IENG 450
INDUSTRIAL MANAGEMENT

CHAPTER 1
ENGINEERING AND MANAGEMENT

A. Engineering

1. The origin of the word "engineering".

Latin *ingenium* = <u>clever invention</u>

Why a Latin word?

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

A. Engineering

2. Engineering inventions in ancient times:

- Melting copper, bronze, iron
- Wheel,
- Screw,
- Column,
- Arch,
- Catapult,
- Bridge,
- Irrigation channel,
- Aquaducts of Romans (It's a system for channeling water from far away sources, over irregularities in the soil into towns)
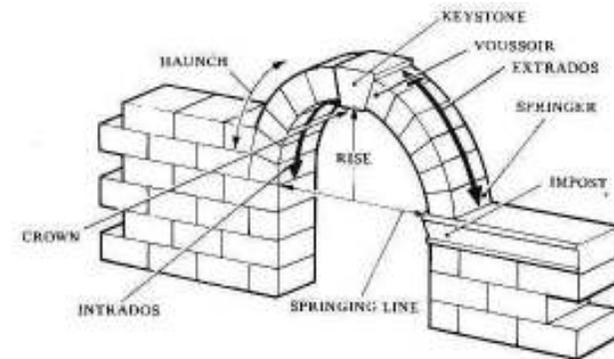
A. Engineering

3. Beginning of engineering education

Country	Institute	Year
France	École des Ponts et Chausées	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 industrial revolution. That time the following equipments were invented: steam-engine, steam locomotive (Stevenson), automated loom.

A. Engineering

4. Engineering as a profession

- Profession:
  - a calling requiring specialized knowledge and often long and intensive preparation, including instruction in skills and methods as well as in the scientific, historical or scholarly principles underlying such skills and methods, maintaining by force of organization or concerted opinion high standards of achievement and conduct and committing its members to continued study and to a kind of work which has for its prime purpose the rendering of a public service.

A. Engineering

4. Engineering as a profession

- Engineers' Council for Professional Development:

    - Engineering is "the profession in which a knowledge of the mathematical and natural sciences gained by study, experience, and practice is applied with judgement to develop ways to utilize, economically the materials and forces of nature for the benefit of mankind."

A. Engineering

5. 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.

A. Engineering

5. 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.

A. Engineering

5. What engineers do?

- Engineering is 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,
  - processes.

A. Engineering

6. Types on engineers

- Originally engineers served the army constructing roads, bridges fortresses.

- $\Rightarrow$ 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.

A. Engineering

7. Engineers in a company

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

B. Management

1. The origin of the word "management".

manus (Latin) = hand

⇒ *maneggiare (Italian) = to handle*

⇒ *manage = to handle* (16th century).

B. Management

2. 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 ≠ manager.

iv. occupational career

B. Management

3. Management levels

a) First line managers (e.g. foreman, supervisor, section chief)
   - ❑ supervise non-managers,
   - ❑ elaborate short run (8hours/1week) operating plans
   - ❑ to satisfy higher level plans of higher level managers.
     - ■ **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)

   - ■ They are either engineers or selected workers. In both cases the relation with workers may have problems.

B. Management

3. Management levels

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

- ❑ supervise managers,
- ❑ make intermediate-range plans to achieve long range goals,
- ❑ evaluate the performance of subordinate units and managers,
- ❑ work with managers on the same level.

B. Management

3. Management levels

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

Examples: Hitachi/walkman, Winery

- They may have any kind of background: engineer, law, even humanities.
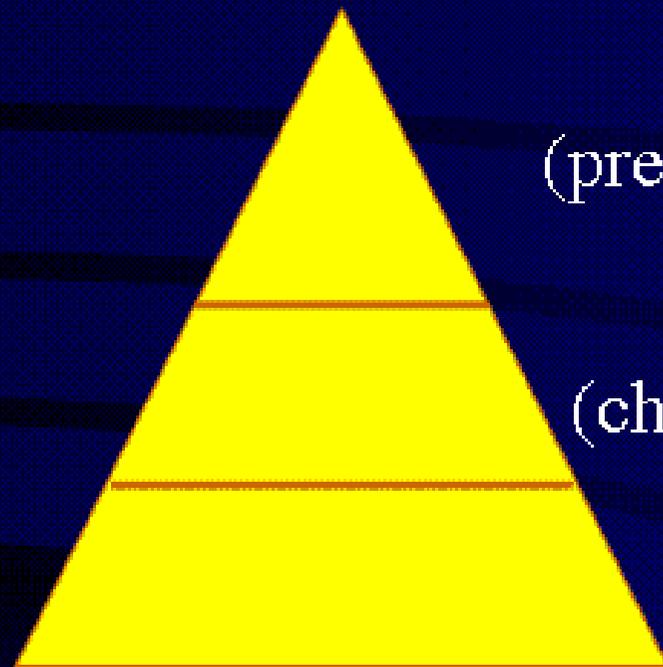
Top-level management
(president, executive vice president)

Middle managers
(chief engineer, division head etc.)

First-line managers
(foreman, supervisor, section chief)

B. Management

4. 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. (The dream of the king. T-Ford)

Organization Chart
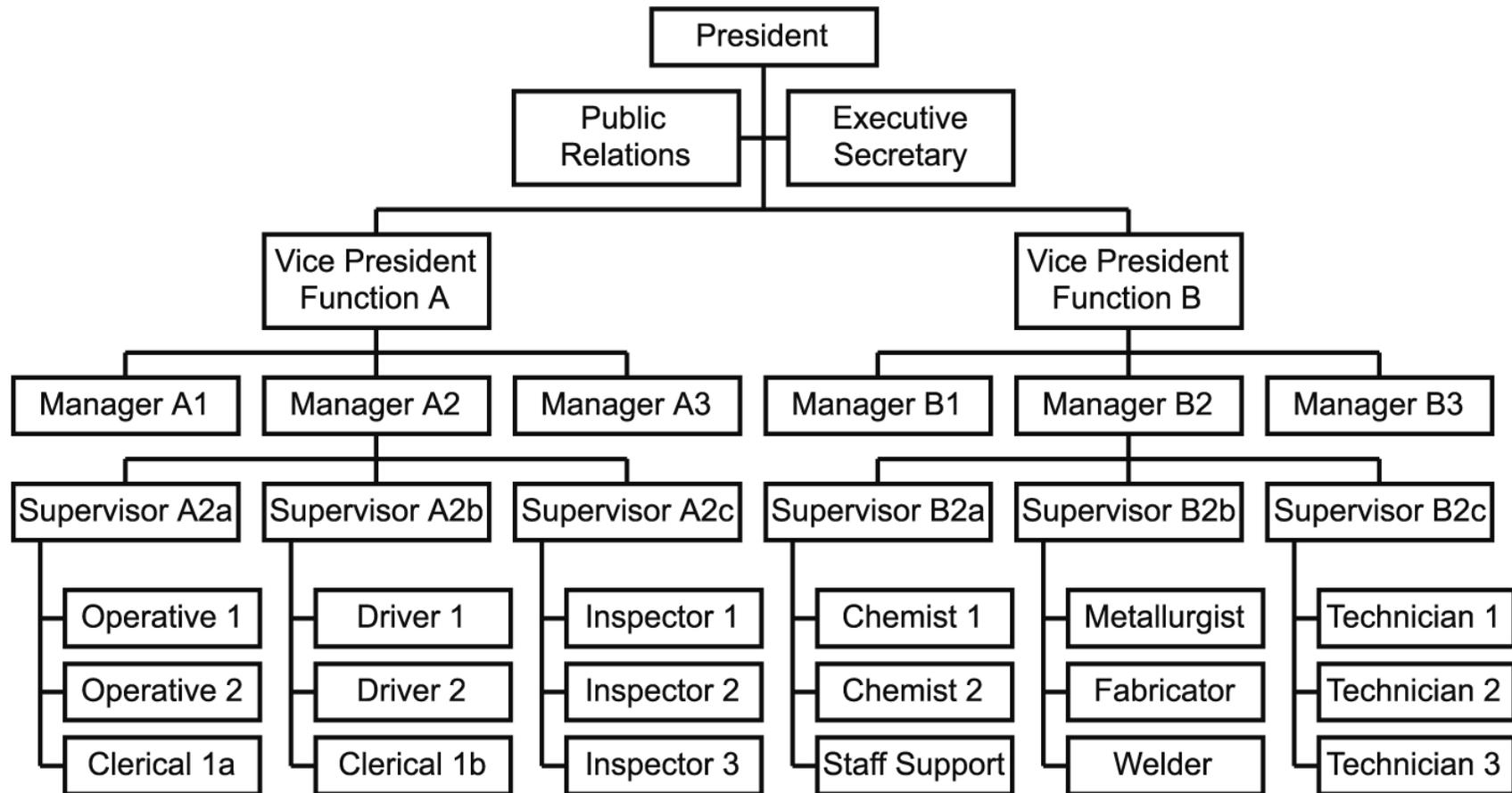
B. Management

4. Roles and skills

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.

C. Engineering Management

- **Narrow sense:** supervision of engineers.

- **A little broader sense:** supervision of engineers + applying quantitative methods (management science).

- **Broad sense:** synthesis of management and engineering. Especially in high-tech industries.