CHEMICAL ENGINEERING AND HUMAN EMPOWERMENT

– AN IRREVERSIBLE SYNERGY.

BY

ENGR. DR. MRS. F.L. KAMEN

Department of Chemical Engineering, Federal University of Technology, Owerri, Imo State.

DEFINITIONS

Chemical Engineering

To a lay man, Chemical Engineering can be defined as the branch of engineering which is concerned with the production of bulk materials in a most economical way by chemical means.

According to American Institute of Chemical Engineers, Chemical Engineering is the profession in which the knowledge of mathematics, chemistry and other natural sciences gained by study, experience and practice is applied with judgment to develop economic ways of using materials and energy for the benefit of mankind. [1]

Human Empowerment

Empowerment is the process of enabling or authorizing an individual to think, behave, take action, and control work and decision making about his job in autonomous, independent, self-directed ways. It is the state of feeling self-empowered to take control of your own destiny. In an organization, empowerment is a desirable management and organizational style that enables employees to practice autonomy, control their own jobs, and use their skills and abilities to benefit both their organization and themselves. [2]

Human empowerment is ultimately and primarily about self-empowerment by the individual in relation to the social group of which that individual is a member. Human empowerment comes through providing opportunity structures for people to achieve, through education and employment, and to gain access to greater social control over resources, along with increased responsibility in the utilization of those resources. It is primarily a matter of providing people the means to empower themselves, or to realize a form of self-empowerment that is largely independent of external structures that are coercive or obligatory in some manner that enforces conformity. Human empowerment, psychologically speaking, is about self-determination and ultimately about self-motivation and independent achievement. For instance, the Internet has empowered people with nearly instantaneous, affordable, temporally unconstrained communications worldwide. Anything that encourages independence through self-determination promotes human empowerment and in turn promotes human development. [3]
Synergy

Synergy is the interaction of two or more factors so that their combined effect is greater than the sum of their individual contribution. It is the creation of a whole that is greater than the sum of its parts. It can also be seen as the increased effectiveness that results when two or more people work together. [4]

CHEMICAL ENGINEERING, AN OUTSTANDING AGENT OF HUMAN EMPOWERMENT

Chemical Engineering is a very important agent of human empowerment. A well-trained Chemical Engineer can virtually adapt and succeed in most sphere of human endeavor more than any other engineer. This may sound as an over statement but it is true. To understand the empowering nature of Chemical Engineering, let us first take a look at the impact of Chemical Engineering on national development which also reflects the career opportunities of Chemical Engineers.

IMPACT OF CHEMICAL ENGINEERING ON NATIONAL DEVELOPMENT/ CAREER OPPORTUNITIES

Chemical Engineering has no doubt impacted positively and greatly in many areas of the nation’s development. Chemical engineers are employed in many industries representing a diverse range of products, employers, and services: Among them are:

1. Chemical Process Industries (CPI)

The CPI's focus is on the development, extraction, isolation, combination, and use of chemicals and chemical byproducts. Chemical engineers in the CPI design and operate the processes and systems to transform, transport, separate, handle, recycle, and store chemicals and their byproducts. These areas include:

- Agricultural chemicals (Fertilizers, pesticides, etc.)
- Specialty chemicals (Caustic soda, calcium carbonate, sulphuric acid, etc)
- Industrial Gases
- Paints, Varnishes, Pigments, and Inks
- Petrochemicals
- Petroleum Products
- Plastics, Synthetic Resins, and Composites
- Polymers
- Pulp and Paper
- Rubber and Rubber Products
- Soaps, Detergents, Perfumes, Fats, Oils, and Cosmetics
- Synthetic Fibers, Textiles, and Films
- Catalysts [5,6]

The list continues, but let us stop here and look at other areas as well.
2. **Food**
The food and beverage industry includes the handling, processing, preparation, packaging, and preservation of food and beverages. Chemical engineers in the food and beverages industry help to formulate new products to meet consumer demand, change ingredients for better flavor, change handling processes for more consistent texture, and freeze dry products or design aseptic packaging to ensure a longer shelf life.

3. **Biomedical**
Chemical engineers work alongside physicians to develop systems that track critical chemical processes in the body. Biomedical specialists may be involved in the design of artificial organs, such as hearts and lungs.

**Process Design**
Chemical engineers design manufacturing facilities and the equipment and materials used inside. Process design engineers work with teams of engineers to develop new or improved processes to meet a company's production needs.

4. **Quality Control**
Chemical engineers work as Quality control engineers to monitor the manufacture of products to ensure that quality standards are maintained. They may bring samples of a product in from a field test, or from a normal application, and test them to determine how specific properties -- such as strength, color, and weatherability -- change over time.

5. **Regulatory Affairs**
Chemical engineers research, develop and monitor policies and procedures to ensure the proper handling of chemicals and chemical components. Chemical engineers in regulatory affairs may be government employees who study the environmental impact of a new chemical, then recommend appropriate guidelines for the chemical's use.

6. **Research and Development**
Chemical engineers seek out new and more efficient ways of using and producing existing products. They explore and develop new processes and products and determine their usefulness and applicability. Chemical engineers working in R&D may work with chemists and other engineers to develop a new process or new product that will better meet customers’ needs.

7. **Sales and Marketing**
Chemical engineers assist customers in solving production and process problems by providing products and services to meet their specific needs. Chemical engineers in sales use their technical knowledge to sell chemicals, equipment, and other products, and provide follow-up services and training, where needed.

8. **Technical Services**
Chemical engineers work with customers, usually on-site, to solve production problems caused by a process or machine. Chemical engineers working in technical services may represent the
manufacturer of a machine to determine why it is not performing as designed. They often must understand the other steps in the production process to determine if there is a breakdown in another area.

9. Biotechnology

The biotechnology industry uses living cells and materials produced by cells, and biological techniques developed through research, to create products for use in other industries. Work in the field of biotechnology has produced antibiotics, insulin, artificial organs, recombinant DNA, techniques for waste reduction and recycling, and hybrid plants that are insect-resistant. Chemical engineers in the biotechnology industry develop and design the processes to grow, handle, and harvest living organisms and their byproducts.

10. Consultancy

Chemical engineers work for many different customers and bring specialized knowledge to individual projects. Most consultants have several years of professional experience. They often must have had many years of practical experiences in the industries.

11. Design and Construction

The design and construction industry works with all other industry sectors to design and build the facilities, specify the machinery, and design and troubleshoot processes that will allow companies to operate safe and efficient plants. Chemical engineers in the design and construction industry are involved with process design and project management, and work closely with other engineering disciplines.

12. Electronics

Chemical engineers in the electronics industry are involved with material development and production, and process control equipment design. Knowing how process equipment in a chemical plant, for example, is supposed to function gives the chemical engineer an advantage in designing control equipment to monitor each process. Chemical engineers are also involved in the manufacturing of microchips and intricate circuitry, using their training to develop the materials and processes that allow such circuits to be properly assembled. Chemical engineers' contributions to the field include producing components that better dissipate heat, and operate faster.

13. Energy and Fuels

Those industries that fall under the category of fuels include petroleum and petroleum products production, and refining, as well as nuclear and synthetic fuels. Typically known for their work in refineries, chemical engineers are also involved in developing alternative energy sources, e.g. fuel cells. Chemical engineers in the fuels industries work on production processes, environmental monitoring, research and development, and process safety.
14. Environmental, Safety and Health

In almost every industry, chemical engineers are involved in areas that concern the environment, waste minimization, and personal health and safety. With every process that involves the use and manipulation of raw materials, some byproducts are produced. The chemical engineer is employed to minimize the production of byproducts, if they are of no use, or find an appropriate use for them. They develop techniques to recover usable materials, and reduce waste created during manufacture of a product. Chemical engineers help minimize waste through process monitoring and control, and by designing new processes that are more efficient. This category also includes those chemical engineers who are involved in waste treatment and disposal, and process safety and loss prevention. They work towards establishing of ‘Green Synthesis’ in all chemical processes. [5, 6]

15. Education:

Chemical engineers with Master and Ph.D. degrees can work as university as lecturers to teach and do research in a variety of exciting areas.

16. Government:

Within the government, Chemical engineers can work in many agencies like, Environmental Protection Agency, Department of Energy, The Military, Nuclear Regulatory Commission, and Department of Agriculture, to name a few.

18. Advanced Materials

Industries in the category of advanced materials use chemical engineers to help develop materials with different properties such as weight, strength, heat transfer, reflectivity, and purity. Industries that employ chemical engineers for these purposes include:

- Aerospace
- Automotive
- Glass
- Ceramics
- Electronics
- Metals
- Nanotechnology
- Photographic Products

Others

Because of their training and skills, chemical engineers make strong candidates for jobs not traditionally associated with chemical engineering: sales, technical writing, law, insurance, real estate, publishing, finance, technical services, and government. Even within the "typical" industries, many engineers are surprised to learn that their responsibilities regularly include management, marketing, packaging, distribution, strategic planning, training, and computer
programming. Chemical engineers are not limited to those industries that produce products made by combining, refining, or processing chemicals. [6]

WHAT MAKES CHEMICAL ENGINEERING SO UNIQUE?

From the preceding section that highlighted the career opportunities of Chemical engineers, it looks as if they are everywhere. In fact, they have their hands in every pie! One begins to understand this when one sees Chemical Engineering as mother of all engineering. A brief look at the curriculum will reveal this. Apart from the core Chemical Engineering courses like Chemical Reaction Engineering, Chemical Process Calculations, Chemical Engineering Thermodynamics, Chemical Process Control, Chemical Processes, Synthesis and Simulation, Transport Phenomena and Separation Processes, Chemical engineering students do these other courses that when added to the core courses make uniquely versatile. These courses include:

a. Workshop Practices
b. Introduction to Statistics and Probability
c. Introduction to Engineering Materials
d. Introduction Electrical and Electronic Engineering
e. Engineering Economy
f. Engineering Management
g. Industrial/Entrepreneurial Studies
h. Computer Programming
i. Chemical Process Design and Economics
j. Environmental Engineering
k. Biochemical Engineering
l. Energy Conversion Engineering
m. Petrochemical Processes
n. Coal Processing Technology
o. Polymer Science and Technology

One can see from the highlights of the Chemical Engineering courses above that they delve into other engineering fields more than any other branch of engineering.

THE SYNERGY BETWEEN CHEMICAL ENGINEERING AND HUMAN EMPOWERMENT

Although most Chemical engineers work for companies, industrial organizations and government agencies, there are also excellent opportunities for a Chemical engineer to be self-employed by setting up small or medium scale industry. Using modern Information systems, design tools and equipment, individual Chemical Engineers can now accomplish what used to require large groups of engineers and support staff. Chemical Engineering, therefore, provides excellent opportunities for entrepreneurs. Chemical Engineering Department of Queen's University Canada has this slogan as her Motto: ‘Be an Entrepreneur - Be a Chemical Engineer’ [8]. This is a way of telling the Chemical engineering students that they are trained to be job providers and not job seekers. One of the Chemical Engineering Elective Courses at Federal
University of Technology, Owerri is called Technology of Selected Chemical Processes. In this course, final year students are taught the basic technologies involved in some selected industries such as paint, soap, detergent, cement, fertilizer, glass, pulp and paper industries [7]. This is with the aim of preparing the students for possibility of setting up small or medium scale industries of their own. It is doubtful if there is any other profession that can be as empowering in versatile areas as Chemical Engineering. In fact, the synergy between Chemical Engineering and Human Empowerment cannot be reversed!

REFERENCES


8. Queen's Undergraduate Internship Program (Retrieved, 2016) ‘Chemical Institute of Canada Career Services’ Chemical Engineering Department of Queen's University Canada.