

Role of Engineers for Development

Engineering:

According to the definition adopted by Accreditation Board of Engineering and Technology (ABET) “Engineering is a profession in which knowledge of mathematical and natural science gained by study, experience and practice is applied with judgment to develop ways to utilize economically the materials and forces of nature for the benefit of mankind.”

Engineering has always been concerned with economical use of limited resources for the benefit of people. The purpose of engineering activities of design and analysis is to determine how physical factors may be altered to create the most utility for the least cost, in terms of product cost, product service cost, and social cost.

Engineer:

The definition of Engineer as per various dictionaries is;

1. One who is trained or professionally engaged in a branch of engineering
2. One who invent, design, analyze, build/construction, and test machines, systems, structures, materials to fulfill the objectives and requirements while considering the limitations imposed by practicality, regulations, safety, and cost
3. One who skillfully manage an enterprise
4. One who has professional obligations towards customers and society
5. One who has a professional commitment to seeking solutions to a broad spectrum of problems that are identified
6. One who is involved in development and continual improvement of processes, systems, products, and materials
7. One who is involved to provide technical solutions and alternatives

Role of Engineer:

Following are the major roles of Engineer;

1. Invention
 - i. Invention of new products
 - ii. Research and Development
2. Development
 - i. Irrigation system
 - ii. Water system (Dams, Storage facilities, Distribution system)
 - iii. Infrastructure (road, bridges, highways, ports, airports, urban rapid transit system)
 - iv. Power system (conventional, alternate energy)

- v. Communication
 - vi. Transportation
 - vii. Residential and Commercial areas
 - viii. Sanitary, Sewage, and Waste management system
 - ix. Industrial (Manufacturing)
3. Design
Design of new product, process, project, system, material, machinery, plants (process, non process) considering;
- i. Functionality
 - ii. Usability
 - iii. Sustainability
 - iv. Constructability
 - v. Quality
 - vi. Reliability
 - vii. Environmental compatibility
 - viii. Safe for usage
 - ix. Supportability (serviceability)
 - x. Maintainability
 - xi. Disposability
 - xii. Economic feasibility
 - xiii. Political, Social, and Technical feasibility
4. Analyze
- i. Analyze for compliance, compatibility, sustainability (social, environmental, and economical)
5. Construct/Build/Manufacturing
- i. Construct/Build/Manufacture as designed
 - ii. Optimal use of resources
 - iii. Customer satisfaction
 - iv. Durability
6. Testing
- i. Test for functionality
7. Improvement
- i. Improve to suit technical advances

Development Consideration:

- 1. Risk based thinking
- 2. Systems Engineering Approach

1. Risk based Thinking:

The revised ISO 9001: 2015 QMS focuses a lot on the risk based thinking which has to be considered from the beginning and throughout the life cycle of the project. Therefore any engineering, engineering related activity has to be developed, executed/implemented/manufactured/constructed, tested taking into consideration risk(s) involved, analyzing the risk and selecting the best alternative.

2. Systems Engineering Approach:

A system is an assembly of components or elements having function relationship to achieve a common objective for useful purpose.

The systems approach is a technique, which represents a broad-based systematic approach to problems that may be interdisciplinary. It is particularly useful when problems are affected by many factors, and it entails the creation of a problem model that corresponds as closely as possible to reality. The systems approach stresses the need for the engineer to look for all the relevant factors, influences, and components of the environment that surround the problem. The systems approach corresponds to a comprehensive attack on a problem and to an interest in, and commitment to, formulating a problem in the widest and fullest manner that can be professionally handled.

This simple behavioral approach to systems is generally known as the Black Box and is represented schematically in FIGURE 1 (Black Box). The Black Box system phenomenon establishes the functional relationship between system inputs and outputs.



FIGURE 1-BLACK BOX

Systems Engineering:

INCOSE (International Council on Systems Engineering) define Systems Engineering as;

“Systems Engineering is an interdisciplinary approach and means to enable the realization of successful systems. It focuses on defining customer needs and required functionality early in the development cycle, documenting cycle, documenting requirements, then proceeding with design synthesis and system validation while considering the complete problem:

Operations	Cost & Schedule
Performance	Training & Support
Test	Disposal
Manufacturing	

Systems engineering integrates all the disciplines and specialty groups into a team effort forming a structural development process that proceeds from concept to production to operation. Systems engineering considers both the business and the

technical needs of all customers with the goal of providing a quality product that meets the user needs.”

Systems engineering provides the basis for a structural and logical approach.

Application Areas for Systems Engineering:

There are many categories of human-made systems, and there are many applications where the concepts and principles of systems engineering can be effectively implemented. FIGURE 2 illustrates application areas for Systems Engineering.

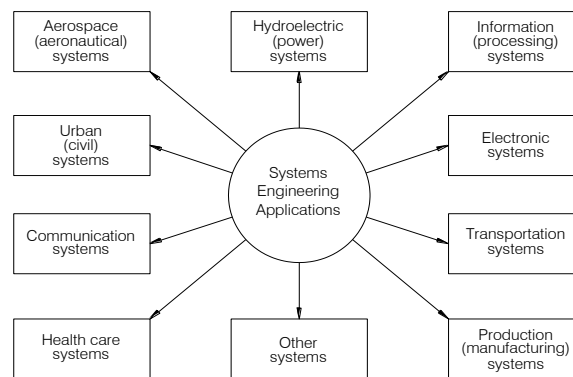


FIGURE 2 Application areas for systems engineering

Benefits of Systems Engineering:

Benefits of systems engineering applications are;

- Reduction in the cost of system design and development, production/construction, system operation and support, system retirement and material disposal
- Reduction in system acquisition time
- More visibility and reduction in the risks associated with the design decision-making process

Finally “**DOING THINGS RIGHT FROM THE BEGINNING**” is the basic role of Engineers to develop competitive, qualitative and economical product, process, project, services, system, material, machinery, and equipment for the benefit of mankind.