

Professional Engineer's Roles and Responsibility

Ab Saman Abd Kader, ^{PhD}

Faculty of Mechanical Engineering
Universiti Teknologi Malaysia,
Skudai, Johor

Abstract - This paper highlights the scope of engineering education and their relevant to engineering profession being globally practiced in various sectors of development. The main objective of this discussion is to create awareness on the importance of engineering education in terms of their contents in responding to the work place requirement. It is to know about engineering profession by and large and also their scope of works in relation to engineer's roles and responsibilities. The contents of engineering education and their dynamic development provide the tools for engineers to play their significant roles and responsibilities across a multidiscipline of engineering profession. The behavioral of professional engineers through a standard code of ethics should create engineers ability to troubleshoot problems under various circumstances and propose a solution through a number of approaches to the benefit of community, nation as well as global integration.

1.0 Introduction

1.1 What is Engineering

There are various definitions on what is engineering and how it relates with the teaching and learning environment. Some of those can be expressed as follows;

"Engineering is all around us, so people often take it for granted, like air and water. Ask yourself, what do I touch that is not engineered? Engineering develops and delivers consumer goods, builds the networks of highways, air and rail travel, and the internet, mass produced antibiotics, creates artificial heart valves, builds lasers, and offers such wonders an imaging technology and conveniences like microwave ovens and compact discs. In short, engineers make over quality of life possible" (William A.Wulf, President of the National Academy of Engineering)

"Engineering is the application of science to the common purpose of life" (Count Rumford)

"Scientists study the world as it is, engineers create the world that never has been" (Theodore Von Karman)

From all these definitions, engineering contents can be further broken down into numerous details. Some of the following are relevant in one way or the other:

- i. Engineering is an art
Aesthetics as well as function found in the Great Wall of China, Pyramid and other wonder of the world is truly an engineering genius in the form of art.
- ii. Engineering is an approximation
The mathematics of engineering system are often used to solve *"Engineering problems are under-defined, there are many solutions, good, bad and indifferent. The art is to arrive at a good solution. This is creative activity involving imagination institution and deliberate choice"*-(Ove Arup)
- iii. Engineering is measurement, estimation, forecast and projection
River flow, noise and vibration from transport system, earthquake, traffic volume, pollution and others.
- iv. Engineering is about modeling and simulation
Validation and verification of an analysis can be tested through modelling and computer simulation.
- v. Engineering is a communication, technical report writing and presentation
Making presentations, producing technical manuals, co-ordinating team of large scale project are all fundamental to engineering practice.
- vi. Engineering is finance
Design, construction, operations, repair and maintenance costs, hiring, chartering and others determine the viability of the intended projects.

vii. Engineering is an invention and design processes

New devices, material selection and viable processes are developed by engineers to meet the requirement that existing technology do not address. Engineers identify and apply the most suitable system to solve engineering related problems using appropriate decision making tools which were acquired through a number of circumstances.

In general, engineering is the art of applying scientific and mathematical principles, experience, judgement, and common sense. Engineering technologists use their knowledge to help design and make bridges, buildings, computers, electrical appliances, power plants, transport infrastructures, etc that we utilise at present. Engineering is also deal with the process of producing a technical product or system to meet a specific need to benefit mankind.

1.2 Who is Engineer

The following are some of the definitions on who is an engineer. Engineer is;

- i. A person who were trained in the design, construction, and use of engines or machines, or in any of various branches of engineering: a mechanical engineer, civil engineer, electrical engineer, chemical engineer, etc.
- ii. A person who operates or is in charge of a power plant system in term of operation, repair and maintenance.
- iii. A consultant in their respective area of expertise
- iv. A skillful manager who manages the implementation of the engineering related decision making processes.
- v. Etc

2.0 Greatest Engineering Achievements of the 20th Century

20th century have witnessed a great achievement in engineering technology in the field of design, information technology (IT), construction, manufacturing, robotic, advanced materials or even the engineering management techniques for problem solving. Some of the newly and enhanced technologies can be described and interpreted as the following,

i. Nuclear technologies

Nuclear technologies provide a new source of electric power and new capabilities in medical research and imaging as well as for unwarranted military use.

ii. Lasers and fiber optics

Pulses of light from lasers are used in industrial tools, surgical devices, satellites, and other products. In communications for instance, a single fiber-optic cable can transmit tens of millions of phone calls, data files, and video images.

iii. Petroleum and gas technologies

Petroleum has been used to providing fuel for cars, home, and industries. Petrochemicals are used in products ranging from aspirin to zippers. Engineering in oil exploration and processing, petroleum products have an enormous impact on world economies, people, environment and politics.

iv. Health technologies

Medical professionals have an arsenal of diagnostic and treatment equipment at their disposal. Artificial organs, replacement joints, imaging technologies, and bio-materials are but a few of the engineered products that improve the quality of life for millions.

v. Imaging technologies

Imaging technologies have expanded the reach of our vision. Probing the human body, mapping ocean floors, tracking weather patterns are all the result of engineering advances in imaging technologies.

vi. Space explorations

The development of spacecraft has expanded our knowledge base, and improved our capabilities. Thousands of useful products and services have resulted from the space program, including medical devices, wireless communications, etc.

vii. Agricultural mechanization

The machinery of farms; tractors, cultivators, combines, and hundreds of others; dramatically increased farm efficiency and productivity.

viii. Electronics

Electronics provide the basis for countless innovations; CD players, TVs, and computers. From vacuum tubes to

transistors, to integrated circuits, engineers have made electronics smaller, more powerful, and more efficient.

- ix. Aeronautics
Modern air travel transport goods and people quickly around the globe, facilitating personal, cultural and commercial interaction.
- x. Automobiles
The automobile may be the world' major transporter of people and goods, and a strong source of economic growth and stability. The automobile is a showcase of 20th century engineering ingenuity, with innovations made in design production & safety.
- xi. Electrification
Electrification powers has literally lighted the world and impacted countless areas of daily life, including food production and processing, air conditioning and heating, refrigeration, entertainment, transportation, communication, health care, and computers.
- xii. Training and advancement programmes
A strong technical knowledge is essential for engineering managers, who must understand and guide the work of their subordinates, and explain the work in non-technical terms to senior management and potential customers. These management positions usually require work experience and formal education.

In most cases. to fill management positions, employers seek engineers who possess administrative and communications skills in addition to their technical knowhow. Engineers who prefer to manage in technical areas should get a Master degree in engineering management, while those interested in non-technical management should get an MBA.

Engineering managers may progressively advance to higher leadership positions within their discipline. Some may become managers in non-technical areas such as marketing, human resources, or sales. In high technology firms, managers in non-technical areas often must possess the same specialized knowledge as do managers in technical areas. Employers in an engineering firm may prefer to hire experienced engineers as sale workers because the complex services can only be marketed by someone with specialized engineering knowledge.

3.0 Engineer's Roles and Responsibility

Engineering encompasses science and art, mathematics and creativity, models and approximations in solving real-world problems. Engineers integrate their knowledge of the physical sciences with more abstracts realms beyond the boundaries of current technology in all areas of life. Chemical and bioengineers are working on drug related systems that work inside cells at the molecular level. An environmental engineers quantify the particle flow of pollutants through soil to clean up abandoned industrial sites, oil spills, and other hazards.

Engineers have many different types of jobs to choose from, including research, design, analysis, development, testing, and sales positions. Engineering work is also organized by traditional academic fields of study. Engineers are problem solvers who search for quicker, better, less expensive ways to meet tough challenges.

3.1 Professional Engineer

A professional engineer is competent by virtue of his fundamental education and training to apply the scientific method and outlook to the analysis and solution of engineering problems. He is able to assume personal responsibility for the development and application of engineering, notably in research, designing, construction, manufacturing, managing and in the education of the engineer. The work is predominantly intellectual and requires the exercise of original thought and judgment.

Engineers are capable of closely and continuously progressing in their branch of engineering through assimilation of various information and application. They are thus placed in a position to make contributions to the development of engineering and its application. The engineering education and training require a broad and general appreciation of the engineering sciences as well the special features of his own branch. He is able to give authoritative technical advice and to assume responsibility for the roles and his responsibility.

3.2 Engineering Professions

The majority of engineers fulfill the key characteristics of professional profession known as follows:

- i. They are required to be expert in a particular area of activity for which an advanced and extended formation is necessary and practice in which requires a high level of theoretical foundation.
- ii. They have mastered in a clearly definable and valuable body of knowledge and understanding.

- iii. They accept responsibility and accountability for the decisions they make against standard conduct and values.

The range of activities covered by engineers is greater than for most other professions. Engineers have over many years formed themselves into associations, the number of which has grown enormously from the founding of the Institution of Civil Engineers (IEM) in 1818 to the present day through a process of initiation, division and amalgamation based sometimes on technical disciplines such as civil, mechanical, electrical and other engineering disciplines.

There are now over 80 national engineering Institutions. In 1962, 13 of the largest Institutions, each holding a Royal Charter, established the Engineering Institutions Joint Council to provide a single forum and representative voice for all professional engineers. This body changed its name to the Council of Engineering Institutions (CEI) on securing its own Royal Charter in 1965. The CEI now comprises 16 Chartered Institutions which are corporation members and another nine with affiliate status.

The major Institutions were originally formed mainly as learned societies for the exchange of views and the dissemination of information among people with a shared interest in a branch of engineering. The efforts was made to raise the quality of its practical training in terms of educational attainments, practical and their personal standing in the eyes of their professional peers. This was done through the establishment of membership criteria which specified minimum requirement for education training and experience and which also imposed a code of professional conduct.

Engineers held 1.5 million jobs in 2002. Over 190,000 engineers worked in the government sectors. About 55,000 were self employed. Electrical engineers hold more jobs than any other engineer disciplines. Mining engineers hold fewer jobs than any other type. The number of jobs for engineers is expected to increase more slowly but rather steadily. However, job opportunities in engineering are expected to be good in future simply because the number of people in engineering education is expected to grow due to forecasted rise of technological development in the country.

4.0 Benefit for Being Professional Engineers

The reason for choosing engineering as a professional career largely attributed to the perception of the job security and market demand

as Malaysia poised to become the industrialised nation by the year 2020. However, several other reasons as follows can also contribute to the phenomena namely;

- i. Job satisfaction
Is important to find a career that provides ones with enjoyment and satisfaction. For numerous reasons, some engineering professions provide a very satisfying working environments.
- ii. Variety of career opportunities
An engineering degree offers a wide range of career opportunity. Within the practice of engineering, there is an enormous variety of job functions.
 - a. For an imaginative and creative, design engineering may be relevant.
 - b. For laboratories and experimental works, test engineering is relevant.
 - c. To organize and expedite projects, look into being a development engineer.
 - d. To be persuasive, consider a career in sales or service engineering.

The engineering analytical skills and technological expertise being developed can also be put to use in many other relevant fields. For example, an engineering knowledge and skills could be applied in the field of medicine or law. Similarly, engineers can also become a politician and use the knowledge of technology and science to set important policy. Ultimately, engineers could also become an entrepreneur in a related field such as in construction, manufacturing, or others businesses.

- iii. Challenging work
Generally, real engineering problems are quite different from most of the problems to be solved. In engineering work, virtually all problems has no readily answer to choose from. Engineers are required to devise a solution and make it applicable.
- iv. Intellectual development
An engineering education will develop the ability to think logically and to solve problems. These are skills that will be valuable throughout the life and not only when solving the engineering problems. For example, the problem-solving skills

can help one to undertake tasks such as planning, finding, organizing and even purchasing.

- v. Benefit society
Engineers benefit the society by developing clean and efficient transportation systems, finding new sources of energy, alleviating the world's hunger problems, and increasing the standard of living through the application of engineering technology.
- vi. Financial security
Financial security should not be the only reason for choosing a career in engineering. Engineering graduates receive the most highest starting salary in any discipline.
- vii. Prestige
Engineers play a pretigious role in sustaining our nation's international competitiveness, maintaining our standard of living, ensuring a strong national security, and protecting public safety.
- viii. Professional environment
In most cases, engineers receive adequate work space and the tools you need to execute their work, including the latest computer hardware and software. Quite often engineers are judged on the productivity as well as quality and quantity of their work.

Enginers have the opportunity to learn and grow through both on-the-job and formal training. Often, the immediate supervisor will closely involved on some challenging tasks. Engineers are usually allowed to attend seminar, conferences and short course when necessary in enhancing their knowledge and skills. Some employers provide funds for engineers to enrol in highern education and training.
- ix. Technological and scientific discovery
An understanding of technology will provide engineers with a better understanding of many issues facing the society and determine the most viable ways in addressing the issue such as utilising a zero-emission electric vehicles to reduce noise, vibration and pollution.
- x. Creative thinking
Engineers develop solutions to a real-world problems. They employ conscious and subconscious mental processing as well as divergent and convergent thinking.

The need for engineers to think creatively is greater now than before. Through creativity, engineers cope with changes.

“Engineering is a great profession. There is the fascination of watching a figment of the imagination emerge through the aid of science to a plan on paper. Then it moves to realization in stone or metal or energy. Then it brings homes to men or women. Then it elevates the standard of living and adds to the comforts of life. This is engineer's high priviledge.” (*Herbert Clark Hoover, Engineer & President of the US from 1929-1932*)

5.0 Conclusion

Engineering exist everywhere in a number of ways and circumstances. It is part of our lives and everything we touch and do, relate significantly to engineering matters in one way or the other. Engineering is about everything around us that are being utilised in a manner that is able to provide answers and solution to various problems that we are facing. Engineering and technology change hand in hand and closely integrated to complement each other.

In order to be meaningful, engineering education and training programme is designed taking into consideration of global requirement for problem solving tool with greater freedom of efficiency. In doing so, a standard have been formulated for such programmes to be accredited and recognised paving the ways for a formal acceptance as a norm for before putting it into practice.

Bibliography

1. Website like Labour Market Information, Engineering an Engineers, 2004
2. Stephen P. Robbins & Mary Coulter, 'Management for Engineers', 1990
3. Board of Engineers Malaysia, 'Engineer Register Malaysia', 2000
4. Herbert Clark Hoover, Engineer & President of the US from 1929-1932
5. Lecture notes on Profesional Engineering Practice, SZM 4802, 2003