

# INDUSTRIAL MANAGEMENT

# IENG450

CHAPTER 1  
ENGINEERING AND MANAGEMENT  
10.03.2021

# Introduction:

- Today's technological society is constantly changing, and with this change comes a need for the engineer to be able to address society's technological challenges as well as the opportunities for the future.
- Engineers play a key role in maintaining technological leadership and a sound economy as the world becomes flatter in today's global economy. To do this, the engineer needs to remain alert to changing products, processes, technologies, opportunities, and be prepared for a creative and productive life and position of leadership.
- This chapter begins with a discussion of the origins of engineering practice and education, the nature of the engineering profession, and the types of engineers, their work, and their employers. Next, management is defined and managerial jobs and functions are characterized. Finally, these topics are synthesized by defining engineering management and a discussion of the expectation of managerial responsibilities in the typical engineering career.

# A. Engineering

# The origin of the word “engineering”:

- The words engineer and ingenious both came from the Latin ingenium, which means a talent, natural capacity, or clever invention.

Latin ingenium= clever invention

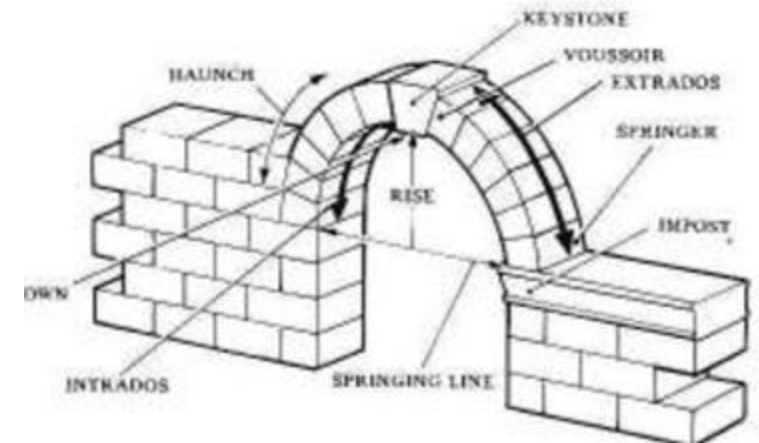
Why a Latin word?

English language = Saxonian (German) + Latin + Viking (Norwegian)  
+ Normann (French)

- Early applications of clever inventions often were military ones, and ingeniarius became one of several words applied to builders of such ingenious military machines.

# Engineering inventions in ancient times:

- Melting copper, bronze, iron;
- Wheel;
- Screw;
- Column;
- Arch;
- Catapult;
- Irrigation channel;
- Bridge;



- Aqueducts of Romans (It's a system for channeling water from far away sources, over irregularities in the soil into towns );

# Beginning of Engineering Education:

Country	Institute	Year
France	Écoledes Pontset Chaussées	1747
USA	U.S. Military Academy	1802
England	Cambridge (mechanical science)	1890
England	Oxford (engineering science)	1909

- The age 18th and 19th century is the time of industrial revolution. That time the following equipment were invented: steam-engine, steam locomotive (Stevenson), and automated loom.

# Engineering as a Profession:

- The first issue (1866) of the English journal Engineering began with a description of the profession of the engineer as follow:
  - “the art of directing the great sources of power in nature, for the use and convenience of man.”
- The Engineers’ Council for Professional Development (ECPD) in 1979, defined engineering as:
  - “the profession in which a knowledge of the mathematical and natural sciences 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.”
- Certainly, engineering meets all the criteria of a proud profession. Engineering undergraduates recognize the need for “intensive preparation” to master the specialized knowledge of their chosen profession, and practicing engineers understand the need for lifelong learning to keep up with the march of technology.
- Finally, engineers provide a public service not only in the goods and services they create for the betterment of society, but also by placing the safety of the public high on their list of design criteria. Each generation of engineers has the opportunity and obligation to preserve and enhance by its actions the reputation established for this profession by its earlier members.

# What is Engineering?

Webster's Dictionary, 1989, defines engineering as follows:

1: The art of managing engines

2: The application of science and mathematics by which the properties of matter and the sources of energy in nature are made useful to man in structures, machines, products, systems, and processes.

- In other words, engineering is the means by which people make possible the realization of human dreams by extending their reach in the real world.
- Engineers are the practitioners of the art of managing the application of science and mathematics. By this description, engineering has a limitless variety of possible disciplines.



# What Engineers Do?

- **The engineering attitude to solve a problem:**

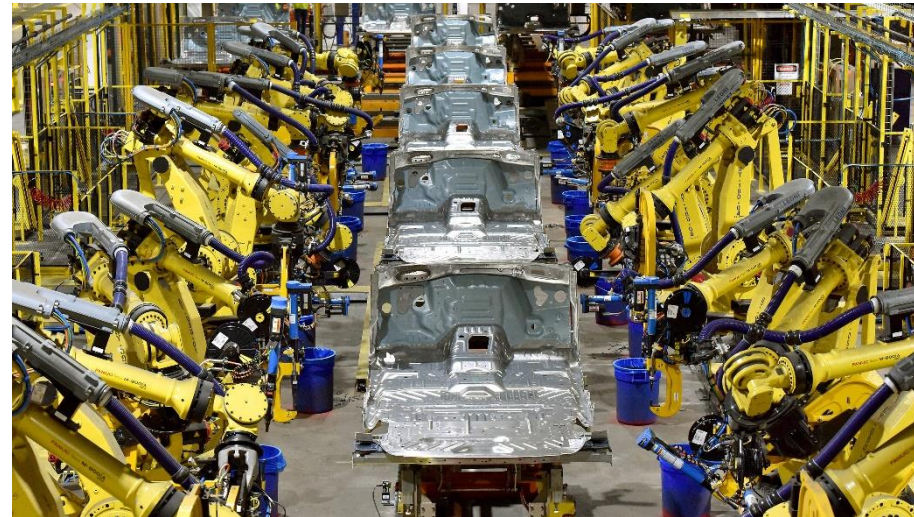
Simplify the problem as much that it still has its original meaning and solve the simplified problem (in an easy way). Typical example: rule of thumb.

- **The attitude of the mathematician to solve a problem:**

Do not simplify it but try to make it even more complicated and solve the general problem.

# What Engineers Do?

- Until the 18th century guns were made individually. In the Independence War of America an order of 10,000 guns was put. 10,000 guns cannot produced on the same way as 1 gun. New production process was need. It is the origin of mass production.
- Assembly line is a further development of mass production.



# Types of Engineers:

- Originally engineers served the army constructing roads, bridges.
- ⇒ Civil engineer is originally a non-military engineer.
- Further branches of engineering developed by differentiation:
  - Electrical and Electronic;
  - Mechanical;
  - Civil;
  - Chemical;
  - Computer;
  - Industrial;
  - Aerospace;
  - Nuclear;
- But many branches of natural and social sciences can be made as engineering.  
E.g. there are biological, environmental, and financial engineering.

# Engineers in a company:

- Manufacturing;
- Research and design (R&D);
- Quality functions;
- Technical sales;
- Logistic support;
- Purchasing;
- Recruiting;

## B. Management

# The origin of the word “management”:

- Maneggiare (Italian) = to handle
  - Manus (Latin) = hand
  - Manage = to handle (16th century).
- 
- In the early sixteenth century manage was gradually extended to the operations of war and used in the general sense of taking control, taking charge, or directing.
  - Management was originally a noun used to indicate the process for managing, training, or directing. It was first applied to sports, then to housekeeping, and only later to government and business.

# Meanings of the word “management”:

- i. An organizational or administrative process;
- ii. A science/discipline/art;
- iii. A group of people running an organization;  
**Remark.** Owner  $\neq$  manager.
- iv. Occupational career

# Different Definitions of Management:

- The work of creating and maintaining environments in which people can accomplish goals efficiently and effectively (Albanese)
- The process of achieving desired results through efficient utilization of human and material resources (Bedeian)
- The process of reaching organizational goals by working with and through people and other organizational resources (Certo)
- A set of activities (including planning and decision making, organizing, leading, and controlling)
- directed at an organization's resources (human, financial, physical, and information) with the aim of achieving organizational goals in an efficient and effective manner (Griffin)



# Important Questions Addressing management:

- What skills must they have?
- What roles do they play?
- What functions do they carry out?
- How are these affected by the level at which they operate?

# Management levels:

## a) **First line managers** (e.g. foreman, supervisor, section chief)

- They are responsible for carrying out the plans and objectives of higher management (to satisfy higher level plans of higher level managers), using the personnel and other resources assigned to them.
- They make short-range operating plans governing what will be done tomorrow or next week (8hours/1week), assign tasks to their workers, supervise the work that is done, and evaluate the performance of individual workers.
- They supervise non-managers;
- They are either engineers or selected workers. In both cases the relation with workers may have problems.

**Remark.** The mathematical background of their planning is scheduling theory, which is also a part of IE. See the future lessons on Planning and forecasting, too.

**Future:** completely automated computer integrated factory without first line managers)

# Management levels (cont.):

b) **Middle managers** (plant manager, division head, chief engineer, operations manager)

- Middle managers make plans of intermediate range to achieve the long-range goals set by top management, establish departmental policies, and evaluate the performance of subordinate work units and their managers, supervise managers, and work with managers on the same level;
- Middle managers also integrate and coordinate the short-range decisions and activities of first-line supervisory groups to achieve the long-range goals of the enterprise (Make intermediate-range plans to achieve long range goals);
- They work with managers on the same level;

# Management levels (cont.):

## c) **Top managers** (e.g. chairman, president, vice president, CEO)

- While they may report to some policymaking group (the board of directors, legislature, or council), they have no full-time manager above them.
- Define character, mission, and objectives;
- Evaluate performance of departments and (leading) managers;
- Determine capacities, products for long-range;

**But** the key point is to determine what demand should be satisfied with which product  
= **selection of the relevant market.**

They may have any kind of background: engineer, law, even humanities.

# Roles and Skills:

**a. Interpersonal:** vertical and horizontal connections.

- Get loyalty;
- People need to feel the firm helps them to reach their individual aims;
- It is a kind of art;

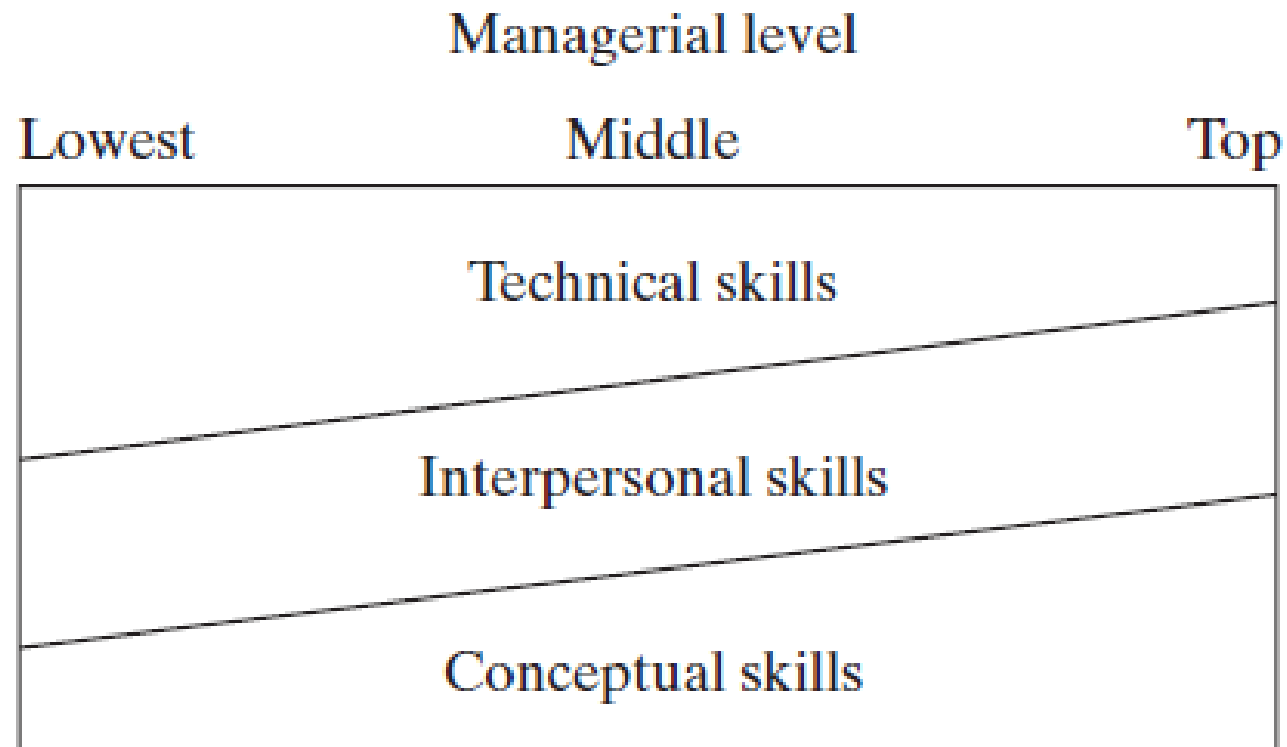
**b. Conceptual skills.**

- To detect the factors determining the success of the company;

**c. Technical and information skills.**

- The knowledge of the supervised process and production;
- Collecting, transforming and distributing information;

# Skills Required Versus Management:



# Functions of Managers:

- **Planning** involves selecting missions and objectives and the actions to achieve them; it requires decision making—choosing future courses of action from among alternatives.
- **Organizing** is that part of managing that involves establishing an intentional structure of roles for people to fill in an enterprise.
- **Staffing** [included with organizing by most authors] involves filling, and keeping filled, the positions in the organizational structure.
- **Leading** is influencing people to strive willingly and enthusiastically toward the achievement of organization and group goals. It has to do predominantly with the interpersonal aspect of managing.
- **Controlling** is the measuring and correcting of activities of subordinates to ensure that events conform to plans.

## C. Engineering Management



# What is Engineering Management?

- Engineering management is the art and science of planning, organizing, allocating resources, directing and controlling activities that have a technological component.
- Engineering management is designing, operating, and continuously improving purposeful systems of people, machines, money, time, information, and energy by integrating engineering and management knowledge, techniques, and skills to achieve desired goals in technological enterprise through concern for the environment, quality, and ethics.
- The engineering manager is distinguished from other managers because he [or she] possesses both an ability to apply engineering principles and a skill in organizing and directing people and projects. He is uniquely qualified for two types of jobs: the management of technical functions (such as design or production) in almost any enterprise, or the management of broader functions (such as marketing or top management) in a high-technology enterprise.

# Need for Engineers in Management:

- Really understand the business.
- Understand both the technology that is driving the business today and the technology that will change the business in the future.
- Treat research and development as an investment to be development, rather than an expense to be minimized.
- Spend more time on strategic thinking about the future as they rise higher in the corporation.
- Are dedicated to solving a customer's problem or satisfying a need, which is how they would define true marketing as opposed to sales.
- Place a premium on innovation.

# Engineering Management:

- **Narrow sense:** supervision of engineers.
- **A little broader sense:** supervision of engineers + applying quantitative methods (management science).
- **Broad sense:** mixture of management and engineering. Especially in high-tech industries.