ENGINEERING
Professional Development

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Mechanical and Aerospace Engineering

ENG190 W'13
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(I)

Professional Development Classes

(I)	(II)	(III)
The Engineering Profession	Creativity In Engineering	License & Regulations
Science & Engineering	The Design Process	Public &Personal Issues
Inventions & Inventors	Working Habits	The Work Place

Class (I)

What is a profession

The Professional Engineer

Science and Engineering

ABET Accreditation

Technology Team

Engineering Challenges

Inventors and Inventions

Engineers at Work

What is a profession ?

According to the Oxford Dictionary

a profession is a paid occupation, especially one that involves

prolonged training and a formal certification.

Characteristics of a Profession

We need an account of the characteristics of professions that will enable us to **distinguish** professions from other occupations.

There is no universal accepted account,

rather a set of characteristics that

hold true of a profession.

Characteristics of a Profession (I)

1) Entrance into a profession typically requires an **extensive period of training**. This training is of an intellectual character.

   Many occupations require extensive apprenticeship and instruction, requiring **practical skills**.

   However, the training required of professionals **focuses more on intellectual** content, distinctive from practical skills.

Engineers and their Profession, John Kemper and Billy Sanders

Characteristics of a Profession (II)

2) Any society that has a sophisticated scientific and technological base is especially **dependent on its professionals**.

Like our dependence on the knowledge possessed by physicians, lawyers, and other specialists, we are dependent on the **knowledge and research** of scientists and engineers.

Characteristics of a Profession (III a)

3) Professionals have a **monopoly** or near monopoly on the provision of professional services.

Control is achieved by requiring that only those who have graduated from a **professional school** should be allowed to hold a professional title.

Engineers and their Profession, John Kemper and Billy Sanders

Characteristics of a Profession (III b)

A profession gains control over schools by **establishing accreditation standards** to regulate the quality of curriculum content.

(ABET - Accreditation Board for Engineering and Technology)

Engineers and their Profession, John Kemper and Billy Sanders

Characteristics of a Profession (IV)

4) Professionals have an unusual **degree of autonomy in the workplace**. Professionals in private practice have considerable freedom, even when working in large organizations.

   The possession of specialized knowledge is a powerful defense of professional autonomy.

This is one of the most satisfying aspects of professional work.

Engineers and their Profession, John Kemper and Billy Sanders

Characteristics of a Profession (V)

5) Professionals are regulated by **ethical standards**, which are usually embodied in a code of ethics.

Professional codes are ordinarily promulgated by **professional societies**, and there are occasional attempts to punish members who fail to abide by the rules stipulated by the code.

Engineers and their Profession, John Kemper and Billy Sanders

Engineers and their Profession (controversy)

Engineers and their Profession[(1)], Chapter 1:

Is Engineering Really a Profession?

Engineering Ethics[(2)], Section 1.2: What is a Profession?

"Engineering could be regarded as borderline."

(1) *Engineers and their Profession*, John Kemper and Billy Sanders

(2) *Engineering Ethics*, C.E. Harris Jr., M.S. Pritchard, and M.J. Rabinsin

Science and Engineering

Science: Create new knowledge

a) Theoretical
b) Experimental
c) Computational

Engineering: Create a wide range of new

a) Processes
b) Systems
c) Materials
d) Devices
e) etc.

Tasks of Scientists (I)

For the scientist, the basic task is to perform **research.**

But research is a broad concept.

A scientist may primarily specialize in creating new **theoretical** explanations for unexplained or recently discovered phenomena.

Or in the pursue of explanations, a scientist may propose **the need to modify existing concepts and theories**, or even propose the existence of new phenomena or events.

(e.g. *the recent search for the Higgs-meson in High Energy Physics*).

Tasks of Scientists (II)

A scientist may be more inclined to perform **experimental work**, designing the experiments and the required diagnostics to prove the theoretical speculations, or just try experiments out of sheer curiosity.

Galileo Galilei : Father of Experimental Research

A theoretical scientist may be inclined to use **computational** techniques (computer codes) to go beyond what can be done from a pure analytical approach.

Tasks of Engineers (I)

The tasks of Engineers are as extensive as the tasks of Scientists.

An engineer may be concerned with the **creation of** devices, systems, processes, structures, new materials, etc.

Approaches can be **Analytical, Experimental, and/or Computational**, depending on the different stages of the project.

Tasks of Engineers (II)

From "R & D" to final product

Research

Development (e.g. of a product)

Design (internal and external)

Develop prototype

Manufacturing

Mass production

Sales

+ *Management of the above*

Branches of Engineering

UC Davis C.O.E.

Biological and Agricultural Engineering

Biomedical Engineering

Chemical Engineering and Material Science

Civil and Environmental Engineering

Computer Science Engineering

Electrical and Computer Engineering

Mechanical and Aerospace Engineering

Other Branches

Industrial, Manufacturing, Marine, Mining, Geological, Nuclear, Ocean, Optical, Petroleum, Systems

Accreditation of an Engineering Program

The engineer stands next to the scientist in the technological spectrum because of the **dependence of engineering upon science and mathematics**.

This brings the issue of the **ABET accreditation** for an Undergraduate Program in Engineering.

ABET *: Accreditation Board for Engineering and Technology*

>>>>

ABET Accreditation

Definition of engineering adopted by **the Accreditation Board for Engineering and Technology (ABET)** is as follows:

*" Engineering is 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. "*

From Concept to Realization : One of a Kind

From Concept to Realization: How To Make It

Velcro

From Concept to Realization: Mass Production

Technology Team

Engineers typically **work as members of a team**. There may be a full spectrum of individual specialties:

Scientist: (Ph.D) (B.S., M.S. typically not sufficient)

Engineer: (Degree with ABET accreditation is desirable)

Engineering Technologist: (B.S. in Engineering Technology)

Technician: (Engineering Technology program for 2 years)
(Drafting, Inspection, Installation, Experimental Assembly)

Craftsperson: Indispensable in all experimental areas (e.g. mechanic, electrician)

Engineering Challenges

Example:

In 1950, W. Edward Deming (American) was invited by the Japanese Union of Science and Engineering (JUSE) to tell them about quality control.

Instead, he gave a lecture about his new ideas of management:

a) The route to success is through **high quality**.

b) Quality defects are the **fault of the manufacturing system**. (e.g. Toyota Recalls)

In other words : Quality over Quantity

Evolution of Manufacturing Sequence

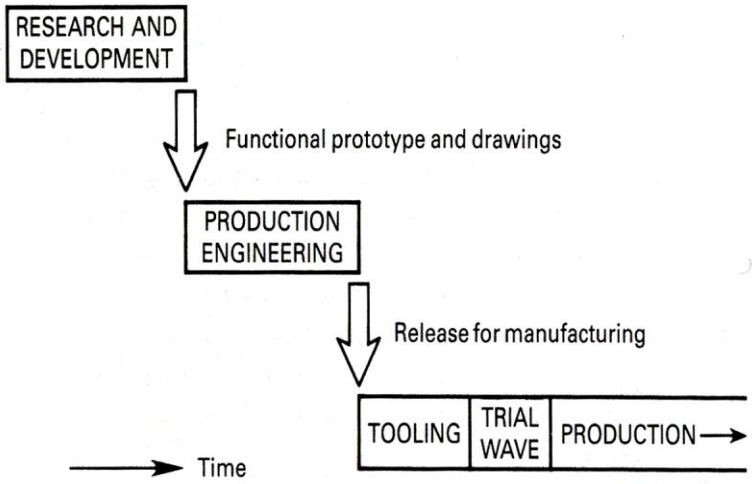


Figure 3–1

The "classic" view of the sequence from research and development, through production engineering, to manufacturing. This view is being superseded by the one shown in Figure 3–2.

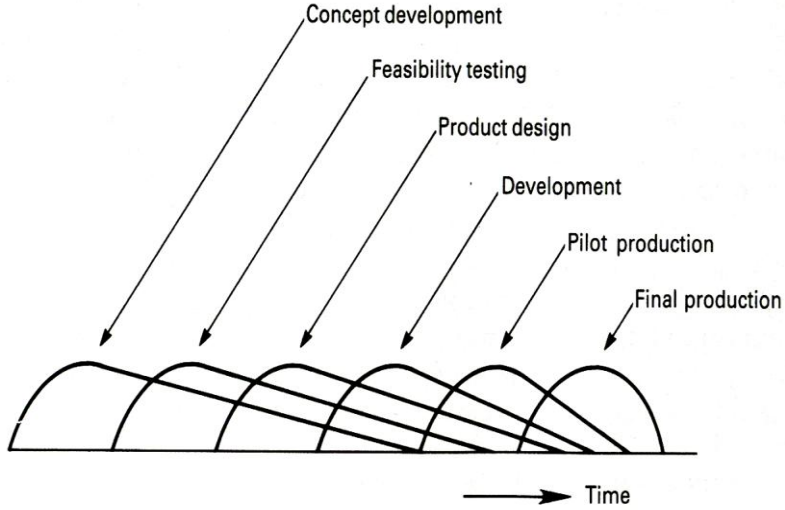


Figure 3–2

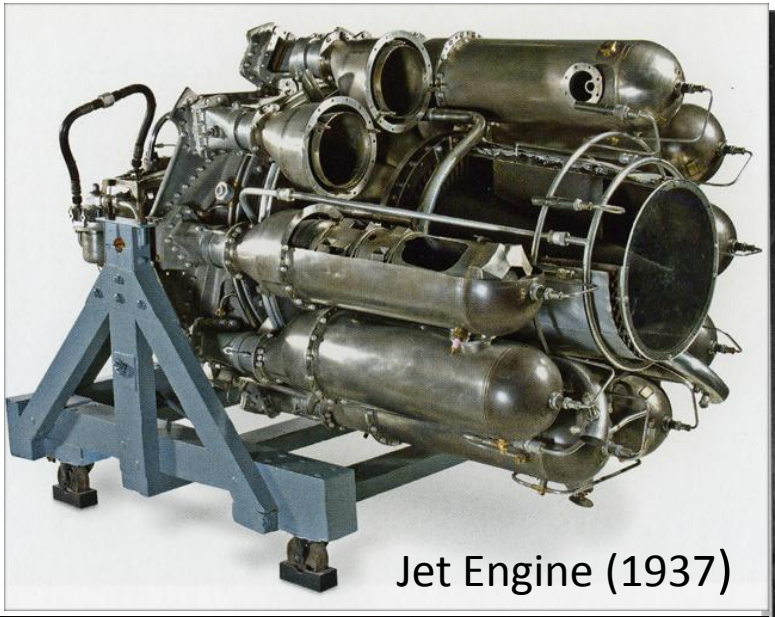
The "overlapping" model of the product development sequence. (Source: H. Takeuchi and I. Nonaka, "The *New* New Product Development Game," *Harvard Business Review*, January–February 1986, pp. 137–146.)

In the new style of **Simultaneous Engineering** many problems associated with manufacturing and quality never arise.

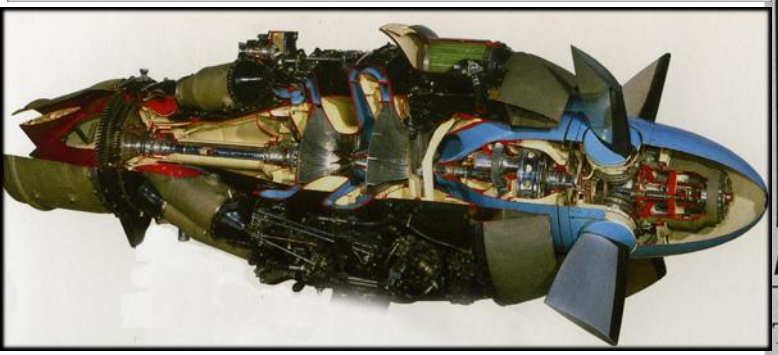
Quality has to be built in at all design stages

Inventors and their Inventions

75 years



Jet Engine (1937)



Turboprop Engine (1937)

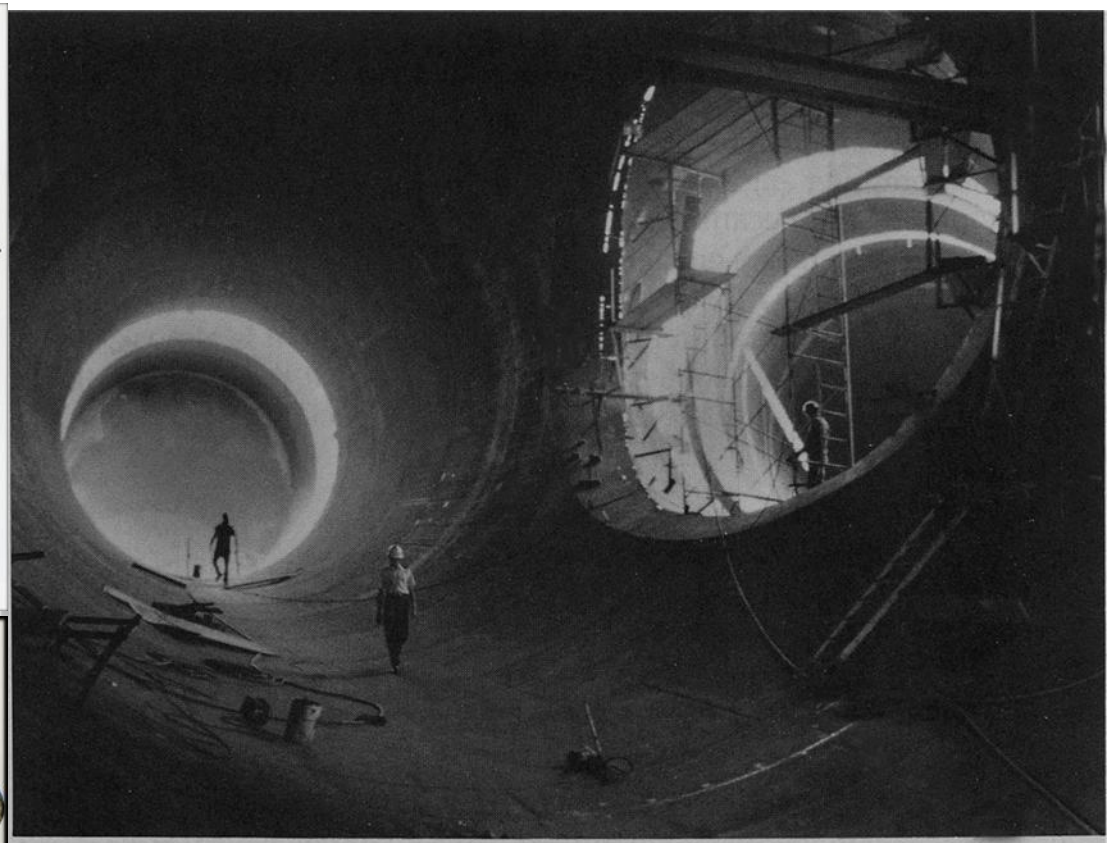


Figure 2–1

This $437 million wind tunnel (shown here under construction) can test turbojet and turbofan aircraft engines at simulated altitudes up to 80,000 feet and at transonic ranges to MACH 3.7. (Courtesy of DMJM.)

Inventors and Inventions

Webster: Inventor – A person who invents, especially one who devices **some new process, appliance, machine, article, or material**.

Wikipedia has a list of over a 1000 famous relatively modern inventions, from the Newton telescope (1642) to the invention of the iPhone (2007).

>> (Stone-tools go back to ~ 3 x 10^6 BC)

Inventions

An invention will be regarded as something that is clearly possessed of

novelty and usefulness.

In the class of *Professor Lee*, inventions were discussed in the context of **patents**.

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Idea >> Invention >Patent >> Inventor

(not necessary an engineer)

(e.g. “Bay Area Inventors Association”)

Motivation of Ideas

Benjamin Franklin: Bifocal Correcting Lenses (1784)

The Franklin Stove (1742)

George de Mestral (Swiss Eng.): Velcro (1941, 1955)

Edwin Land: Polaroid Self-developing Film Camera (1947)

Karl Elsener: Soldier's Knife (1891)

Due to competition, Elsener introduced

a symbol, the Swiss Flag's cross (as Trademark).

Becoming the well known Swiss Army Knife.

Thomas Edison: American Inventor

1,093 US patents in his name:

……..

Light Bulb (1879, 1880)

Public Electricity Supply (1882)

Phonograph (1877)

Dictating Machine (1888)

Stock Ticker (1891)

Kinetoscope (1891)

Cinematography

"I readily absorb ideas from every source, frequently starting where the last person left off."

-Thomas Edison

Patents and the Incandescent Light Bulb

Thomas Edison's first successful light bulb model was used in public demonstration at Menlo Park (1879).

Edison continued to improve this design and filed for U.S. patent #223,898 (granted on January 27, 1880) for an electric lamp using "a carbon filament or strip coiled and connected to contact wires"

…

Note:

James Linsday: Invented the Incandescent Light Bulb in Scotland (1835)

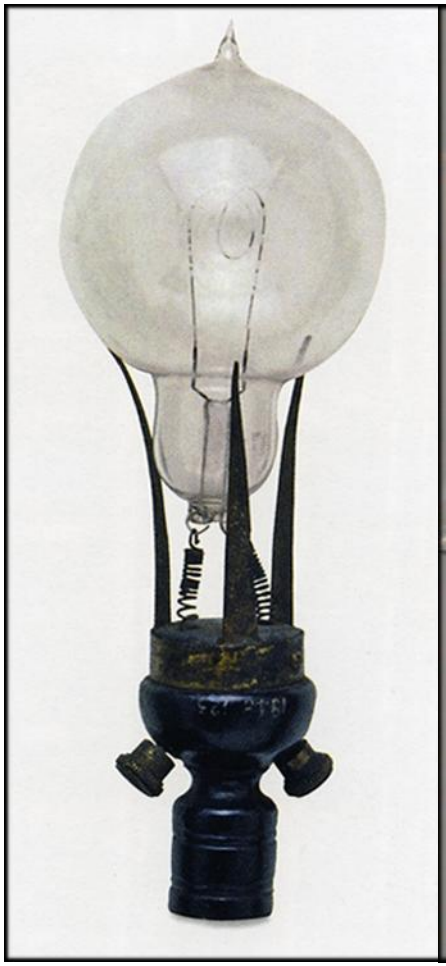
Irving Langmuir: Tungsten Filament Light Bulb (1916)

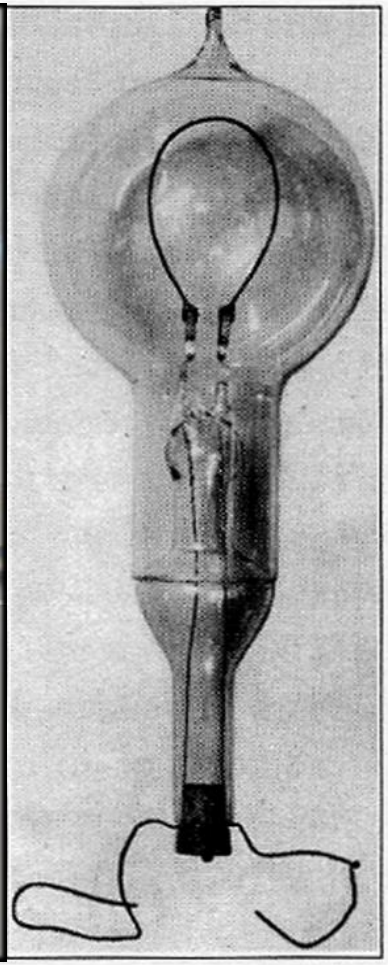
The Incandescent Light Bulb

(A)
Linsday
Lamp
1835

(B)
Edison's
Lamp
1979

(C)
Edison
Lamp as it
appeared in
1880





(A) (B) (C)

Edison : American Businessman (I)

Edison was one of the first inventors to apply the principles of **mass production** and large-scale **teamwork** to the process of invention.

Because of that, he is often credited with the creation of the first

Industrial Research Laboratory.

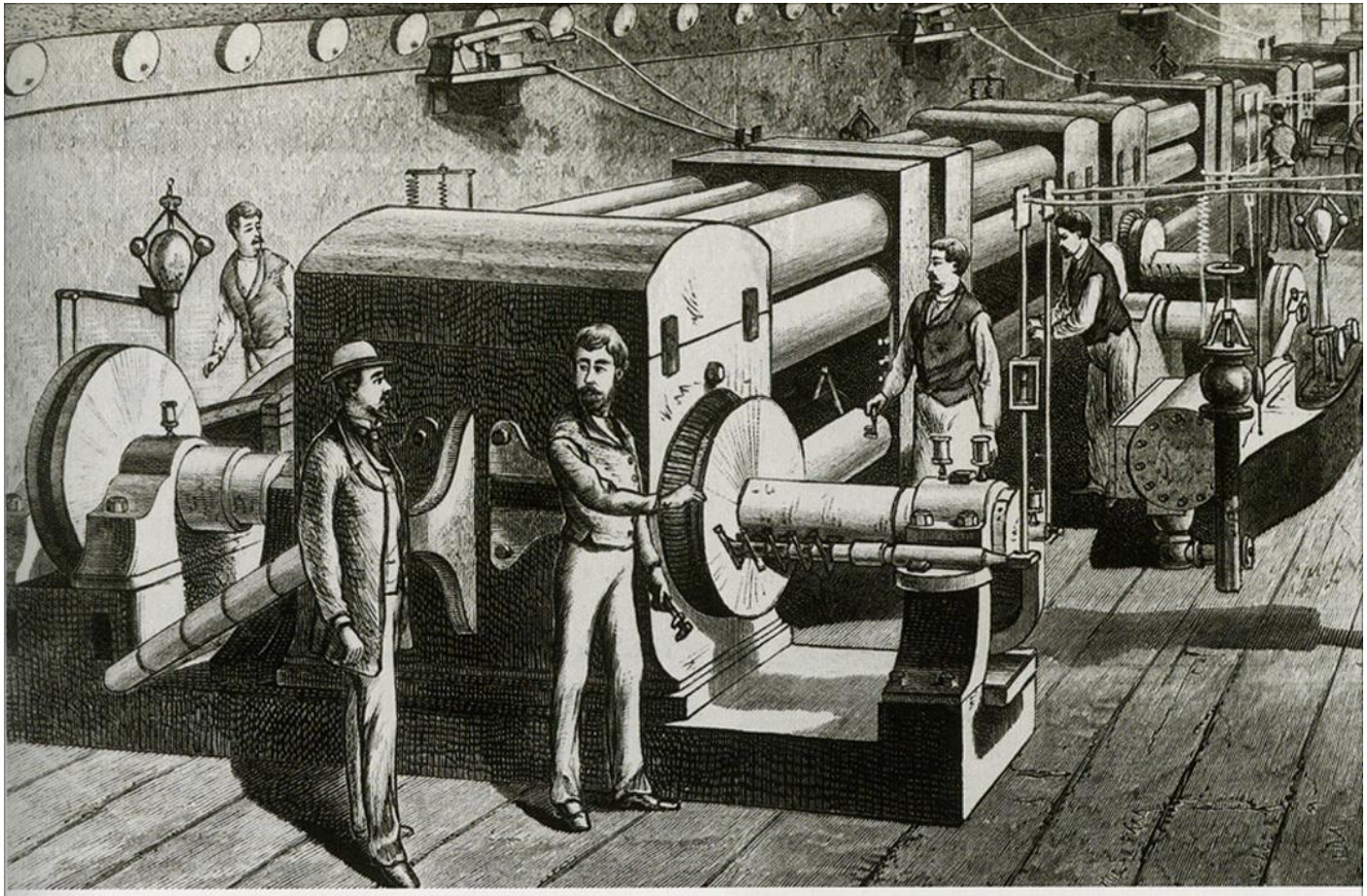
Edison's Menlo Park Research Lab

Edison: American Businessman (II)

Edison patented a system for **electricity distribution** in 1882, which was essential to **capitalize** on the invention of the electric lamp.

On December 17, 1882, Edison **founded** the *Edison Illuminating Company.*

Edison Illuminating Company (1882)



Public Electricity Supply (1882)

Edison switches on electricity for the masses.

Edison Illuminating Company (~ 1890)

He lost the company to
George Westinghouse (~ 1887-89)
after long legal battle over the lamp
and the electrification of towns.

Their rivalry never ended.

(Notes : Tesla, AC, chair, phonograph, GE

Next Class Agenda

Creativity in Engineering

Technical Design

Brainstorming

Team Work

Free exchange of ideas

Industrial Design