

19.8 WRONGFUL TERMINATION

Wrongful termination refers to the case of a person being dismissed when he should not have been. If the dismissal is in violation of the written contract terms then it is a breach of contract and is liable to be sued in a court of law. In India, it is generally the workers' unions that take up the management against such wrongful terminations.

> *The theme of the Hollywood movie* Philadelphia, *starring Tom Hanks and Denzel Washington, provides an interesting case study for wrongful termination. Tom Hanks' employer terminated his services because Hanks contacted AIDS. Tom Hanks sued his employer, since it was illegal to terminate on the basis of AIDS. The employer attested that the termination was only due to his inefficiency in work and had nothing to do with AIDS. He produced witnesses in a court of law to prove his point. By cross examination, Hanks' lawyer Denzel Washington established that the employer congratulated Tom Hanks for his efficient work just before the presence of AIDS was known, thereby proving that the termination of the services was on illegal grounds and so he won the case.*

19.9 SEXUAL HARASSMENT

Continuous annoying and teasing or attacking women on the basis of sexual considerations is called sexual harassment. It can take the forms of threats of penalties, offers of rewards, assaults, and annoyance. It also includes harassment by female superiors on male employees and sexual harassment of employees of the same sex. Some of the following illustrate sexual harassment as cited by Mike Martin et al.

- After an interview for the post of a secretary, a woman candidate is told that she will get the job if she yields sexual favors to the interviewer.
- A woman employee is told by her boss she will be given the first priority in getting a promotion, if she is nice to him and proposes to visit a hotel. When she refuses, she is not given the promotion, but is given less interesting jobs.
- Against her will, a woman is grabbed and kissed by her boss, who asked her to stay late after work hours. When she resists, she is fired the next day.

- A woman turns down her boss's proposal for a date and tells clearly that she is not interested in him. But he continues to repeatedly ask her out.
- The male colleagues of a woman employee leer at her clothing and body and make sexual suggestions.
- A male engineer enjoys telling his secretary about his sex life, disregarding her protests against hearing about it.
- A female boss enjoys touching and caressing her personal secretary, despite the latter's protests and threatens her with dismissal unless she accepts her advances.

19.10 QUID-PRO-QUO TACTICS

Quid-pro-quo is Latin for *'this for that'* or in other words, a trade. This is when the employer makes sex or other advances as a prerequisite to getting something in the workplace, like *'sleep with me and you will get this job'* or *'sleep with me or you are fired'*. When this trade is on the basis of sex, it is illegal.

19.11 SEXUAL HARASSMENT FROM POINT OF VIEW OF ETHICAL THEORIES

- Both the act utilitarian theory of John Stewart Mill and rule utilitarian theory of Richard Brandt emphasize the ill effects sexual harassment would have on the victim's happiness and self-fulfillment, and on women in general.
- Duty ethics theories of Immanuel Kant and Johan Rawls condemn sexual harassment as violating the boss's duty to treat people with respect and dignity and not merely as personal properties for gratification of one's sexual and power interests.
- Rights ethics theories of John Locke and Melden would see it as serious violation of human rights to pursue one's work free from pressures, fears, penalties, and insults that typically accompany sexual harassment.

19.12 LEGAL PROTECTION AGAINST DISCRIMINATION

The Indian Constitution provides enactments like Factory Acts and Labor Laws that control discrimination to some extent. In addition, tribunals have been constituted wherein the affected employees can appeal for justice against discrimination.

In the USA, the following acts are proclaimed:

- Civil Rights Act of 1964
- Age Discrimination in Employment Act of 1967
- The Equal Employment Opportunity Act of 1972
- The Sarbanes Oxley Act of 2002, primarily for control of activities in the corporate sector

These acts give diverse civil, criminal, and administrative provisions and spell out the protection for the employees in the corporate sector against discrimination and harassment. In general, these acts do not prohibit termination of an employee by the employer, but if it is a breach of contract terms or a result of discrimination that can be proved, as illustrated in the Section 19.8 then it is termed wrongful termination and is subjected to review by the tribunal or the court.

Question Bank

PART A

(Each question carries 2 marks which you are expected to answer in 3 minutes.)

1. Define and explain the term 'discrimination'.
2. How does discrimination affect the employee morale in general?
3. What do you understand by 'equal-opportunity employer'?
4. Compare weak and strong preferential treatment.
5. Distinguish between disparate treatment and disparate impact.
6. Distinguish between sex discrimination, and sexual harassment.
7. What is quid-pro-quo? Illustrate.

PART B

(These are mostly 8-mark questions to be answered in 12 minutes, presuming that the time allotted for a 100-mark question paper is 3 hours. Sometimes the same question may be asked as a 16-mark question to be answered in 25 minutes.)

1. Discuss with illustrations in each case, the discrimination based on gender, age, language, and disability.
2. What are the different forms in which sex discrimination can take place? Illustrate them with case studies.
3. Discuss the different forms in which sexual harassment can take place.

4. Discuss how ethical theories deal with the problem of discrimination and harassment.
5. Enumerate and discuss the several legal protections available for the employees against discrimination.

PART C

(Objective-type Questions)

Name the form of discrimination/harassment in each of the following cases:

If the discrimination / harassment is as below	It is called discrimination of
(a) During job interviews, selecting candidates only from a certain gender	(a)
(b) Fixing different salary structures or perquisites of employees based on their community	(b)
(c) Fixing lesser salary for women employees selected under the same job specifications	(c)
(d) Provision of differential work atmosphere to locals and expatriates	(d)
(e) Terminating an employee just because he is suffering from asthma	(e)
(f) Asking women employees for sexual favours	(f)
(g) Ill-treatment during work	(g)
(h) Being harsh to one person in contrast to being kind to others	(h)
(i) Belittling a subordinate in front of others	(i)
(j) Not passing the leave applications or medical bills of a particular subordinate,	(j)
(k) Dismissing employees who are at the verge of their retirement	(k)
(l) When the company is forced to reduce the number of staff due to economic reasons, selecting only those from specific communities or genders for dismissal	(l)

UNIT VI

Global Issues

List of Chapters

20

Globalization

- Birth of MNC's
- Benefits for the MNCs Doing Business in Less Developed Countries
- Moral Difficulties
- Benefits to the Participating Company in the Host Country
- Transfer of Technology
- Appropriate Technology
- Relative Values
- International Rights
- United Nations International Bill of Human Rights
- Promoting Morally Justifiable Measures
- Business Process Outsourcing

In this era of international trade liberalization, multinational corporations, that is, corporations of one country expanding their operations in other countries, have become a common feature. This has given rise to several issues related to such international operations and these are discussed in this chapter. This is essential for professionals whose corporations do business in foreign countries.

Keywords: *Multinational corporations, host country, host society, transfer of technology, appropriate technology, ethical relativism, descriptive relativism, rational relativism, human rights, international rights, UN International Bill on Human Rights.*

20.1 BIRTH OF MNCs

Today we live in a world of globalization where most countries, especially India, have opened the gates for international competition and cooperation in manufacture and marketing. Thus, the industrial culture has been transformed from a protected economy to a world-class production.

During the pre-globalization period, many organizations operated within circles that had similar cultural and social structure, often having identical or a single cultural framework. The companies or countries worked in a closed system. As a result, the value systems and ethical norms did not vary much among individuals or groups.

The growth and development of multinational corporations is the significant result of globalization. MNCs are basically based in developed countries like USA, Germany, and Japan, opening up their branches and production centers in developing or underdeveloped countries.

20.2 BENEFITS FOR MNCs DOING BUSINESS IN LESS DEVELOPED COUNTRIES

- Inexpensive labor
- Availability of natural resources
- Favorable and lower tax structures
- New market outlets
- Less government restrictions like the pollution control norms
- New outlets for dumping their second-grade products not accepted in the countries of origin
- Ease of dumping waste products due to less restrictions in dumping

20.3 MORAL DIFFICULTIES

However, moral difficulties arise along with the business and social complications apart from these benefits.

- Loss of jobs for the country of origin when the manufacturing is taken across borders
- Loss of revenue and taxes for the country of origin.
- Loss of political independence in the host country.
- Lack of definition and understanding of the moral responsibilities and cooperative working in the host country.

20.4 BENEFITS TO THE PARTICIPATING COMPANY IN THE HOST COUNTRY

- New jobs
- New skills
- Transfer of technology
- Sharing of wealth
- Increased revenue and tax income
- Increased customer satisfaction of possessing foreign branded goods (esteem value)
- Other social benefits

20.5 TRANSFER OF TECHNOLOGY

The fundamental benefit to the host country by the MNC is technology transfer as cited above. Generally, whenever an MNC commences its operations in a foreign country, its technology is adapted in the new venture. By this, the MNC gains new markets while the host country gains a new technology. This is called *technology transfer* and involves adapting the technology in a new environment. This transfer of technology can either be in hardware like machines and installations or in techniques like skills and procedures. Research institutions, consulting firms, and MNCs are, in general, the agencies for technology transfer.

20.6 APPROPRIATE TECHNOLOGY

In several situations, the advanced technology adapted by the MNC, which has been successful and efficient in its own country, may not be suitable to the host country in view of the social factors of the host country. For example, fully automated equipment may be ideal in one country where the labor cost is high but not appropriate in a country where labor is very cheap. Appropriate technology can hence be defined as the desired combination of labor and capital mix based on the economical and social conditions of the host country, which achieves the targeted goal of the project at the minimum cost. The basic principle of appropriate technology is that the technology

- Should not effect the development of the host country,
- Should not effect the environment,

- Should not squander the scarce resources, and
- Should be suitable for the social conditions of the host country.

20.7 RELATIVE VALUES

This reorientation of values gives rise to the concept of relative values or relativism.

1. Ethical Relativism

This depends on the theory that actions are morally right within a particular society when they are approved by the laws and customs or other conventions of that society. This means that when a person migrates or moves to a new society, he has to adapt to the laws and conventions of the new society, however powerful or ethical a person he was in his homeland. That is to say, 'While in Rome, do as the Romans do'. However, this aspect has been misinterpreted and misused by those occupying foreign lands during the world wars, etc., when they wanted to show their supremacy by disregarding the ethics culture of the occupied land and imposed their own cultures and moral conventions on the people of land they occupied and unjustly persecuted innocent people. This was significantly prevalent in Nazi-occupied countries during World War II. The other instance where the occupiers disregard the morals of the original residents and imposed their own morals is that of the practice of apartheid in South Africa.

2. Descriptive Relativism

This states that value beliefs and attitudes differ from one society to another. This aspect only signifies the existence of certain distinct set of morals in each, whereas ethical relativism signifies what happens when one moves from one society to another. This view can also be expressed by the term *ethical pluralism*, which signifies that there is more than one justifiable moral perspective, that is there may be a number of moral variations in formulating, interpreting, and applying basic moral principles.

3. Rational Relativism

This signifies that moral judgments should be on a case-to-case basis and all the factors related to those cultures and their ethical standards involved should be considered freely without any bias to a particular culture. While Martin et al. called this *moral relataionlism*, this author prefers to call it *rational relativism*, as this signifies the rational application of the relativism. It can also be called *contextualism*, as the moral judgments are based on the context of the situation. For example, telling a lie is considered immoral. But in certain cases telling a lie may not cause moral harm to any one involved, but may save embarrassment or even the life of someone. Our own *Bhagavad Gita* or *Mahabharata* propounds this view profusely.

> *When the benevolent and ever-truthful king Harishchandra was forced to lose his kingdom, due to his verbal commitment given long ago to the cunning sage Viswamitra, his minister advised him,*
>
> *'Prana vitta mana bhangambulandu bonka vachunu aghamu pondadu Adhipa' (in Telugu),*

meaning, 'When it comes to the loss of life or money or honor, you can lie and you will not go to hell, O King.'

20.8 INTERNATIONAL RIGHTS

In ethical relativism, we discussed about people occupying foreign lands and imposing their own morals and cultures on the original residents, like that of apartheid in South Africa. This has raised a lot of hue and cry from human rights organizations. A *human right* is defined as a moral obligation on all people of one community or group to treat that of another community or group with dignity and respect.

This aspect is very significant in case of those MNCs doing business or operations in other countries. They have to obey and respect the morals and rights of persons when they do business in a host country, even when these morals or rights are not present in their own country. In his book *The Ethics of International Business,* T Donaldson emphasizes the need for international rights.

20.9 UNITED NATIONS INTERNATIONAL BILL OF HUMAN RIGHTS

As early as 1948, the United Nations adapted the Universal Declaration of Human Rights, subsequently modified and adapted as the United Nations International Bill of Rights that ascribes to all human beings the following rights.

1. The right to live
2. The right to liberty

3. The right to worship
4. The right to marriage and not to marry without free consent
5. The right not to be held in slavery
6. The right to freedom in physical movement
7. The right to freedom of speech and association
8. The right to subsistence
9. The right to social security and work
10. The right to assemble peacefully and participate in Government
11. The right to participate in and form trade unions
12. The right to physical security
13. The right to ownership of property
14. The right to minimal education
15. The right to fair trial
16. The right to freedom from torture
17. The right to non-discriminatory treatment on basis of race, sex, etc.

We may add to this list some more freedoms which are decided on case-to-case basis, like the Sikh bus conductors employed in London Transport winning their right to wear turbans while on duty.

20.10 PROMOTING MORALLY JUSTIFIABLE MEASURES

MNCs and the host government shall ensure that the following are adhered to:

1. Respecting the basic human rights of the people of the host country
2. Respecting the laws and culture of the host country
3. MNCs giving benefits of their activities to the host countries
4. Providing fair wages for fair day's work for the employees
5. Not discriminating against the local employees and the expatriates of the same work description. In fact MNCs shall employ expatriates only if skilled personnel for a particular job are not available in the host country.
6. Promoting the welfare of their employees.
7. Improving the morally justified institutions in the host country.
8. Providing sufficient security and prevention of hazardous processes and activities. The MNCs shall pay for the extra risks undertaken by the employees and the society against those hazardous processes.

20.11 BUSINESS PROCESS OUTSOURCING

The latest form of MNCs without physically locating themselves in foreign countries is Business Process Outsourcing (BPO). Similar to the outsourcing of materials from foreign countries, BPOs outsource technical expertise through the Internet. Today, several experts and consultants can register their expertise with BPO portals. Foreign companies, mostly those in USA, who want some software solutions or any other consultancy work to be done, refer to the Internet to identify their service providers and conduct business. By this, both the companies as well as the consultants can partner in doing business without their physically leaving their respective countries. The host company benefits as the service costs in their country may be much higher.

Question Bank

PART A

(Each question carries 2 marks which you are expected to answer in 3 minutes.)

1. What are MNCs? Explain their importance.
2. What is meant by transfer of technology?
3. What is meant by appropriate technology?
4. Discuss the ethics involved in the statement,
   Aswathama hataha, kunjaraha.
5. What is meant by apartheid?
6. Illustrate ethical pluralism.

PART B

(These are mostly 8-mark questions to be answered in 12 minutes, presuming that the time allotted for a 100-mark question paper is 3 hours. Some times the same question may be asked as a 16-mark question to be answered in 25 minutes.)

1. Discuss how the advent of MNCs have benefited the host countries, but at the same time brought new ethical issues.
2. Discuss the three concepts of ethical relativism.
3. Enumerate and illustrate the UN charter of international rights.
4. What are the responsibilities of MNCs to the host country?
5. Discuss the ethical issues that have risen out of the emergence of BPOs.

PART C

(Objective-type Questions)

1. Fill in the blanks:

(i) MNC means _____________ _____________ _____________

(ii) BPO means _____________ _____________ _____________

(iii) Ethical relativism : _______ :: Be a Roman while in Rome : *Aswathama hataha, kunjaraha*.

(iv) Apartheid means discrimination by _____________

2. Answer if the following statements are true or false:

(i) Right of speech in a foreign country means you can criticize their president freely.

(ii) Inexpensive labor is the most significant benefit of an MNC.

(iii) MNCs must not give benefits of their activities to the host countries.

21

Environmental Ethics

- Introduction
- Basic Environmental Issues
- Sustainable Development
- Global Environmental Issues
- International Initiatives on Environmental Issues
- Environmental Scenario of India
- Oil Spills
- Environmental Impact Assessment
- Engineer's Role in Environment Protection
- Environmental Engineering
- Green Design
- Principles of Green Design
- Environmentally Conscious Manufacture
- Basic Approaches for Resolving Environmental Problems
- Conclusion

The definitions of the basic environmental issues, sustainable development and the international initiatives taken in this direction are discussed in this chapter. The role of the engineer in sustaining the environment and the principles of green design are also highlighted.

Keywords: *Environmental management system, environmental audit, sustainable development, global environmental issues, Magna Carta of environment, Rio Declaration, Kyoto Protocol, green design, environmentally conscious manufacture, environmental ethics, cost-oblivious approach, cost-benefit approach*

21.1 INTRODUCTION

The Industrial Revolution and the consequent development of new chemical industries and other manufacturing processes involving chemicals have caused substantial pollution of the environment. This pollution was considered a necessary evil of the economic development of a country and was not taken seriously till the middle of the 20th century.

Although nature was the main focus of the nineteenth and twentieth-century philosophies, contemporary environmental ethics emerged as an academic discipline only in the 1970's. The questioning and rethinking of the relationship of human beings with the natural environment reflected an already widespread perception in the last thirty years.

Multiplication of this problem resulting in issues like depletion of the ozone layer has created a high-level awareness as well as a movement among all concerned. This movement sought to highlight the role of the engineer as the key figure in the development of processes that result in pollution, and that he is also responsible for developing counter-processes to control pollution at the same time, achieving the desirable production targets. This created an awareness of what an engineer must do and commit himself in controlling the degradation of the environment. This awareness has given birth to a new branch of ethics, called *environment ethics*.

21.2 BASIC ENVIRONMENTAL ISSUES

Before explaining the ethical aspects of the environment, it is better to have the basic concepts of environmental issues.

Definitions

1. Environment

It is the surroundings in which an organization operates, including the air, water, land, natural resources, flora, fauna, humans and their interrelationship. Surroundings in this context extend from within the organization to the global systems.

2. Environmental Management System

It is the overall management system that includes organizational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing, and maintaining the environmental policy.

3. Environmental Management System Audit

It is a systematic and documented verification process of objectively obtaining and evaluating evidence to determine whether an organization's EMS conforms to the EMS audit criteria set by the organization or to the international standards and for communicating the result of this process to the management.

4. Environmental Policy

It is a statement from the organization of its intentions and principles in relation to its overall environmental performance that provides framework for action and for the setting up of its environmental objectives and targets.

21.3 SUSTAINABLE DEVELOPMENT

- The medieval concept of industrial development was that if development has to take place, a little of environment has to be sacrificed. *If use of chemicals is necessary for a better process, discharging the effluents of these chemicals into the open is inevitable.*
- During the mid-twentieth century, global consciousness on the need to sustain the environment despite development has been created.
- In simple terms, ***sustainable development*** is the development process without any destructive activity, thus integrating development with environment.
- It is the process of meeting the basic needs of the present generation without effecting the life and scope of future generations.

21.4 GLOBAL ENVIRONMENTAL ISSUES

- Global warming (or greenhouse effect)
- Acid rain
- Ozone-layer depletion
- Transboundary movement of hazardous wastes
- Ocean contamination

- Decrease in diversity of wild life
- Deforestation
- Desertification
- Pollution of rivers, lakes, and ponds
- Water-related diseases among humans as well as animals
- Increasing respiratory illnesses
- Unmanageable solid and hazardous waste generation

Apart from the above, some of the recent environmental issues faced in the Indian context are

- Artificial ripening of mangoes by harmful chemicals as revealed in May 2005
- Bio-medical disposal, as highlighted in the press during August 2005
- Toxic wastes from the bleaching and dying units in South India, that became a major issue in 2004–2005, etc.

21.5 INTERNATIONAL INITIATIVES ON ENVIRONMENTAL ISSUES

At the United Nations Conference on Human Environment held at Stockholm on 5 June 1972, the famous declaration called the *Magna Carta on Environment*, was made and the following resolutions were made.

- All humans have the fundamental right to freedom, equality, and adequate conditions of life in an environment of quality that permits a life of dignity and well being.
- Humans bear a solemn responsibility to protect and improve the environment for the present and future generations.

The UN General Assembly adapted the above resolution in December 1972 and declared June 5 as *World Environment Day*.

The other global initiatives are

- Charter on Economic Rights and Duties of States in 1974.
- United Nations Habitat Conference on Human Settlement held at Vancouver in 1976.
- United Nations Desertification Conference at Nairobi in 1977.
- Inter-Governmental Environmental Education Conference at Georgia in 1977.
- United Nations World Water Conference for ‘Clean Drinking Water and Sanitation for all’ in November 1980.

- World Conference on Environment Development held in 1984 where the expression *of Sustainable Development of Environment* was conceived. An Earth Summit in Rio de Janeiro for 1992 was planned.
- Montreal Protocol in 1987.
- Clean Air Act amendments of USA in 1990.
- Copenhagen Amendments in June 1992.
- United Nations Conference on Environment Development (UNCED), Earth Summit on Environment was held at Rio De Janeiro in 1992, the most strategic international effort for the preservation of environment, where the Rio Declaration on Environment and Development was signed by all participating countries. The details of the Rio Declaration are given in Annexure II.
- Kyoto Protocol in 1997, which is one of the latest and most significant documents, required the industrialised nations to reduce emission of carbon dioxide and other greenhouse gases (GHGs) by an average of 5.3% below the 1990 level by 2012. There was a consensus of the scientific community, including that in US, that climatic change is a human-made phenomenon and there is an urgent need to cut down the carbon emissions.

  This had come into force as late as 20 February 2005 after all the countries ratified it except USA, which was blamed for its big brotherly attitude by all other nations including the European Union. Even during the G-8 conference conducted in Gleneagles in Scotland during May-June 2005, the US administration initially refused to accept the above consensus but in deference to the pressure from the European countries, conceded to the above consensus. But till day there has not been any positive step taken to achieve the Kyoto protocol.

Nevertheless, in general, most of these initiatives as cited above have emphasised and succeeded to some extent in ensuring the following:

- Categorising the ozone-depleting substances like CFCs and halogens according to their *ODP (Ozone Depletion Potential)* and gradual reduction of the production of these items
- Reduction in the use of high ODP materials in automobile and refrigeration industries
- Removal of air conditioners, foam insulation materials and CFCs from cars before crushing them
- Use of warning labels on the products containing high ODP materials
- Banning of non-essential products using ozone-depleting substances

21.6 ENVIRONMENTAL SCENARIO OF INDIA

The National Productivity Council, in one of its seminars on Environmental Management Systems, has indicated the following scenario in India with respect to environment pollution.

- India is one of the top twelve among impure water countries.
- 75% of our rivers, lakes, and pond water are polluted.
- 75 million working days per year are lost due to water-related diseases.
- India is the world's third largest generator of organic water pollutants (BOD load being 17,60,000 kg/day, which is 8% of the global discharge).
- Phasing out of ozone-depleting substances like CFCs, has not been effective so far.
- Overall environmental compliance by industries is only 45%.
- Cleaner production technology and techniques are not adapted in industry.
- Reactive approach of industry for pollution and its related problems is not defined.
- There is lack of awareness of green consumerism and green markets.
- There is poor awareness among public on environmental issues.

21.7 OIL SPILLS

Notwithstanding the above scenario, Madras Port has adapted a inflatable oil boom, that would contain the oil that has spilled into the waters and prevent it from further spreading, before it can be skimmed off, or otherwise removed. Figure 21.1 illustrates this.

Fig. 21.1 *The inflatable boom operating from a tugboat at San Diego port (photograph taken by the author)*

21.8 ENVIRONMENTAL IMPACT ASSESSMENT

As a result of the Bhopal Gas Tragedy, Indian environmentalists have given serious thought to the process of Environmental Impact Assessment (EIA) to fulfill the following objectives.

- To identify adverse environmental problems that may be expected to occur
- To incorporate the development of action oriented measures
- To identify the environmental benefits and drawbacks of the project, as well as its economic and environmental acceptability to the community
- To identify the critical environmental problems that require further study and monitoring
- To examine and select the optimal alternative from the various relevant options available
- To invite the public in the decision-making process related to the environment
- To assist all stakeholders and those involved in the development and environmental matters to understand their roles, responsibilities, and overall relationships with one another

21.9 ENGINEER'S ROLE IN ENVIRONMENT PROTECTION

1. As an experimenter involving environmental issues, the engineer must be aware of his role in environmental protection. He should be human-centric and eco-centric.
2. He should have full knowledge and confidence in his projects and should be meticulously careful to foresee the environmental effects of the project activities.
3. He should have sincere concern about the environment during the project planning and execution stage and ask the following questions for himself:
   - How does the industry affect the environment?
   - How far such ill effects, if any, can be controlled?
   - Is political or physical regularization needed?
   - Are reasonable protective measures available for immediate implementation?
   - Can the engineer as an individual ensure safe and clean environment?
4. He should preplan all the activities and processes and the control systems without frequent replanning or redesigns.

5. He should plan for safe exits.
6. He must budget the funds required for these control systems including the safe exits, etc.

21.10 ENVIRONMENTAL ENGINEERING

Environmental engineering is the application of engineering principles during all stages of setting up of a manufacturing unit with a view of protecting and enhancing the quality of environments and enhancing public health and welfare. These include green design, green manufacture, and development of environment-friendly systems for disposal of solid, liquid, and gaseous wastes.

21.11 GREEN DESIGN

Green design involves systematic consideration of environmental objectives and factors during all stages of developing products, services or production processes. This also includes planning for recyclability, biodegradability, and other eco-friendly disposals of the products after their life cycle. Other names for Green Design are *Design for Environment (DOE)*, Environment Engineering, etc.

21.12 PRINCIPLES OF GREEN DESIGN

- Consider the physical and chemical structure of the material before selection.
- Avoid toxic materials.
- Evaluate manufacturing processes.
- Design for longer life.
- Design for ease of assembly and disassembly.
- Incorporate source reduction.
- Design for interchange ability.
- Design for recycling.
- Review packaging.

Avoid design and use of throw-away-after-use materials like the ultra-cheap carry bags made of plastic.

21.13 ENVIRONMENTALLY CONSCIOUS MANUFACTURE

Environmentally Conscious Manufacture (ECM), also called *green manufacture*, is to reduce the harmful effects of manufacturing and by developing processes and methods of manufacture suitably to reduce the generation of harmful wastes, emissions, and other hazardous effects of products and to reduce the energy consumption. The principal issue is reduction or elimination of occupational hazards. One striking example is the elimination now adapted in the use of lead in soldering or as an additive in petrol or paints in view of its toxicity. Another example is the mandatory reduction in the manufacture of asbestos sheets.

21.14 BASIC APPROACHES FOR RESOLVING ENVIRONMENTAL PROBLEMS

1. Cost-oblivious Approach

This includes all efforts made to make the environment as clean as possible, whatever, may be the cost to do so.

- No level of environmental degradation is accepted.
- This approach is somewhat similar to that of *rights and duty ethics*.
- Though ideal, this approach has two obvious problems.
    - It is difficult to define exactly what is *as clean as possible,* and
    - In the highly competitive world of Indian industry, where every rupee counts, industries try to use the above vagueness as a loophole and only try to do minimal expenditure to provide short-run measures, just effective enough to create an impression among the public that they are protecting the environment which may not be true in the long run.

2. Cost-Benefit Approach

The problems are analysed in terms of the benefits derived by reducing the pollution problems. The costs and benefits are weighed to determine the optimum combination.

- Here, the target is not to achieve a completely clean environment but an economically viable environment protection.
- This can also be compared to *utilitarian theory.*

However, this approach too suffers from four major difficulties.

- It is difficult to assess the true cost of human life or loss of a species or environmental protection.
- It is difficult to assess accurately the costs and benefits, and much guesswork or factor of safety has to go into the calculations.
- This approach does not necessarily specify who should bear the cost and who should get the benefit.
- The cost-benefit analysis does not take morality and ethics into account. The decision is simply based on mathematical/ simulations and calculations and there is no room for a discussion as to whether what is done is right or wrong.

3. A Combination of Professional and Personal Ethics

Unlike professional decisions like bridge designs, projects involving the environment affects the engineer personally even as a member of the public. Hence, there is the need to apply his decisions with reference to his personal ethics.

Whatever may be the approach, it is essential that the engineer applies both his professional and personal ethics, at the same time meticulously following laws and regulations of the state.

From the perspective of human health, the engineer's responsibility to protect is clear, which must be balanced between consideration of the well being of his employer, the public, and the community.

21.15 CONCLUSION

Having understood the scenario of the environment issues and the evolution of the environment management systems, it is hoped that the engineer perceives all processes or the industrial project from the environment perspective and applies his mind in achieving his objective of the project with minimal environmental degradation.

Question Bank

PART A

(Each question carries 2 marks, which you are expected to answer in 3 minutes.)

1. Define Environment Management System.
2. What is sustainable development?

3. Enumerate the several global environmental issues.
4. How does bio-medical waste disposal effect the environment?
5. What is green design?
6. What do you understand by environmentally conscious manufacture?

PART B

(*These are mostly 8-mark questions to be answered in 12 minutes, presuming that the time allotted for a 100-mark question paper is 3 hours. Sometimes the same question may be asked as a 16-mark question to be answered in 25 minutes.)*

1. Discuss the different international initiatives taken in sustaining environment.
2. Discuss Kyoto Protocol.
3. What is environment impact assessment? Discuss the factors involved.
4. What is an engineer's role in protecting environment?
5. Discuss the principles of green design.
6. What is the meaning of cost-oblivious approach and cost-benefit approach? Discuss their features.

PART C

(Objective-type Questions)

1. Fill in the Blanks:

(i) Financial audit : _______ :: Accounts : Enviroment

(ii) Cost-benefit approach : _______ :: Loyalty to employer : Loyalty to society

2. Answer if the following statements are true or false:

(i) Ozone is harmful for the body. So the ozone layer is harmful for the environment.

(ii) Acid rain contains harmful and non-potable water.

(iii) Climatic change is a human-made phenomenon and there is an urgent need to cut down the carbon emissions.

22

Computer Ethics

- Is Computer an Integral Part of the Engineer's Work?
- Computer Ethics
- The Broad Categories of Computer Crimes
- Hacking
- Recent Forms of Computer Crimes
- Domain Squatting
- Security Risk through Pen Drives and Wireless Network
- How to Identify and Save Yourself from Computer Crimes?
- The Ten Commandments of Computer Ethics
- The Eight Ethical Principles for Software Professionals
- Mobile Phone Crimes
- Reaction of the Mobile Phone Manufacturers
- Mobile Etiquette Guidelines
- Ethical Hackers

Several new forms of computer crimes are described and discussed in this chapter, with a view to make the engineer appreciate the harms created, thereby shun them from the ethical point of view and also to develop counter measures. Special mention is made about ethical hacking and the security risk on confidential information through Internet.

Keywords: *Computer ethics, computer crimes, hacking, privacy, viruses, worms, Trojans, phishing, domain squatting, pen drives, wireless network, spoofed websites, pop-up windows, Ten Commandments of computer ethics, mobile phones, mobile phishing, black mailing, industrial espionage, extrovert syndrome, MMS, earplugs allowed to one ear only, traffic concentration, cellphone mounts on cars, ethical hacking and mobile etiquette guidelines, radio-frequency signals.*

22.1 IS THE COMPUTER AN INTEGRAL PART OF AN ENGINEER'S WORK?

Computers have today become inevitable tools in engineering and business. The number of ways in which computers have brought benefits to the society need not be emphasized. Unfortunately, the same computers are today misused leading to serious ethical issues.

During the early days of computers, that is prior to 1960, they provided only arithmetical or data-processing assistance and no other use of the computers were thought of, and so they had no serious impact on ethical or non-ethical usage. The subsequent problems faced especially after the introduction of the Internet has increased the problems of misuse, computer hacking, data stealing, unwanted communication, manipulation of passwords to steal from bank accounts, introduction of computer viruses, etc., creating the need for codes of ethics in computer fields also.

22.2 COMPUTER ETHICS

Since it is the engineer who mostly plays the role of designer, manufacturer, manager and user of computers, the subject *computer ethics* has become an essential branch of engineering ethics. There have been several definitions of the term computer ethics.

- It is the field in which we examine ethical problems, aggravated transformed, or created by computer technology—*Walter Manner (1970).*
- It is the field which studies the way in which computers pose new versions of standards and more dilemmas, exaggerating the problems and forcing us to apply ordinary moral norms in uncharted realms. Computers give a new twist to the old ethical issues that are already well known—*Deborah Johnson in her book Computer Ethics*.
- It is a field concerned with policy vacuums and conceptual muddles regarding the social and ethical use of information—*James Moore.*
- Computer ethics should be viewed as a branch of professional ethics, which is concerned with standards and practices of codes of conduct of computing professionals. *Computing professionals* are those involved in the design and development of computer artifacts. The ethical decisions made during the development

of these artifacts have a direct relationship to many of these issues discussed under the broader concept of computer ethics—*Donald Gotterbarn (1990).*

22.3 THE BROAD CATEGORIES OF COMPUTER CRIMES

Where the computer is the instrument in carrying out the unethical act, like using computer to defraud a bank.

1. e-Commerce, despite its ease of operation by the user, also provides ease of hacking and misuse by unauthorized persons.
2. This unauthorized person can come to know of passwords, by which he can direct a bank's assets to be placed in an account or a location accessible to him through a remote computer terminal. From this, he can easily withdraw the money after getting it transferred to his own bank account without anyone suspecting till the actual account holder happens to see his statement and comes to know of the loss.
3. Since the location of the computer from which this crime is committed is unknown till investigation is made, the criminal can easily abscond with the loot.
4. The quantum of money stolen in this manner is much larger than that committed by normal bank robbers, who rob through gunpoint. As seen in Chapter 17, the former are white-collared criminals, while the latter are blue-collared criminals.
5. Where the computer is the object of the act, like the stealing of the computer or introduction of computer viruses.
6. Where the official software gets pirated and sold unauthorized.

22.4 HACKING

Hacking has been a major form of computer crime by which information can be assessed from other computers.

1. By hacking, the data in other computers could be altered or defaced, or false information given.
2. Where unwanted communication is being sent to unaware computer users by prying into their privacy.
3. Loss of privacy can lead to embarrassing situations to the unsuspecting user even if the eavesdropper enters into the private chatting by chance and has no immoral intentions.

4. Unethical acts by the hacker who repeatedly enters into private chats of the user and harasses the person with unwanted discussion especially if the user happens to be a female.
5. Blackmailing by immoral hackers.
6. Hackers coming to know of the passwords and IDs of unsuspecting users and misusing them for stealing from their bank accounts, etc., as indicated in the previous paragraph.

22.5 RECENT FORMS OF COMPUTER CRIMES

Apart from the computer virus we are all familiar with, there have been other forms like worms and Trojans. Another crime that has recently been identified is called 'Phishing'.

1. Virus

A virus is a piece of computer program or code that attaches itself to a host program or file so it can spread from computer to computer, infecting the files as it travels. Viruses give wrong and damaging instructions to the computer and can damage the software, hardware, files, and other data.

Just as biological viruses range in severity, computer viruses can range from mildly irritating to downright destructive.

It may be noted that the virus does not spread without human action such as sharing a file or sending an e-mail. Thus, with a little bit of common sense and care, we are less likely to fall victim.

Today we have several antivirus software in the market, each being capable of identifying a certain type or types of viruses. But unfortunately, computer criminals perpetually create new viruses that are unidentified or immune to the existing scanners. This necessitates still more specific virus scanners. This vicious cycle continues.

2. Worm

A worm, like the virus, is designed to copy itself from one file to another, but it is worse. It needs no human action but spreads automatically over networks by taking control over the features of the computer. A great danger of the worm is that it can replicate in great volumes. For example, it can send out its copies to everyone listed in your e-mail address box, and these new worms would do the same, causing a domino effect. This has been very common in the Internet.

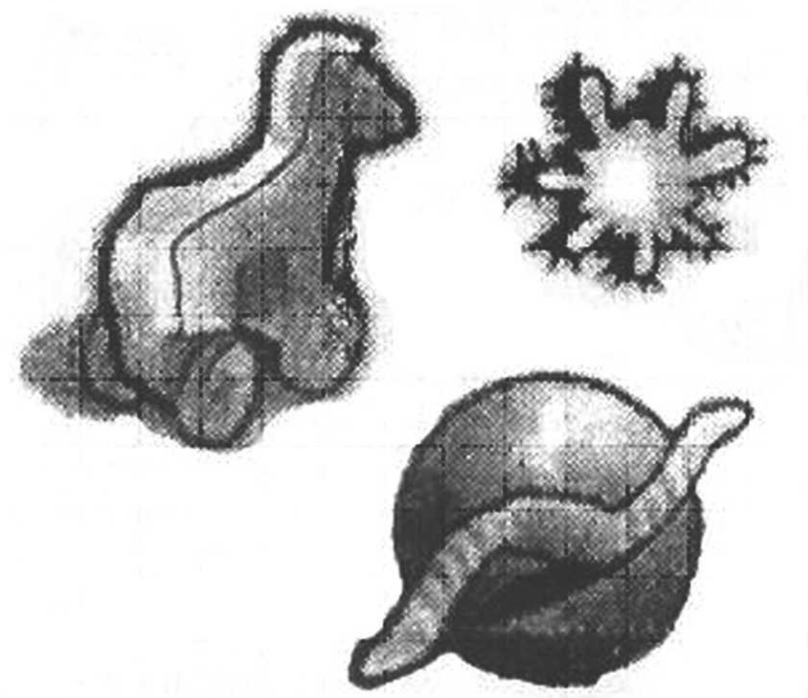

Fig. 22.1 *Symbols representing the virus, worm, and Trojan*

3. Trojan

A Trojan is a computer program that appears as useful software but on the other hand, it compromises on the security and causes damage to the files. This is like the wooden horse left behind by the retreating Greeks as their parting gift to the victorious Trojans, but it later turned out to contain hidden Greek soldiers who later took over Troy. Trojans are generally included in software that you download free of cost. For example, a recent Trojan came in the form of an e-mail message that included attachments claiming to be Microsoft security updates but turned out to be viruses that were not only immune to the anti-virus and firewall software, but were designed to disable the same.

4. Phishing

Phising is a type of deception designed to steal your identity. It is like catching a large fish by offering a small fish as bait. The criminal sends you a message under a pretense such as your banker asking you to update your password, etc. They seem to come form popular websites that you trust or have financial or other confidential dealings with, and appear official enough asking you to update the ID number, passwords, account information, and other personal data.

> *There have been cases of the hacker offering gifts or saying that the client won a raffle, and requesting him to indicate the ID no. and password so that the money could be credited to his bank account. Later the hacker would use these to withdraw money from the client's account without his knowledge and vanish.*

Figures 22.2 and 22.3 illustrate this crime. In Fig. 22.2, the scam artist places a link in the e-mail message that appears to be a legitimate website. He may also create a pop-up window (1) that looks exactly like the official site but it actually takes you to a phony site link to a copycat site called *spoofed websites*. Once you are in the spoofed site, you may

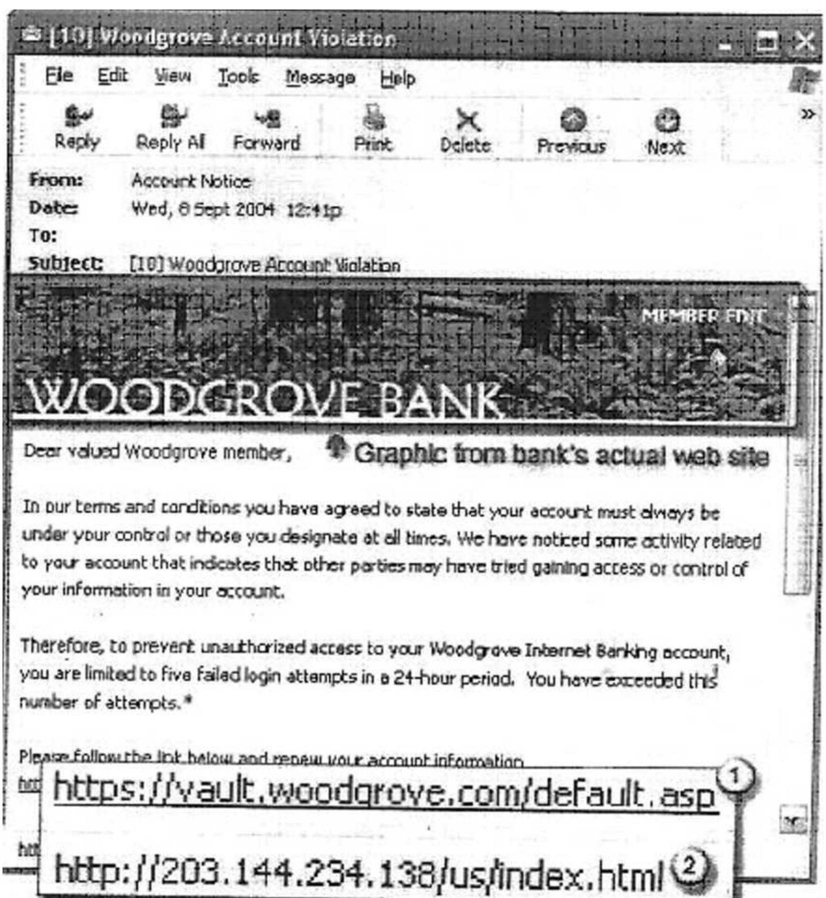

Fig. 22.2 *An illustration of phishing e-mail message with a deceptive URL address*

Fishy business: A screen shot taken on Monday shows the home page of "Yafoo" which mimics the popular Internet portal site "Yahoo." The Japanese police arrested a 42-year-old man 13 June 2005 on suspicion of stealing personal information through "phishing," a scheme based on use of faked websites. It was Japan's first arrest over phishing, in which perpetrators use emails appearing to come from a legitimate company and directs recipients to fake websites where they are asked for personal or financial information. (AFP)

Fig. 22.3 *Another illustration of phishing e-mail message in Japanese*

unwittingly answer their queries on your personal information with baits of getting a special offer or a gift. They then use your information to purchase goods in your name or otherwise steal your identity for scam purposes. The above figure illustrates how the word *Yahoo* is mimicked by the word *Yafoo*.

22.6 DOMAIN SQUATTING

Domain name (also called trademark or brand or logo or identity) in any field of activity is a registered identification symbol or brand name over which a particular individual or company has the exclusive and sole rights. Domain squatting is the act of registering domain names and trademarks that are identical or confusingly similar to popular brand names and use it in Internet search engine, by bombarding with a host of websites having IP addresses identical or similar to the original brand names, thereby misleading public who go more by brand name or logo in choosing products and services. Domain squatting has in recent times become a big nuisance to many large companies that thrive on the popularity of their brand name or logo in their business prospects. In view of lakhs of websites being available for each activity, it is a Herculean task for the original domain-name holder to be vigilant over search engines and discover any such domain squatting. This crime first surfaced in 1998, when the cases were referred to WIPO Arbitration and Mediation Centre.

22.7 SECURITY RISK THROUGH PEN DRIVES AND WIRELESS NETWORK

The *pen drive* is a revolutionary development of convenient removable data storage system. Unlike CDs, they do not need any special drives to copy the data from the hard disk, but they can do so through any USB port and transfer them elsewhere. They are quite economical, a 1.00 GB pen drive costing hardly ₹700. Moreover, they are tiny—no bigger than a match box. But these advantages have made them highly vulnerable tools of computer crimes. In addition, the installation of wireless Internet connections to the computers have also made it easy for the hackers to commit the above-mentioned crimes with less probability of detection.

In fact, as late as December 2006, this issue had figured in the Parliament of Indian Government, which observed with concern, the use of high-tech devices in espionage activities. It has also emphasized that the most important electronic device used by the conspirators is the pen drive which is small, lightweight, removable, and cannot be noticed when transported in shirt pockets or make-up boxes.

> *A recent survey reported that the information security in corporate India is yet to get the level of seriousness required, especially in an environment where removable storage devices are increasing in number and availability.*

22.8 HOW TO IDENTIFY AND SAVE YOURSELF FROM COMPUTER CRIMES?

Microsoft and other software developers suggest the following steps:

- Never open an e-mail from a stranger, especially when the subject is attractive offering you prizes, discounts, etc.
- Be suspicious of unnatural subjects like ‘Oh my dear’, ‘darling’, etc.
- Report the matter immediately to the sender or the service provider.

- Avoid clicking on links in e-mail messages or even some websites.
- Do type the addresses directly into your browser or use your personal bookmarks.
- Do check the security certificate or other indications before entering personal or financial data into a website.
- Do not enter personal information in pop-up windows, unless you check them thoroughly.
- Never respond to possible scammers through the reply button. Always reply by separate e-mail to the address the message is supposed to have come from.
- Never open an attachment even from someone you know, unless you know what the attachment is. Many times even your friend forwards his incoming mail without being aware of the virus or other scams in it.
- Always keep your anti-virus software up-to-date.

22.9 THE TEN COMMANDMENTS OF COMPUTER ETHICS

1. Don't use a computer to harm other people.
2. Don't interfere with other people's computer work.
3. Don't snoop around into other people's computer files.
4. Don't use a computer to steal.
5. Don't use a computer to bear false witness.
6. Don't copy or use proprietary software for which you have not paid.
7. Don't use other people's computer resources without authorization or proper compensation.
8. Don't appropriate other people's intellectual output.
9. Think about the social consequences of the program you are writing or the system you are designing.
10. Use a computer in ways that insure consideration and respect for your fellow humans.

22.10 THE EIGHT ETHICAL PRINCIPLES FOR SOFTWARE PROFESSIONALS

IEEE has developed the following code of ethics for the software professionals in the form of eight principles.

Software engineers shall commit themselves to making the analysis, specifications, design, development, testing, and maintenance of software, a beneficial and respected profession in accordance to their commitment to the health, safety and welfare of the public. Software engineers shall adhere to the following eight principles.

1. Public Software engineers shall act consistently with public interest.

2. Client and Employer Software engineers shall act in a manner that is in the best interests of their clients and employer, consistent with public interest.

3. Product Software engineers shall ensure that their products and related modifications meet the highest professional standards possible.

4. Judgment Software engineers shall maintain integrity and independence in their professional judgments.

5. Management Software engineering managers and leaders shall subscribe to and promote an ethical approach to the management of software development and maintenance.

6. Profession Software engineers shall advance the integrity and reputation of the profession consistent with the public interest.

7. Colleagues Software engineers shall be fair to and be supportive of their colleagues.

8. Self Software engineers shall participate in lifelong learning regarding practice of their profession and shall promote an ethical approach to the practice of the profession.

22.11 MOBILE PHONE CRIMES

While the last decade of the twentieth century has been dubbed as the Internet era, the first decade of the twenty-first century can be dubbed as the mobile phone era. Both the Internet and the mobile phones have completely transformed the way of life of humans all over the globe, and the extensive services they have provided us are very significant. At the same time, they have given birth to innumerable crimes and ethical issues.

In Section 22.3, we have cited several computer crimes committed through the Internet. In a similar fashion, the mobile phones, especially those with built-in cameras, have provided lots of opportunities to criminals to make a fast buck at the cost of others. This book clubs this type of crime with computer crimes because the videos from the phones are later transferred to a computer from where the actual criminal activity takes place.

22.11.1 A Warning

A news item of 25 August 2005 reports as under:

> *If you receive a phone call on your mobile from any person, saying that he or she is a company engineer, or telling that they are checking your mobile line and you have to press #90 or #09 or any number, end this call immediately without pressing any number. This is a hoax call (identified in Section 22.3 of this chapter as phishing) from a fictitious company that uses a device so that once you press #90 or #09, they can access your SIM card and make calls at your expense.*
>
> *Also, if you receive a call and your mobile displays XALAN on the screen, don't answer the call. If you answer, your phone will be affected by a virus which will erase all the IEMI and IMSI information from your mobile and the SIM card, which will disable your phone from the network. You will have to buy a new phone. This information has been confirmed both by Motorola and Nokia. There are over 3 million phones being infected by such viruses all over the world now.*

22.11.2 Blackmailing

The latest crime that is perpetuated by mobile phones with built-in cameras is to take photographs of unsuspecting persons, do some graphic alternations and send them to several persons through MMS (MultiMessaging Service). This would generally be preceded by a telephone call to the unsuspecting person for blackmailing and to ask for some favor. The following is another news report of 27 August 2005 to illustrate this point.

> *It has become quite the in thing, not just among adolescent boys in the dark corners of the classrooms, but even at social dos and parties, it has become quite common for an amused crowd of people to be bunched together around one phone waiting excitedly for the latest MMS to unfold in front of their eyes. As long as there is a bunch of graphic experts who are willing to indulge in this sort of cyber crime, who will be next on the MMS hit list, is what keeps everyone guessing.*

Even as late as November 2006, despite the Government's restrictions on Internet browsing centers, a popular Chennai actress was caught in an MMS mischief, her photo morphed by computer graphics.

22.11.3 Industrial Espionage

This crime, detailed in Chapter 17, has been facilitated further by the existence of camera phones. People may walk into design offices as a visitor in the guise of making a personal phone call elsewhere over their mobile phone, and simultaneously direct the camera towards documents and take photographs without raising any suspicion to the concerned manager.

22.11.4 Photographing of Prohibited Zones

Hidden cameras in small-sized phones are increasingly being used to take photographs in prohibited zones like defense stations. Of course, the security may check and collect all such phones at the entry gate, but this deprives genuine mobile-phone users who want to make urgent phone calls.

22.11.5 Use of Mobile Phones While Driving

This is one of the most dangerous things to do while driving. The risk of accidents while talking and driving is said to be four times than that by driving under a little intoxication. The news received over the phone at that time may be too much to divert the attention of the driver for a second and that would be enough to cause serious accidents. Hence, almost 23 countries all over the world have so far banned this, but India and even United States are yet to follow.

> *In spite of heavy traffic restrictions, strict exercise of control over drivers and the meticulous following of the traffic rules by all car drivers, this author was surprised to find during his short US stay in 2005 that it was a common sight to find car drivers talking over mobile phones incessantly even at speeds exceeding 80 kmph. Even in recent times, even as late as 2012, traffic department's billboards on highways could be seen carrying notices like 'earplugs are allowed for one ear only' meaning a driver can continue to talk over his mobile through an ear phone connected to one ear, leaving the other ear free for traffic concentration (sic).*

Despite international awareness on the dangers of talking over mobile phones while driving, automobile manufactures or small-time auto fitters provide mounts on car dashboards to hold the cellphones in position. While this allows for hands-free for driving, the tendency to talk during driving, and hence the risk of getting diverted, increases. Hence, ethical engineers should desist from designing such cellphone mounts on cars.

22.11.6 Extrovert Syndrome

Medically speaking, an extrovert is a person who openly expresses his inner thoughts. Unconsciously, he gestures, talks to himself, and shows emotions and expressions openly, appearing to be odd to others to the extent that they are shunned by public. Today, several persons keep their mobiles in their pockets and communicate through an earphone cord. The exciting news they hear make them forget they are on a public road and they talk or gesticulate in air during conversations to the amusement of others, even to the extent of someone complaining to the police.

22.11.7 Health Effects of Exposure to Radio Frequency Signals

The signals received by a mobile phone especially when it is placed in the left breast pocket of the shirt, close to the heart, is known to have a bad effect on the heartbeat and the ear. Before a new model is made available for sale, it must be tested and certified by The Federal Communications Commission of the US Government for safe exposure to radio signals, by placing it at strategic locations of the body like the ear, breast, etc. But many manufacturers do not conduct these tests meticulously, let alone their being aware of the effects. Thus, in any case, it has been recommended by FCC to place the mobile at least 10 mm away from the body and at least 150 mm away from any pacemaker if fitted onto the user. In spite of these ill effects, we find it common for people to keep the mobile in the left breast pocket. Even the constant bending of the head to hold the phone near the ear can also affect the neck muscles in the long run.

22.11.8 Other Misuses of Mobile Phones

1. Use of Phones in Seminars or Meetings If the phone rings amidst serious discussions, everyone gets distracted and the speaker would certainly lose the flow of his thoughts.

2. Use of Phones in the Classrooms This is another bad impact of modern technology. As reported in the newspapers of 30 August 2005, Anna University said,

> *We have banned the use of cellphones in the campuses, because a lot of students were sending messages inside classrooms and some of them were even speaking on their mobiles, and we feel that it is distracting for both the teacher and students.*

22.12 REACTION OF THE MOBILE PHONE MANUFACTURERS

The MMS, which led to the circulation of obscene pictures through camera-enabled mobile phones as illustrated above, has rattled mobile phone manufacturers all over the world like Samsung. Motorola, and Nokia. They are now worried about the immoral purposes for which their products are being used and have concentrated on releasing ethical guidelines for their use. While Motorola and Nokia said they have been telling their users about ethical usage each time a mobile phone is sold, Samsung has released 'Samsung Mobile Phone Etiquette and Responsibility Guidelines for Camera Phone Users' and requested every user to follow this set of guidelines when using the camera or video function of the mobile phone.

22.13 MOBILE ETIQUETTE GUIDELINES

1. The privacy of persons around the user of the camera phone should be respected. Camera phones should not be used to take photographs of individuals without their knowledge and consent.
2. Camera phones should not be used to take photographs in public places deemed 'private' like swimming pools, changing rooms, and gyms.
3. One must respect the individual office and the educational or industrial environment where the confidentiality of design and information is a matter of great importance. Camera phones should not be used in those areas without the prior approval of the authorities concerned.
4. Camera features on the phone should not be used in areas where cameras are not encouraged or prohibited, like airports, high-security zones, museums, cinema theatres, and live performances.
5. Camera phones should not be used to shoot and circulate objectionable material. It is illegal and punishable by law.
6. It is dangerous to use phones while driving. Users should refrain from using them while driving.

22.14 ETHICAL HACKERS

IT security, or *cyber security*, is the protection of information against unauthorized disclosure, transfer, or modification, whether accidental or intentional. Since a computer network is the key for the flow of information, it is vital to protect the computer systems and network from hacking, information stealing, and corruption. That is the reason for cyber experts acquiring specialized skills in hacking and getting employed in the corporate sector. Their main function is to attempt hacking into the confidential secured information developed by the company without their knowledge. In a way, they test the security of the systems by making all hacking attempts made by a criminal hacker. They are called ethical hackers and are actually paid by the organization to detect breaches in the organization's network. It is like the popular Indian saying, '*a thorn can be removed only by a thorn*'.

Question Bank

PART A

(Each question carries 2 marks that you are expected to answer in 3 minutes.)

1. Is the computer an integral part of the engineer's work? Illustrate.
2. Define computer ethics.
3. Explain the significance of computer ethics to the engineer.
4. What is hacking? What are its ills?
5. What is a Trojan?
6. Explain phishing.
7. Enumerate the eight ethical principles of IEEE for software professionals.
8. What is the meaning of mobile phishing?
9. Mobile phones have abetted industrial espionage to a large extent. Explain.
10. What do you understand by mobile-phone ethics?

PART B

(*These are mostly 8-mark questions to be answered in 12 minutes, presuming that the time allotted for a 100-mark question paper is 3 hours. Sometimes the same question may be asked as a 16-mark question to be answered in 25 minutes.)*

1. Discuss the broad categories of computer crimes.
2. Distinguish between computer viruses and worms. Explain and illustrate their ills.

3. Discuss how you can save yourself from the above-mentioned computer crimes.
4. What do you understand by the Ten Commandments of computer ethics?
5. Though the mobile phone is a marvel in technological advancement, it has brought several vices into the society. Discuss.
6. Cite and illustrate some of the mobile etiquette guidelines.

PART C

(Objective-type Questions)

1. Fill in the blanks:

(i) Viruses : _______ :: replicating during opening a file : self replicating

2. Answer if the following statement is true or false:

Computer ethics is the field in which we examine ethical problems, aggravated, transformed, or created by computer technology.

3. Match the following:

(i) Accessing information from some other computer	(a) Phishing
(ii) A computer program that attaches itself to a host program so it can spread to other computers, infecting the files	(b) Worm
(iii) The virus that needs no human action but spreads automatically over networks by taking control over the features of the computer	(c) Industrial espionage
(iv) A computer program that appears like a useful software but steals the security and damages the files	(d) Camera-mobile phones
(v) The criminal sends you a message under a pretense like your banker asking you to update your password, etc.	(e) Mobile phishing
(vi) Hidden cameras in small-sized phones used in taking photographs in defense or prohibited zones	(f) Virus

(vii)	Hidden cameras in small-sized phones used in taking photographs in design offices to steal designs	(g)	Hacking
(viii)	Receiving a hoax phone call on your mobile to press #90 or #09 or any number	(h)	Trojan

23

Weapon Development

- Industrial Revolution and Weapon Development
- Role of IT in Weapon Development
- Evil Effects of Weaponry
- Problems Faced by Today's Defense Industry
- Engineer's Dilemma in Weapon Manufacture
- Case Studies on Engineer's Dilemmas in Weapon Development
- Global Nuclear Disarmament Movement
- The Indian Scenario
- Production of Plutonium 238

An engineer employed in the defense industry is always in a moral dilemma. His professional loyalty needs him to participate in the design and production of war materials, whereas his personal ethics of anti-war sentiments go against it. This chapter goes into this conflict of interests. It also reviews the present-day situation on the arms race.

Keywords: *Industrial Revolution, defense industry, defense establishments, role of IT, Internet, anti-personnel bombs, napalm bombs, nuclear arsenal, Non-Proliferation Treaty (NPT), Nuclear Weapon States (NWSs), Comprehensive Test Ban Treaty (CTBT), Coalition for the Nuclear Disarmament and Peace (CNDP), Weapons of Mass Destruction (WMD), Nuclear Suppliers Group (NSG).*

23.1 INDUSTRIAL REVOLUTION AND WEAPON DEVELOPMENT

While James Watt's discovery of steam power or Stevenson's invention of the steam engine helped technological progress during the Industrial Revolution era, it is the need for producing more and more arms and warfare equipment during that period that triggered the quick development of this technological progress. Here is where the engineer played a major role in the design, development, and manufacture of warfare equipment to satisfy the defense needs of his country. Even today, the largest employer of engineers worldwide is the defense industry, either directly or indirectly.

Business relating to weaponry and military needs has been the prime need of a government. Every country, especially developed countries like the USA, allocates large chunks of its financial budgets on military development and purchase or production of weapons and warfare equipment.

23.2 ROLE OF IT IN WEAPON DEVELOPMENT

While the subsequent paragraphs decry the role of the army and the defense departments in endangering the world in today's nuclear arms race, we should also admit the contribution of the defense establishments in the development of basic and applied sciences. Through the complex relationship between the defense, industry, and academy, all have benefited from many spin-off applications that have their origin in national defense and security. These spin-offs include satellite communications, global positioning systems, microwave ovens, and plastics. Even the Internet was originally developed as a means of secure and reliable communication in the event of wide nuclear attack on the US. Another new concept, network-centric warfare, seeks to achieve advantage over adversaries by delivering accurate and relevant information instantaneously to the appropriate actors to have situational awareness in real time. As in the commercial IT sector, this has compressed the time scales of transactions from weeks to seconds and enabled lightning-speed command and control of resources and their movements. In the past five years, defense agencies have re-engaged the public sector with a reverse role of beneficiaries of the technology transfer. As a result, the commercial IT revolution has far outpaced the transformation of its legacy parent, the Department of Defense (DoD).

23.3 EVIL EFFECTS OF WEAPONRY

One of the worst developments of military technology was the invention of the atomic bomb. The USA dropped these bombs on Hiroshima and Nagasaki of Japan in August 1945, during the Second World War. Though this single event had brought the war to a quick end, the aftermath of this bombing has been catastrophic. Lakhs of innocent people died or had permanent disabilities, that too the innocent public, who knew nothing about war or why they were fighting. It was to be war against Hitler's Nazi rule, but just because Japan's emperor sided with Hitler and attacked Pearl Harbor, a US military base, USA took revenge on Japan by dropping these bombs which had such catastrophic effects. In fact, Sir Alfred Nobel, the inventor of the atom bomb, was so much disgusted with this non-peaceful use of his invention that he instituted the Nobel Peace Prize.

23.4 PROBLEMS FACED BY TODAY'S DEFENSE INDUSTRY

- The defense industry is basically expenditure oriented and eats away a large chunk of the country's expenditure.
- Development of modern gadgets like night-vision binoculars cost a lot of money, not because of the manufacturing cost involved but because of the secrecy involved.
- Today it suffers from *technology creep*. The present types of weapons are fast becoming obsolete. And additional money and energy is needed for developing modern weaponry.
- The projectile of the arms must be accurate and highly focused to the target but should not affect the surroundings. This had become difficult for military planners.
- With today's advancement in computer technology and miniaturization as detailed in the previous chapter, maintaining defense secrets is a Herculean task.
- In view of the confidentiality involved, the transactions are not transparent and give raise to corruption that can shake whole governments. It affects the political stability of a country. The Tehelka episode is an illustration.

23.5 ENGINEER'S DILEMMA IN WEAPON MANUFACTURE

While being employed for the defense industry in the development of arms and warfare equipment, the engineer faces the moral dilemmas created by conflicts of interest. On one side, he will be guided by his patriotism and desire to rise in his profession, while on the other hand, he may not like to work for any weapon manufacturer as he knows these weapons are meant to kill human beings and innocent public. Any human being, by nature, is against war or such killings and would find weapon manufacture unethical. He would also consider the fact that weaponry would aid blackmailing tactics played by the stronger countries on the weaker countries.

War also requires construction of bridges, especially in the warfront areas or building up of nuclear power plants. The engineer may find this work more ethical as bridges are not meant to kill innocent people but can be used by them after the war. Here, his ethical obligation would be to design and construct safe bridges that would not collapse and kill people during non-war periods, and also to build power plants that do not emit radiation.

23.6 CASE STUDIES ON ENGINEER'S DILEMMAS IN WEAPON DEVELOPMENT

- An engineer gets involved in the production of anti-personnel bombs. When they explode, they emit sharp fragments of steel or plastic on the victim. They can also be timed to explode after several hours. This engineer is fully aware of this danger but if he chooses to involve in it, he may defend himself by saying that if he does not do it, someone else may do it and that by doing this job, he is earning his livelihood.
- A chemical engineer gets involved in the production of napalm bombs, which uses a jellylike petroleum product that hurts the victim by impact. He may say that it is the government's job to stop the production of these bombs, not his.
- An engineer who is a specialist in manufacture and operation of guided missiles may say that he is proud to be able to help his country through his involvement. On the other hand, he may add that he only wishes for a war-free universe.
- A nuclear engineer appreciates well the dangers of increasing the nuclear arsenal. He may defend himself by saying he is doing his level best to reduce the impact of the radiation on public. In fact, this author had actually heard a nuclear scientist make the following statement.

> *During the Nagasaki bombing days, the bomb was heavy and its drop could not be focused to a smaller area. But*

today, nuclear bombs are small-sized and could be so highly focused on the targets that only the intended target like the military base can be destroyed and destruction of innocent public around the area can be avoided.

Joseph Telushkin in his book *The Ten Commandments of Character* had illustrated similar case studies in the form of questions and answers. One of them is given here:

Question: *My conscience bothers me because a small portion of my work concerns supporting and advertising for weapon research. Is it ethical to support such research?*

Answer: *Weapons research is not, in and by itself, unethical. Indeed, if all moral people assumed that it was then the armies of the most evil regimes would have triumphed in every war they fought. World War II would have ended in Nazi takeover of the world and civil wars would have ended with the world ruled by totalitarian governments. So the larger question for you to address is, are the people for whom I am engaged in research, doing it on behalf of evil governments that will use these weapons to murder, terrorize, or subjugate innocent people? If they are then any help you provide is unethical. But if the work is being performed on behalf of democratic regimes and the weapons would be used against those who use armaments against the innocent or to undermine lawful regimes then such work is not unethical.*

23.7 GLOBAL NUCLEAR DISARMAMENT MOVEMENT

We have enough nuclear warheads to destroy this planet many times over. Not only have Greenpeace and other anti-nuclear activists in civil society protested against nuclear testing, but India too has been in the forefront, calling for global nuclear disarmament. The following gist of a news report of 16 July 2005 illustrates the sad situation of the nuclear arms race.

Despite almost 35 years of existence of the Non-Proliferation Treaty (NPT), the Nuclear Weapons States (NWSs) have failed to carry out nuclear disarmament. Even the efforts to bring the Comprehensive Test Ban Treaty (CTBT) into force have also failed. The US rejected it in the Senate and it virtually sealed its fate. The two five-yearly review meetings held in 2000 and also in May 2005 have both resulted in *non-starters. Nothing tangible was possible in persuading the NWSs to move towards nuclear disarmament.*

23.8 THE INDIAN SCENARIO

The Coalition for the Nuclear Disarmament and Peace (CNDP), an umbrella organization for more than 200 civil societies, met in June 2005, in Panaji, India. It noted seriously the failure of the NPT Review conference held in May 2005 to make any progress as cited above, on the implementation of the nuclear powers' obligation for a time-bound global nuclear disarmament program, as a result of the stance adapted by USA. The CNDP chalked out a program of action by its state chapters and member organizations to create awareness among all sections of people, especially the youth, on the persisting danger that nuclear weapons posed to humanity and its environment and habitat. *(based on a newspaper report of 25 June 2005)*

During the visit of the Indian Prime Minister to France in September 2005, a joint statement on prevention of *Weapons of Mass Destruction (WMD)* was given as follows:

> *France acknowledges the need for full international civilian nuclear cooperation with India and will work towards the objective by working with other countries and the Nuclear Suppliers Group (NSG) by deepening bilateral cooperation. France appreciates India's strong commitment to prevent weapons of mass destruction (WMD) proliferation and the ongoing steps it is taking in this regard. In this context, both countries will also work on a framework agreement on defense cooperation, besides the promised dismantling of Nuclear Suppliers Group (NSG) regime.*

A former chief of the Indian Naval Staff had observed the following:

> *Many questions still remain unanswered.*
>
> - *How are we going to ensure correct interpretation of the intent, especially if deception is in the mind of the adversary?*
> - *If things are going very badly in the conventional warfare scene, can we be sure that the losing party will still not raise to the level of nuclear exchange?*
> - *Can these weapons not be deployed either by accident or due to a misinterpretation of detection on any of the many sensors?*
> - *What then is the way ahead?*

23.9 PRODUCTION OF PLUTONIUM 238

Despite the world's protest against nuclear arms, the US decides to produced Plutonium 238, one of the most deadly isotopes of the element, for use in secret missions, possibly in spy missions and undersea devices. This is so radioactive that even a speck can cause cancer.

A newspaper report appearing in June 2005 can be summarized as under:

> *This program, if extended to its plans, could produce 50,000 drums of hazardous radioactive waste. It is likely to face opposition from environmentalists who fear it is a potential threat to the nearby Yellowstone National Park.*

Question Bank

PART A

(Each question carries 2 marks that you are expected to answer in 3 minutes.)

1. What is the Industrial Revolution?
2. Justify the statement that the Industrial Revolution was triggered by the need for higher arms production.
3. What is Greenpeace Movement?
4. Write short notes on NPT.
5. Write short notes on CTBT.
6. Write short notes on NWS.
7. Write short notes on WMD.
8. What are the evil effects of the arms race?
9. What are the salient features of the latest joint declaration by India and France?
10. Write short notes on production of Plutonium 238.

PART B

(These are mostly 8-mark questions to be answered in 12 minutes, presuming that the time allotted for a 100-mark question paper is 3 hours. Sometimes the same question may be asked as a 16-mark question to be answered in 25 minutes.)

1. Discuss the role of IT in defense establishments.
2. Discuss the problems faced by the defense industry today.

3. Illustrate how the engineer working for defense production would justify himself.
4. Discuss India's role in anti-nuclear arsenal activity.

PART C

(Objective-type Questions)

1. Answer if the following statements are true or false:

(i) The raid on Pearl harbor was an aftermath of bombing on Hiroshima.
(ii) Japan was an ally of Britain during World War II.

2. Match the following (Role of the relevant engineer in warfare)

(i) Mechanical engineer	(a) High-speed telecommunication
(ii) Civil engineer	(b) Maintaining electrical power
(iii) Electrical engineer	(c) Production of napalm bombs
(iv) Electronics and Communication engineer	(d) Internet
(iv) Nuclear physicist	(e) Naval shipbuilding
(v) Marine engineer	(f) Building of bridges
(vi) Chemical engineer	(g) Building nuclear arsenal
(vii) IT engineer	(h) Manufacture of guns

24

Ethics and Research

- Moral unity and integrity
- Honesty
- Eight ways of misusing the truth in research studies
- Other Forms of Lack of Integrity in Research and Development
- Case Studies in Research, Experimentation, and Operation
- Challenger Case Study
- The Columbia Space Shuttle
- Chernobyl Case Study for Maintenance and Operation of Nuclear Plants
- The case of Three Mile Island Power Plant
- The Case of the Chernobyl Nuclear Power plant Disaster
- Similarities between the Accidents at Three Mile Island (TMI) and Chernobyl
- Kashiwazaki Kariwa Nuclear power Plant of Japan
- Bhopal Tragedy Case Study for The Maintenance of Chemical Equipment
- Kumbakonam School Fire Tragedy

This chapter emphasizes the need for ethical standards in research and development of new projects. It also discusses case studies on spacecraft design like that of Challenger, nuclear power plant design and maintenance like that of Chernobyl, design and maintenance of process plants like the Bhopal tragedy and design of safe exits like that of Kumbakonam fire disaster. These case studies indicate the importance of ethics appreciation in the design and maintenance of equipment on the operation of which lives of millions around depend.

Keywords: *Moral unity and integrity, honesty, misusing the truth, trimming, cooking, forging, plagiarism, multiple authorship, space ship, launch vehicle. propellant fuel, booster rocket, field joint, joint rotation, O-rings,*

putty, jettisoning, blow-by, NASA, SRMS&QA (Safety, Reliability, Maintainability Systems and Quality Assurance), Aerospace Safety Advisory Panel, Robots, FREESTAR mission, insulation tiles and wriggle test, nuclear war race, core reactor, fuel rods, moderator rods, pilot operated relief valve (PORV), emergency injection of water (EIW), primary booster pump, demineralizer, resin beads, loss of coolant accident (LOCA), containment structure, self-amplifying effect, self-dampening effect, Pressurized Water Reactors (PWR), Graphite Moderated Boiling Water Tube Reactor (RBMK), MIC, LPG tanks, toxic gas, design shortcomings, management shortcomings, maintenance shortcomings, safety awareness, technical preparedness, fire exit, overcrowded classrooms, crisis management training.

24.1 MORAL UNITY AND INTEGRITY

We had seen several aspects of honesty and integrity in Chapter 2. These are more relevant in research studies and hence these aspects are repeated as explained below.

- *Moral unity*
- *Moral integrity*
- *Compromise*
- *Discretion*

24.2 HONESTY

Honesty is a fundamental virtue for those engineers who engage in relationships with their employers and clients. These relationships are based on trust that the engineers will perform effectively and truthfully the activities for which they are employed. Honesty takes the following three forms:

- Honesty in acts, like refraining from stealing, account manipulation, etc.
- Honesty in speech in telling the truth always
- Honesty in beliefs

24.3 EIGHT WAYS OF MISUSING THE TRUTH IN RESEARCH STUDIES

1. Lying
2. Deliberate deception
3. Withholding information
4. Failing to promote adequately the dissemination of information
5. Failure to seek out the truth
6. Revealing secretly, confidential or proprietary information
7. Allowing one's judgment to be effected by corruption and bribery
8. Allowing oneself to be subjected to extortion

24.4 OTHER FORMS OF LACK OF INTEGRITY IN RESEARCH AND DEVELOPMENT

1. Trimming data by smoothening the irregularities for the purpose of showing them as accurate and precise. However, this is allowed to some extent by convention.

2. Cooking data like deliberately omitting certain data that would lead to a different result than intended.

3. Forging data by inventing some or all the data without exactly performing the experiment.

4. Plagiarism by use of intellectual properties of others without due reference to them or credit though drawing a line between legitimate and illegitimate use of intellectual properties is often difficult.

5. Multiple authorship though legitimate, in general, sometimes some researchers include too many names as authors, just to satisfy the need of some to show a large number of publications.

24.5 CASE STUDIES IN RESEARCH, EXPERIMENTATION, AND OPERATION

The following case studies illustrate the engineers' role in ethical research, experimentation, and operation of engineering projects.

24.6 CHALLENGER CASE STUDY

24.6.1 Why is the Explosion that Occurred in the Challenger Shuttle Ship Considered an Example of Experimentation?

At the outset, the explosion on 28 January 1986 in the Challenger Spaceship, in which seven astronauts were killed, looks like any other accident that would be considered as a case study for the safety of launch vehicles. True. But at the same time, there were many things done in this case for the first time. NASA had experimented on the design features and underestimated the risks and, hence, it is a lesson on how the experimenters should consider all the factors and give them equal significance before experimenting with the shuttle, that too with human astronauts on board. To quote NASA historian Alex Roland, who commented on the NASA space programmes several months before the Challenger crash,

> *The American taxpayer bet $14 billion on the shuttle. NASA bet its reputation. The Air Force bet its reconnaissance capability. The astronauts bet their lives. We all took a chance. When John Young and Robert Crippen climbed aboard the orbiter Columbia in 12 April 1981, for the first shuttle launch, they took a bigger chance than any astronaut before them. Never had the Americans been asked to go on a launch vehicle's maiden voyage. Never had astronauts ridden solid propellant rockets. Never had Americans depended on the engine untested in flight.*

24.6.2 Basic Features of Challenger

A space shuttle, like the Challenger, is a carrier vehicle to put a satellite into space. On re-entry into the atmosphere, it falls safely into Pacific Ocean. It is so designed that after its retrieval, it can be reused to launch other space satellites.

It basically consists of an orbiter that looks like a small-sized airplane fastened to an assembly of two solid propellant rocket boosters and one liquid propellant rocket booster (Fig. 24.1a). The rocket boosters function only during the first few minutes after launch, after which they are jettisoned and recovered from the ocean, only to be repacked with fuel and reused.

Fig. 24.1 *General view of the orbiter fastened to the booster rockets*

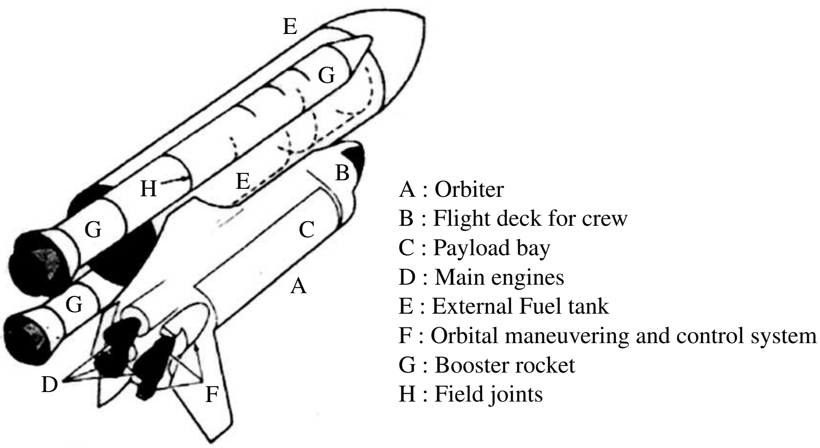

Fig 24.2 *Another view of the orbiter fastened to the booster rockets with details*

24.6.3 Design Features of the Rocket Boosters

While solid boosters have the advantage of higher thrust per kg of fuel, they have the disadvantage that they can neither be turned off or can they control the thrust, whereas liquid boosters can be controlled by throttling the supply or shutting off the fuel.

Prior to Challenger, the space shuttle used was Titan missile and in 1974 NASA decided to build a larger shuttle and awarded the contract to a company called Marton Thiokol, who developed a scaled-up version of Titan with additional booster cylinders. This design was approved by NASA in 1976.

A key aspect of the booster is the field joint where the individual cylinders containing the fuel are fastened together by tang and clevis joints (Fig. 24.3a). Each joint is sealed by two O-rings, made of synthetic rubber to prevent leakage of hot gases. Since these O-rings

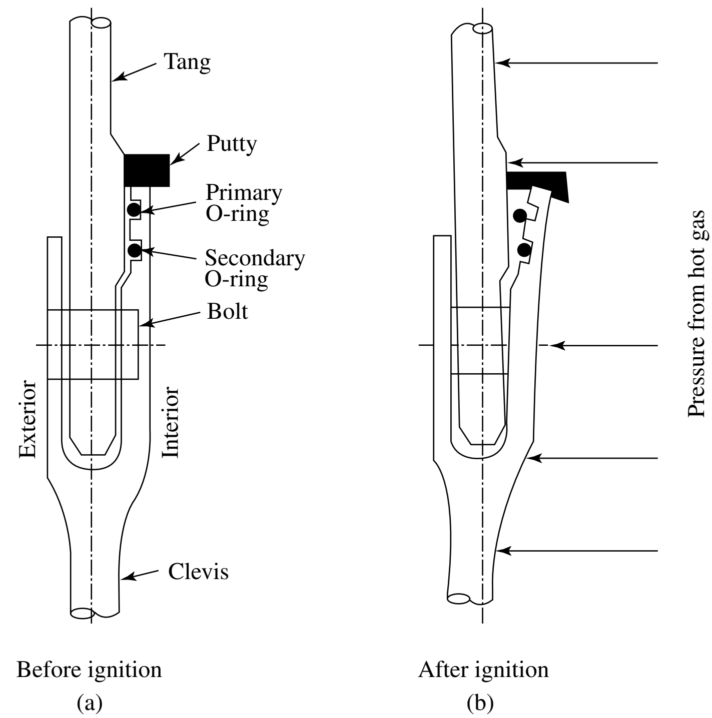

Fig 24.3 *View of the tang and clevis arrangement of the field joint*

are not optimally heat resistant, an additional layer of putty is applied on the joint.

When the rocket is ignited, the internal pressure causes the booster wall to expand outward pushing the joints to open slightly (Fig. 24.3b). The purpose of the putty is to take up this pressure and to push the O-rings into the gap for effective sealing.

24.6.4 Past Experiences of Shuttle Vehicle Launch

In 1981, when this shuttle was used for a second flight, erosion was noticed in the O-rings, but it was felt to be acceptable, since the purpose of the shuttle is only for the few minutes from the take-off. Nevertheless, this problem of O-ring erosion was highlighted and pointed out by the engineers of Thiokol as a black spot in the design.

During another launch of the shuttle in January 1985, post-flight examination of boosters revealed black soot and spilled oil on the surface, which gave rise to serious concerns. In July 1985, Thiokol engineers planned to replace the O-rings by steel billets for better heat resistance, but unfortunately the new designs were not ready by January 1986, when the manned flight on the Challenger was scheduled in. NASA was promptly alerted to defer the launch schedule, but the US Government. was in no mood to listen, since the European Space Agency was developing another type of shuttle, and US did not want to lag behind in time.

24.6.5 Political Pressure on NASA

Before the launch, NASA at Alabama did have a teleconference with Thiokol at Utah and Kennedy Space Center. During this, Thiokol engineers did point out the existence of a cold front at the launch site, which is as low as 20°F (minus 8°C), supposedly lower than any previous launch period and expressed that the O-rings may not function ideally at such low temperatures. However, some of the NASA engineers disagreed with Thiokol engineers saying that the data collected was too inconclusive to warrant deferment. There seems to no correlation between temperature and the degree to which the blow-by gases could erode the O-rings, they argued. But, in fact, it is the loss of elasticity of the O-rings at very low temperatures, if not the erosion, that subsequently became the major factor that led to the crash. This is explained further in Section 24.6.8.

Also, the then American Vice President, George Bush, who was already unhappy at the temporary deferment of the first launch schedule, pressurized NASA to arrange for this teleconference. Consequently, NASA pressurized the senior manager of Thiokol to overcome the resistance from his engineers and get the project completed on schedule.

24.6.6 Take your Engineering Hat Off and Put on Your Management Hat'

In deference to this instruction, the Senior Manager of Thiokol cut short the arguments of his engineers by saying, "Take your engineering hat off and put on your management hat", which has now become a famous expression in Professional Ethics. This aspect is detailed in Paragraph 13.7.2 under critical loyalty.

24.6.7 Early Hitch

At the eleventh hour of the launch, a defective control mechanism was identified and was rectified but this delayed the scheduled launch by a few hours.

24.6.8 How Exactly the Explosion Occurred on 28 January 1986

Several cameras were fitted on to the launch vehicle to monitor the critical areas and these could be seen from the monitor TV screens at the ground station. Initially, one of the cameras focusing on to the right booster recorded puffs of smoke coming from the aft field joint. Unfortunately, the ground monitors thought this to be caused by a steel cylinder of this segment expanding outwards and causing slight joint rotation. Actually, what happened was this: Due to extremely low temperatures, the O-rings became less elastic and did not seat properly. The putty, supposed to be heat resistant, also opened up the gap and due to the extremely low temperature did not regain its position. And hot gases burned past (called blow-by) the O-rings (Fig. 24.3b).

Fortunately enough, this blow-by caused the byproducts of the solid fuel combustion like soot, to form into a glassy oxide and seal the gap temporarily. The disaster would not have occurred if these oxides held firmly in the gap. But the very strong wind shear acting upon the shuttle during the first one minute was too high and shattered all the oxides. The gap opened again and the hot blow-by gases quickly burned thorough the external tank of the liquid propellant booster, causing the explosion.

24.6.9 The Aftermath of the Challenger Accident

1. The shuttle program was grounded for some time and the review of shuttle safety done.
2. A commission consisting of noted scientists and engineers, called the *Blue Ribbon Commission* was set up to enquire into the safety aspects.
3. During the enquiry, the two Thiokol engineers testified the facts and their warning about the O-rings together with the internal memos they had written about the possible failure of the O-rings. This had embarrassed the management of Thiokol, who took them away from the project of redesigning the field joint, forcing one of them to go on medical leave. This aspect is dealt with in more detail in Chapter 19 on discrimination and harassment.
4. A flood of letters reached NASA from public and seniors, criticizing the safety aspects of NASA, giving several recommendations for improvement.
5. On 22 January 1988, NASA released a press item stating

In response to several views of NASA safety and quality of the programs conducted in the aftermath of the Challenger accidents and associated recommendations *for improvements, NASA has acted to elevate agency emphasis on safety and implement organizational changes to strengthen SRMS&QA programs. There has been a 30% increase in NASA personnel assigned to SRMS&QA function since January 1986.*

6. Despite the above statement, a long-time manager of NASA had reported that the current policy of cutting down the shuttle workforce and privatizing the shuttle was jeopardizing the safety of future missions.
7. The Aerospace Safety Advisory Panel reported in May 1996 that

The multiplicity of changes and the uncertainty by the transition to a single contractor, downsizing, reinventing NASA, increased workload, loss of significant personnel capabilities and low morale have bred an environment which is ripe for human error.

8. These events have encouraged a strong lobby for robots replacing astronauts in future flights.

A robot is a machine that functions in place of a living humans. Robots are especially desirable for certain work functions, because unlike humans, they never get tired, they can undergo physical conditions that are uncomfortable and hazardous, they can operate in airless conditions, they do not get bored by repetitions, and they cannot be distracted from the task on hand.

24.6.10 A Strikingly Similar Incident after Two Years! and Yet Another in 2003!

In 1988, the spaceship Discovery was launched by the launch ship Atlantis. After its solid rocket boosters were retrieved and examined, it was noticed that the burning rocket propellant had burned one of the primary O-ring seals in one of the booster rockets of Atlantis. This problem was not discovered until four days after the launch. It was stated that this problem was particularly worrisome because a similar leak caused the explosion of Challenger in 1986. Though this had not resulted in any mishap, it exposed how people do not learn form past experience and rectify the faults in subsequent experiments. However, a somewhat similar design negligence resulted in the Columbia space shuttle disaster of February 2003, which is highlighted in subsequent paragraphs.

24.7 THE COLUMBIA SPACE SHUTTLE

On 1 February 2003, the space shuttle Columbia, after (ironically) a successful mission in space, broke apart as it re-entered the earth's atmosphere 60,000 meters over Texas, just 15 minutes before it was scheduled for landing. It killed all its seven astronauts and the debris was scattered over hundreds of miles in Texas forests.

24.7.1 Features of the FREESTAR Mission

The series of flights of this mission titled FREESTAR (Fast Reaction Experiments Enabling Science, Technology, Application, and Research) was dedicated to research in physical and other space sciences. There were 28 flights between 1981 and 2003 culminating in the 2003 disaster. It conducted about 80 experiments comprising hundreds of samples and test points. The orbiter was called EDO (Extended Duration Orbiter). The first flight of this series was in 12-14, April 1981, with John W Young and Robert Crippen as the crew. The penultimate flight on March 2002 had accomplished successfully the Hubble Space Telescope Servicing Mission.

24.7.2 Crew of Columbia Flight of 2003

Rick D. Husband	Commander	(His second flight)
William C McCool	Pilot	(His first flight)
Kalpana Chawla	Mission Specialist	(Her second flight)
David M. Brown	Mission Specialist	(His first flight)
Laurel B Clarke	Mission Specialist	(His first flight)
Ilan Ramon	Payload Specialist	(His first flight)

24.7.2 How the Explosion Occurred

This disaster of Columbia occurred due to peeling of insulating tiles during the re-entry. A total of 24,000 tiles were glued to the body. Some of them were bonded to the fuel tank that was to be maintained under minus 400^{o}F. Apparently, the ice formed at such low temperature must have come off and hit the tiles and under this impact, the tiles peeled off. This peeling off caused a chain reaction of several tiles coming off and this caused an imbalance Also, the loss of insulation increased the surface temperature during the re-entry resulting in the melting of the aluminum hull.

Prior to launch, a *wiggle test* was made to check the strength of the bond at high temperatures. However, the extremely low temperature of the fuel tank and the possibility of the formation of ice and its breaking off during high-speed flight was not thought off.

Another report says that the cameras mounted on the outside showed a gash of 7.5 by 30-inch size on the shuttle's left wing soon after the lift off caused by the launch debris. Just before the blast, the crew reported a loss of temperature sensors on the left-wing hydraulic systems, which was due to the peeling of the tiles.

24.8 CHERNOBYL CASE STUDY FOR MAINTENANCE AND OPERATION OF NUCLEAR PLANTS

24.8.1 The Hazards of Nuclear Power Plants

One of the greatest inventions by Alfred Nobel, the harnessing of atomic energy, had unwittingly gifted to humankind the evils of nuclear war race among industrialized nations. This started with the bombing of Hiroshima and Nagasaki by Americans and even as on date till 2013, the race has not ended. America only talks of Nuclear Proliferation Treaty, that is the limitation of nuclear arms by other countries, but does not want to apply it for itself.

The other application of nuclear energy, which is the generation of electric power by controlled fission process, is well sought of. With more and more countries setting up nuclear power plants and getting benefit in the form of economical power, these have become a common but significant feature in the world's power-generation scenario.

Nevertheless, these nuclear power plants are not without the inherent hazards, and we have not yet been able to control the fission process completely so as to be hazard free. Added to this, the lack of optimal training, mismanagement, ignoring certain safety precautions, etc., makes nuclear power generation as highly hazardous. There have been several accidents that have occurred in nuclear power plants resulting in heavy causalities and monetary losses. It is hence necessary for the engineers to know the basic process involved, the minimal safety precautions that need to be adhered to, etc., to understand why a small judgment error results in major mortal issue. It is also the reason why books on ethics discuss nuclear power plant accidents, especially major ones like those at Chernobyl and Three Mile Island.

The tables in the following page list some of the accidents that have occurred in nuclear power plants, both in USSR and USA, since the early fifties.

Table 24.1 *A series of accidents in nuclear power plants*

Sl. No.	Year of accident	Location of the plant	Cause and Effect
A : USA			
1	1951	Detroit	Reactor overheated, releasing radioactivity into atmosphere
2	1959	Santa Susanna, California.	Partial meltdown of fuel rods resulted in shutdown of the plant
3	1961	Idaho Falls	An explosion at the plant killed three persons
4	1966	Detroit	Partial meltdown of the fuel rods released radioactivity into atmosphere
5	1971	Marticello, Minnesota	An explosion resulted in over 53,000 gallons of radioactive water being released into the Mississippi river
6	1979	Three Mile Island, Pennsylvania	Discussed in detail as a case study
7	1979	Irving, Tennessee	Unspecified accident released radioactivity into the atmosphere
8	1982	Rochester, NY	Unspecified accident released radioactivity into the atmosphere
9	1982	Ontario, NY	Unspecified accident released radioactivity into the atmosphere
10	1985	New York City	Unspecified accident caused leakage of radioactive water.
11	1986	Webbers Falls, Oklahoma	An explosion in a tank containing radioactive gas killed one person and resulted in other unspecified losses
B : USSR (Former Confederation of Soviet countries like Russia and Ukraine)			
1.	1957	Chelyabinsk	A spontaneous reaction in spent fuel rods caused substantial release of radioactivity into the atmosphere
2	1966	Melekes	A sudden surge in power released radioactivity into the atmosphere
3	1974	Leningrad	Explosion at the plant resulted in unspecified losses
4	1977	Byeloyarsk	A partial meltdown of the fuel rods occurred

(contd.)

(contd.)

5	1978	Byeloyarsk	The same plant reactor went out of control after a roof panel fell into
6	1982	Chernobyl	An unspecified mishap released radioactivity into the atmosphere
7	1985	Balakovo	A relief valve busted resulting in the death of 14 personnel
8	1986	Chernobyl	A major explosion destroyed the whole plant, resulting in the worst-ever catastrophe in nuclear plant history

24.9 THE CASE OF THREE MILE ISLAND POWER PLANT

The explosion at the Three Mile Island (TMI) nuclear power plant on 28 March 1979 brought into light the hazards of nuclear power plants and created an awareness for the need for meticulous training of the operating personnel in following the safety regulations and operational procedures to the letter.

24.9.1 General Working Principles of a Nuclear Power Plant

Figure 24.4 gives a schematic diagram of the plant. A nuclear reactor works on the principle of heat generated by the nuclear fission in a closed reactor. The plant has three water circuits, **A**, **B**, and **C**. The water in the primary or the heavy water circuit **A**, gets heated by the above nuclear fission in the reactor **D**. It is pumped through the steam

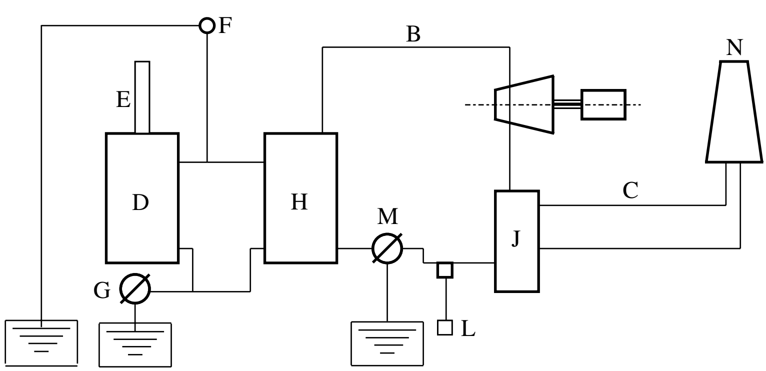

Fig. 24.4 *Schematic diagram of a nuclear power plant*

A, B, C: Primary, secondary and cooling water circuits, **D**: Core reactor, **E**: Control Rods, **F**: PORV, **G**: Primary booster pump (EIW), **H**: Steam generator (boiler), **I**: Turbine – Generator, **J**: Heat Exchanger, **K**: Demineraliser, **L**: Condensate tank, **M**: Secondary water booster pump, **N**: Cooling tower generator **H** (or the boiler) for heating the water of the secondary circuit **B** into steam. This heavy water of the primary circuit is recirculated to the reactor core. A relief valve **F** present in the primary circuit called *Pilot Operated Relief Valve (PORV)*, relieves the excess pressure in the reactor and simultaneously the *Emergency Injection of Water (EIW)* **G** takes place to replenish the loss of pressure through the valve.

The heat energy of the steam from the boiler in the secondary circuit gets converted to mechanical energy at the turbine **I**, which operates a generator to produce electric power, the final output. The steam in the secondary circuit, after the turbine, gets cooled to water in the heat exchanger **J** by the third water circuit **C**, called the *cooling water circuit*.

After the heat exchanger, the water of the secondary circuit is pumped back to the boiler, through a demineraliser **K** where resin beads clean the water of all the minerals, greases, and other solids that contaminate it.

24.9.2 Chronology of Events that Led to the Accident

1. The whole problem started in the early hours of 28 March 1979 at 4 a.m. at the demineraliser, when some of the resin beads got caught and choked the water line. This led to the shutting down of the pumps **M** feeding water to the secondary circuit.
2. As there was no flow of water, the water in the boiler got reduced reducing the effectiveness of the boiler to cool the water on the primary circuit. Unfortunately, the dry steam blocked the movement of water in the water-level indicator because of which the operating personnel were not aware of the low water situation.
3. The personnel also ignored the other problem, viz., the nonfunctioning of the booster pump.
4. Consequently, the temperature and pressure in the core rector increased. And this made the relief valve open out and let out the water of the primary circuit in the form of steam.
5. This activated a safety alarm that automatically lowered the control rods **E** to reduce the temperature.
6. Simultaneously, the steam in the primary circuit also blocked the operation of the water-level indicator due to which the operators were not aware that the water level in the primary circuit was dangerously low, prompting them to switch off the primary water-booster pump. This signaled the *Loss of Coolant Accident (LOCA)* alarm. But this only confused the operators because the water level gave the contrary indication.

7. When the day shift workers arrived at 6 a.m., the hazard was noticed and immediately a general emergency was declared. They pumped water into the primary circuit and opened the PORV.
8. Even before that time the chemical reaction between the dry steam and the fuel rods in the core reactor resulted in the generation of hydrogen which exploded at the high temperature without damaging the structure or giving any other indication.
9. This explosion was heard by the operators as a 'thud', which they mistook for a voltage surge. in the electrical system.
10. The fuel rods got partially melted and the contaminated water overflowed into the building causing a catastrophe of radiation and effecting several workers.
11. Only at around 3 p.m. the initial temperature could be restored and normalcy resumed.
12. The damages due to this accident had run into billions of dollars.

24.10 THE CASE OF THE CHERNOBYL NUCLEAR POWER PLANT DISASTER

24.10.1 Chronology of Events

The nuclear power plant at Chernobyl, Ukraine (former USSR), had an explosion on 26 April 1986, resulting in a major catastrophic effect on almost half of the globe. Chernobyl used RBMK reactors, which is the Russian abbreviation for *Graphite Moderated Boiling Water Tube Reactor*.

1. It all started at 1.00 p.m. of 25 April 1986, with the plant engineers planning to do an experiment on the plant cycle to determine the time lag between the shutting down of the power plant and the commencement of power generation by the standby diesel generator set. This experiment needed the reactor to be operated at 50% capacity. They also shut down the emergency cooling system as they thought the system might effect the experiment.
2. In the meantime, there was sudden requirement of power by the HQ at Moscow, who sent in instructions to increase the power to the peak level. The experiment had just started and they needed the full day to complete it. Nevertheless, in deference to the instructions from the HQ, they decided to defer the experiment and ran the reactor till late evening as required by HQ.

3. At 11 p.m., that is during the night shift, they recommenced the experiment.
4. To reduce the duration of experiment, they lowered the control rods at a fast rate to reduce the power to 50% capacity. This initiated the self-dampening effect of the reactor as explained in the next paragraph and the power dropped to less than 10%. This is a critical situation to continue with the experiment. The chief engineer in charge of the experiment had two options before him:
   - To let the reactor cool completely and wait for at least two days to let the poisonous gases dissipate before starting the reactor again, or
   - Immediately continue increasing the power and complete the experiment before the end of the shift. He was aware of the danger of unmanageable controlling of the reactor, but he considered it to be of very low probability.
5. He took the latter decision to be able to complete the experiment as early as possible and passed instructions to his engineers accordingly.
6. So, they raised almost all the control rods, except 18, while the safety regulations required at least 28 rods to be inserted. Even the primary cooling system was deactivated, as they thought it might interfere with the experiment. Unfortunately, for him this turned out to be a wrong judgment.
7. Thirty seconds before the explosion, at around 1.22 a.m. in the night, the workers felt the reactor temperature being uncontrollably high and with only three control rods in the reactor, the water in the primary circuit was super heating. In a panic, they shut off the coolant water and dropped the control rods, but it was too late.
8. The floor began to vibrate due to the high pressure and the pipes burst. The superheated steam reacted with fuel rods generating hydrogen and oxygen gases. The explosive mixture of the gases detonated destroying the reactor and the containment construction.
9. The plant director was called up at his residence, but was not told of the full destruction. In their own fear, the engineers underplayed the damage. He accordingly did not realize the seriousness and took some time to react.
10. The fire service was called in, but as it was well past midnight, they did not come well prepared with protection equipment and they were not alert. Most of them died due to radiation.

24.10.2 How Safety Precautions were Flouted in this Case

Having gone into the chronology of the accident, let us first review the safety systems incorporated in the design of the reactor that were, in general, flouted.

1. This nuclear power plant works on the same fission process as the Three Mile Island plant, or in that case, like most other nuclear plants around the world.
2. To reduce the heat generated, apart from the primary water, the plant uses graphite rods as moderators or control rods. The more they are inserted into the fuel rod chamber, the more they inhibit the fission and thus the heat generated in the reactor is controlled by these rods, apart from removal of the heat by the primary water. The Chernobyl plant uses a total of 211 control rods, of which a minimum of 28 rods are supposed to be inside the chamber at any time for the highest temperature corresponding to the peak power generation.
3. While control rods control the heat generated in a linear scale as indicated by the control panels, the inherent property of nuclear fission is that the temperature rises and falls down in an exponential scale, poorly indicated in the control panels. This is like controlling the accelerator of a two-wheeler with a defective spring rod connected to the carburetor. The initial twist of the throttle does not increase speed as it is expected. However, by keeping the thriller in the same position, the spring acts belatedly and then there is a spurt of speed, even if you have kept the throttle lever at the same position. In case of a nuclear reactor, similar effect is noticed, called self-amplifying and self-dampening effects. Surprisingly, such a significant factor was ignored while conducting the experiment and this has become a major cause for the explosion.
4. Because of the above factor, it was specified that when the temperature of the reactor is between 80% and 100% of the peak, it is the uncontrollable zone and no attempt should be made to increase power till the temperature falls below that level.
5. Under no circumstances should the cooling system be deactivated during the normal working. However, the engineers thought it would be safe to deactivate them during the experiment.

24.10.3 Aftermath of the Explosion

1. At 1.24 a.m. of 26 April 1986, the explosion took place and blew the top of the containment building exposing the hot molten materials in the reactor core to air.

2. 31 power plant workers including the firefighting personnel died immediately due to the debris.
3. Helicopters were used to pour sand and chemicals to contain the fire for several hours.
4. The reactor site was fully covered by concrete mass to prevent further escape of radiation.
5. Over 4000 workers were estimated to have died out of exposure to radiation within a few days.
6. The radioactive cloud covered the whole of Eastern Europe including as far as Norway.
7. Within a week, radioactive levels escalated all over Europe and Asia.
8. Over 45,000 persons was estimated to have died.
9. 70,000 people mostly Ukrainians were disabled.
10. Over five million people were exposed to radiation.

24.11 SIMILARITIES BETWEEN THE ACCIDENTS AT THREE MILE ISLAND (TMI) AND CHERNOBYL

- Pressurized Water Reactors (PWR) were used at TMI, whereas Chernobyl used Graphite Moderated Boiling Water Tube Reactor (RBMK), which has weaker containment system relative to the space into which gases and steam can expand in case of extraordinary pressure build-up. This results in letting gases and steam leak out during any mishap.
- Both PWR and RMBK reactors are sensitive to vibrations.
- In both accidents, the operatives were careless about maintenance and proper operation of the control valves.
- The preparedness during emergency situation was low in both cases.
- There had been no review of the operating procurers by experts in both cases.
- In the case of Chernobyl, the operatives and even the senior executives could not correctly assess the dangerous situation developing and underplayed the extent of dangerousness of the situation when they reported the matter to the HQ.

24.12 KASHIWAZAKI KARIWA NUCLEAR POWER PLANT OF JAPAN

Though this is not a case study of explosion in plants like the above two, a news item of July 2005 highlights the use of tripping mechanism in case of suspected radiation leaks.

> *A nuclear power reactor in northern Japan stopped automatically on Sunday after a protective device on one of the turbines kicked in, but there was no radiation leak, the plant's operator said. Officials are investigating the cause of the shutdown of the No, 5 reactor at the Kashiwazaki Kariwa Nuclear power plant, about 200 km northwest of Tokyo, Tokyo Electric Power Companies in a statement.*

24.13 BHOPAL GAS TRAGEDY CASE STUDY FOR THE MAINTENANCE OF CHEMICAL EQUIPMENT

Union Carbide's chemical plant at Bhopal used large quantities of Methyl Isocyanide (MIC), a highly toxic gas used in the manufacture of pesticides. This is normally in gaseous form but was stored as a liquid under high pressure like LPG in tanks of 1000-gallon capacity.

On the night of 2nd December 1984, a leak developed sending toxic gas over the surrounding slums killing over 2000 people and permanently disabling or otherwise causing ill health to lakhs of people. The basic reasoning attributed to this tragedy was the accidental mixing of water with MIC.

The Basic Shortcomings

The postmortem of the several factors that led to the accident revealed the following causes that can be classified into three groups:

- Design shortcomings
- Management shortcomings
- Maintenance shortcomings

A. Design Shortcomings

1. Two similar-looking pipelines connected to the MIC tank and used for maintenance works, were laid side by side. The former was to flush the residual MIC into another chamber and only

after the tank was free of any residual MIC, the latter was to be opened to rinse and clean the tank with water. The possibility of opening the wrong valve by mistake was ignored.

2. Knowing fully well that if water is let into the MIC tank when MIC is present, high pressure and temperature could generate causing serious explosions and otherwise accidents, no safety precautions were built in this direction.
3. No closed chamber was provided around the relief valve to prevent leaking MIC to be let into open air.

B. Management Shortcomings

1. Union Carbide Inc. did not transfer all the safety mechanisms planned for their US plant to the Bhopal plant.
2. The Government of India wanted the plant to be operated by Indians only. This led to a crash-training course to the operators at the US plant, during which the safety training took a rear seat.
3. Eroding of safety standards happened while changing over from American Standards to Indian standards.
4. High turnover of employees in Bhopal contributed to
   - Insufficient and half-hearted training,
   - Low safety awareness,
   - Low technical preparedness, and
   - General attitude about lack of safety consciousness at work.
5. The management, as a part of cost-saving efforts, curtailed plant-maintenance activities. The maintenance supervisor of the second shift was shifted to the first shift and his jobs were assigned to the production supervisor who was less trained in maintenance operations.
6. Internal financial pressure of the parent company Union Carbide also led them to relinquish supervision of the safety of the plant.
7. The final inspection team sent by them to visit the Bhopal plant in that year warned of several potential hazards, which were not taken up seriously by the management. This procrastination in rectifying the hazards led to the accident.
8. The management did not enforce the wearing of masks and gloves even after cases of vomiting, etc., among workers.
9. The people residing in the slums around the factory were not advised by the management about the potential hazards of the factory.
10. The management took no attempt for the evacuation of the public from the surroundings after the accident.

C. Maintenance Shortcomings

1. The safety standards had specified the tank to be filled up to only 60% of its capacity, while it was being filled to 75% capacity.
2. A stand-by tank, which was supposed to be empty to enable transferring gas during flushing, too was filled with MIC.
3. A relatively new worker was assigned the job of cleaning the pipes and tanks without supervision.
4. The refrigeration unit, which was supposed to prevent excess heat generation in the tank, was not functioning for the past five months but was not repaired.
5. The alarm that was supposed to warn workers of excess heat was improperly set so that it too became ineffective at the critical time.
6. The gas scrubber designed to neutralize the gas was shut down to save energy, as it was assumed to be needed only when the plant was running.
7. The flare tower to burn off the escaping gases (missed by the scrubber) was under repair.
8. After the leak, the workers did try to minimize the damages by spraying a water jet, but the jet's capacity was only 100 feet, while the gas was escaping from a 120-feet high stack.

24.14 KUMBAKONAM SCHOOL FIRE TRAGEDY

On 16 July 2004, the fire tragedy in the Saraswati Primary School and Sri Krishna Aided Higher Secondary School, both housed in the same building at Kumbakonam, Tamil Nadu, India, was one of the worst in the state, when about 90 children of primary and nursery classes were killed. The fire, which sparked from the midday-meal kitchen while meals were being prepared, spread to the thatched shed and engulfed the classrooms in a matter of seconds. Even the classrooms in the first floor had only thatched roofing. To make matters worse, there was a narrow staircase that had several sundry materials obstructing the free passage. The following may be cited as some of the contributing cases.

1. The school had about 900 students housed in overcrowded classrooms.
2. The kitchen was located adjacent to the staircase making it hot at the exit passage.
3. Firewood ovens were used instead of gas cookers.
4. Even the classrooms in the upper floors housing 180 children had thatched roofing.

5. While older children were housed in *pucca* classrooms, only the nursery and primary schoolchildren were housed in classrooms that had thatched covering.
6. The only staircase was very narrow and stacked with sundry materials to prevent exit in crises.
7. The thatched portion housing the primary children was located on the other side of the staircase, with a large hall housing older children in between. The caused the delay for the younger children to go out as the older children being nearer to the staircase rushed out first.
8. It was a matter of crisis and the little children did not know what to do and which way to run.
9. The schoolteachers were not trained to handle children in such crises.
10. It was also alleged that some of the teachers did not guide the children properly in that crisis, but rushed out faster to save themselves. The allegation was based on the reports that they escaped without any injury while 90 children perished.
11. The education department did not inspect the school for three years, nor took any steps to eliminate the obvious hazardous conditions of the school.
12. The school management took no action to replace the thatched sheds by *pucca* roofing or to reduce the overcrowding of the classes.
13. On the whole, this tragedy reflected gross negligence of duties of the government departments, the school management, and the teachers.

Dr. Abdul Kalaam, the President of India, had penned the following poem in memory of the children killed in the tragedy.

Oh dear little ones! Oh dear little ones!

For you, parents had glorious dream!

And you were all immersed in your own dreams

Yet, Agni engulfed you and all those dreams

Taking you to Almighty's divine presence

Usually, departed old parents are buried by sons

Whereas, Kumbakonam saw a sad scene!

Crying parents burying their little ones!!

Oh Almighty! Show your grace on the little ones

And keep them in Thy holiest presence!!

Oh Almighty, bless those parents wailing in grief

To have the strength to bear this great loss

May thy compassion and grace pervade all souls

And bring down the pain and wipe away the tears

Oh Almighty! Show your grace on those little ones.

(Reproduced with kind permission from the President's Office)

24.14.1 Not Learning from the Past?

This was the fourth major fire in Tamil Nadu.

1. On 7 June 1997, 60 people were killed in a fire at the Brihadeeswara Alayam at Tanjavur when a yagna was being performed in a thatched pandal.
2. On 6 August 2001, 30 mentally ill patients, some chained to their cots in a mental asylum, perished in Yerwadi in the southern end of the state.
3. On 23 January 2005, over 30 persons including the bridegroom, died in a marriage hall in Srirangam near Tiruchirapalli.

24.14.2 Rights and Responsibilities of Parents

All parents, before admitting their wards in a school, should check and satisfy themselves about the following.

- General air quality,
- Ventilation systems, roofing systems,
- Fire preventions systems, and
- Safe exits.

As parents, they have every right to get convincing response from the school management to their queries as illustrated in the following checklist.

24.14.3 Suggested Checklist

Kumbakonam and other fire tragedies that occur so frequently in India call for a comprehensive analysis and development of prevention systems by the government and educational authorities. It is suggested that the local offices of the Educational Department prepare questionnaires and checklists as below and visit every school in their control periodically and issue certificates without which the schools may not be allowed to function.

A. Fire Prevention

1. Does each classroom have fire extinguishers, especially near switchboards?
2. Are fire-sprinkler systems provided?
3. What are the potential fire hazards like kitchens?
4. What fire exits are provided other than the staircases?
5. How many staircases are present? If there is only one, is it sufficient to vacate all the students in less than a minute in case of fire?
6. Are the staircases and other fire exits free from blocks?
7. What is the distance between the farthest classroom and the staircase?
8. Are the buildings locked or blocked? Is security vigilant enough to open the gates wide in case of emergency?
9. Are all the staff trained to handle the children in case of emergency?
10. Are fire drills held periodically?
11. Do you have emergency lighting system, specially in case of institutions that teach at night?

B. Air Quality

1. Are exhaust fans fitted in each classroom?
2. Are the ventilation units free or blocked (with vegetation, sundry storage materials, etc.)?
3. Is there a potential source of air contamination in the near vicinity like chimneys from industrial plants, exhaust from the neighboring buildings, etc.?

C. General

1. How old is the building?
2. Is it a thatched roof or temporary cloth roofing or asbestos roofing or *pucca* RCC roofing?
3. Is the roof in good repair?
4. Is there evidence of waterlogging in the rooms or on the roofing?
5. Are the walls damp?
6. Are the walls or floors flaking or with sharp projections enough to cause injuries to the students?

7. What actions are taken in case of complaints by parents or students or teachers about the absence or insufficiency of the above?

Question Bank

PART A

(Each question carries 2 marks, which you are expected to answer in 3 minutes)

1. What was the purpose of the Challenger spaceship?
2. Distinguish between liquid propellant and solid propellant with reference to the power generated and controllability of ignition.
3. What is the meaning of jettisoning?
4. Why is the orbiter is designed like a plane rather than like other satellites?
5. What is the purpose of the putty used in the field joint?
6. Compare the similarities between the Challenger disaster of 1984 and Columbia disaster of 2003.
7. What is a robot? How is it suitable for space exploration?
8. What is FREESTAR?
9. What is meant by TMI?
10. What are the similarities between the accidents at TMI and at Chernobyl?
11. What is NPT?
12. Why do wed study the case studies of these accidents in ethics?
13. Failure of which component of the power plant led to eh TMI accident?
14. Explain the function of the control rods used in nuclear fission.
15. Why is it essential for the engineer to discuss about Bhopal gas tragedy as a case study?
16. What should be the role of the teachers of primary schools in crisis management?

PART B

(*These are mostly 8-mark questions to be answered in 12 minutes, presuming that the time allotted for a 100-mark question paper is 3 hours. Sometimes the same question may be asked as a 16-mark question to be answered in 25 minutes.)*

1. Why do you consider the Challenger disaster more as an illustration of experimentation than on safety?

2. Explain how exactly the putty and O-rings failed resulting in the explosion.
3. Discuss the statement '*Take off your engineer hat and put on the manager hat'*.
4. Discuss the aftermath of the Challenger disaster.
5. What ethical lessons do you draw from the Challenger case study?
6. Discuss the statement *'people do not learn from past experience'* with reference to the Columbia disaster.
7. Discuss how nuclear power plants pose hazards to the general public.
8. Discuss the general working principle of the TMI nuclear power plant.
9. Explain the chronology of events that led to TMI accident.
10. What ethical lessons do you learn from TMI accident?
11. Explain the chronology of events that led to Chernobyl accident.
12. Discuss the specific safety precautions that were flouted in Chernobyl leading to the accident.
13. What ethical lessons do you learn from Chernobyl accident?
14. What is the aftermath of Chernobyl accident?
15. Discuss the factors that act as threats in an MNC's successful operation in foreign countries.
16. Discuss the several operational shortcoming that were responsible for the Bhopal gas tragedy.
17. Discuss the factors that led into Kumbakonam school-fire tragedy.

PART C

(Objective-type Questions)

1. Fill in the blanks:

(i) ________ joint is the critical location that ultimately resulted in the explosion of Challenger space ship.

(ii) The O-rings are made of ________ (synthetic material/steel billets)

(iii) Among the Columbia crew, _______ is of Indian origin.

(iv) MIC means ____________ ____________ ____________

(v) A majority of the victims in Kumbakonam fire were studying in ____________ class. (primary / higher secondary)

2. Answer if the statement is true or false:

(i) The engineers of Marton Thiokol commited the mistake by not pointing out the weakness of the O-rings.

(ii) Columbia crashed during the very first flight of the mission FREESTAR.

(iii) The high temperature of the re-entry caused the insulation tiles to peel off.

(iv) MIC is an odorless gas. (True or false)

(v) Kumbakonam school tragedy started because of a cigarette butt.

3. Match the following:

(i) Challenger disaster	(a) Thatched roofing
(ii) Columbia disaster	(b) O-ring failure
(iii) Three Mile Island disaster	(c) Wrong testing procedure
(iv) Chernobyl disaster	(d) Non-illuminated safe excite
(v) Delhi theatre disaster	(e) Failure of relief valve
(vi) Titanic disaster	(f) Peeling off of insulation tiles
(vii) Kumbakonam school disaster	(g) Poor maintenance of valves
(viii) Bhopal disaster	(h) Insufficient safe-exit equipment
(ix) Insufficient safe exit equipment	(i) Chernobyl Disaster
(x) Poor maintenance of valves	(j) Challenger disaster
(xi) Ignoring danger signals raised by engineers	(k) Kumbakonam Fire accident
(xii) Unplanned switchover from test mode to power generation mode	(l) Titanic disaster
(xiii) Encroachment in fire exits	(m) Bhopal Gas Tragedy

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