# Biomedical Engineering Ethics

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# GOALS

Some **Key Concerns** in **Engineering Ethics**, **Biomedical Research**, **Medical and Clinical Ethics**

**Concepts** related to the fundamentals of **Ethics**,

Classical, Contemporary **Ethical Theories**, Methods,

Structure and function of **Ethical Committees**

The basics of **Medical and Clinical Ethics**
     **Informed Consent**
     **Patient Autonomy**
     **Quality of Life**
     **Experimentation** involving **Human Subjects**

Ethics of basic and **Applied Research Using Animals**

**Safety**, **Risk**, **Reliability**

**Cloning** and **Stem Cell Research**

# Gains to be provided by Engineering Ethics Education

* Intellectual **Engineering Identity Consciousness** along with its Historical Development, Cultural and Global Dimensions,

* To realize the **Effects of Engineering** on 'Global, Economic, Environmental and Social' contexts with an understanding of Professional, **Ethical Responsibility**,

* To be informed about **Organizational Norms, Ethical Principles** and Standards,

* Creating a broad perspective by recognizing different **Ethical Approaches**, Developing Tolerance to Differences of Opinion and Understanding,

* **Understanding the Ethical Dimensions** in Professional Decisions and Behaviors by understanding the Values of Others, questioning the results of the decision taken

# Gains to be provided by Engineering Ethics Education

* The formation of **Ethical Awareness** by Recognizing the Changing Aspects of Ethical Problems, **Sensitivity**

* The importance of exhibiting **Ethical Behavior** and to **Gain Skills in Solving Ethical Problems** Realize that **Needs of the Solution**, when solving engineering problems, not **Creating New Problems**, **Protecting Values**,

* Awareness about the necessity of **Lifelong Learning**

*To understand the **Professional Organizational Culture**

* Ability to **Work Effectively** in an **Interdisciplinary Group** and to **Communicate Effectively**

* Seeing the **Option to Live FREE**



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# What is Engineering?

A complex but fundamentally unimaginative application of science?

Problem solving or a "new power in the world"?

*"as the practical study of how to make people and things work together better, an undertaking as creative as art, as political as law."* (Michael Davis)

*"Process of using the knowledge and skills required to design, build, build, operate, maintain, recycle a product or process with important technical content for a desired purpose. "* (Royal Academy of Engineering)

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Does science have a more important status?

Is technology just the application of science?

While science is like a master, does technology apply just like a slave?

NO, technology is not merely applied science.

# What is Engineering?

What do we call communities that invent useful things or add to our knowledge of how to do it?

*Technician*?　　　　Applied scientist?　　　　Engineer?

Technician is an assistant, one who carries out routine work under direction of a scientist, engineer, architect etc.

A workshop at the research lab of petroleum company; the audience; half chemists and half chemical engineers.
*"Inventing something useful or discovering new knowledge?"*

About half the chemists voted for " New Knowledge" and half for "Inventing Something Useful".

The engineers, all voted for "Usefulness".

# The Beginning of Engineering

Begin with the **Stone Age** and **first tools**?
Confusing with technology…

don't do **manual labor** ➡ **prepare instructions** to carry out

With the **first projects** large enough to have some people
**laying out** a plan and others implementing it.
They begin with the building of Stonehenge, the Pyramids…

Architects are the First Engineers?

1600s… things called "engines"-but "engine" then simply meant
a complex device for some useful purpose, a contraption
showing intelligence in design...

The first engineers were **Soldiers** associated with
the "engines of war".

They were not yet engineers in the sense that concerns us.
They were, the driver of a locomotive is an engineer, etc.

# History of Engineering

During the Ottoman Empire, similar to Western societies, the purpose of defending the empire.
During the Tanzimat period, after 1830s.

Engineers resembled architects in;
*being able to make drawings for construction projects,
*develop detailed instructions from those drawings,
*oversee the application of those instructions. They differ:

**1.** much better trained in the new mathematics and physics. They had the ability to consider systematically questions most architects could only deal with intuitively or ignore.

**2.** because the strategies of engineering had their roots in the necessities of war, engineers paid more attention to **reliability, speed** and other practicalities. So, for example, the **systematic testing** of materials and procedures in advance of construction, characteristic of engineers.

# Engineer Identity in Society

Technology Good or Bad or Neutral?
Purpose and Area of Use?
The most effective person in this process is the engineer with his **social identity**.

The <u>quality of life in the society</u> that is desired to be improved so, Society directs engineering activities.
Thorstein Veblen, addressed engineers in the late 1800s, drew attention to the distinction "between engineers and capitalist employers".

Contrary to employers' **maximum profit** target, engineers are concerned with **efficiency**. He put forward the view that the increase in productivity in industry will be achieved only by spreading the rationality of engineering and the social engineering approach to the society.

The consciousness in the production target could not compete with the "profit logic".

# Engineer Identity in Society

Intellectual and cultural roles of engineers and their social responsibilities have changed dramatically over time.

1930s, Veblen called on engineers to become power on the political platform with the '**Technocratic Movement**'.

Howard Scott, suggested that the '**Neutrality**' required by a scientific method was found only in technocrat experts. He thought that the domination of virtue would only be accomplished with the **rationalization** with the reduction of wastefulness through '**Planning**'. Engineers were called to take an active role in the "**Management**" of the enterprises they work with.

Jürgen Habermas, drew attention to
the differentiated role of engineering as
part of the 'economic system and administrative levels'.

# Engineer Identity in Society

The position of engineers with their different identities
increasingly diverged from the Veblenian approach;
They are thought to focus on their <u>Individual Interests</u> by
forgetting their <u>Social and Universal Responsibilities</u>
through their independent positions.

## **<u>Biomedical Engineering</u>**

In its broadest sense, biomedical engineering has been
with us for centuries, perhaps even thousands of years.
In 2000, German archeologists uncovered a 3,000 -year-
old mummy from Thebes with a wooden prosthetic tied to
its foot to serve as a big toe.

Also the roots of biomedical engineering as an academic
endeavor, reach back to early developments in
electrophysiology, which originated about 200 years ago.

# Ethics and Engineering

Unfortunately, today, the philosophy of engineering is where the philosophy of science was a hundred years ago.

Apart from all technical actions, engineering should also include in debates on the **Meaning of Actions**.

Auschwitz, Buchenwald Camps are great success?

Why engineers should not just act as **Technical Robots**'?

History of Engineering ⟷ History of Standardization

Constructing tables, formulas, or procedures defining safety, reliability, convenience, or other elements of good practice. These standards cover everything from strength of beams to be used in highrise buildings to the distance between threads on a screw.

# Ethics and Engineering

Where standardization is important,
that will be enough to justify following the present standard
until a new consensus emerges.

Generally agree that the **Safety**, **Health** and **Welfare** of
the **Public** rather than that of the **Client** or **Employer**
comes first.

Whereas for Health Care Professionals,
the **Safety, Health** and **Welfare** of the **Patient**
comes First.

The public interest, like the interests of colleagues or
other third-parties, is secondary.

# Ethics and Engineering

## What values does engineering incorporate?

Values such as **Efficiency, Safety** and **Honesty** are considerations to be taken into account in deciding what to do. They cannot, as such, be obeyed or disobeyed.

In contrast, **Standards of Practice**, including a **Code of Ethics**, do tell us how we should act.

Engineers define **Efficiency** so that they can measure it, assign numbers, and thereafter seek to control it.

Engineering tends to analyze a situation so that its distinctive skills can be applied. One distinctive skill of engineers is giving mathematical structure to practical problems. The concept of efficiency allows them to exercise that skill.

# Ethics and Engineering

Consider, the safety factor for steel struts supporting a bridge.
If we examine a typical code of engineering ethics,
we find many provisions that demand more than mere
**Fairness, Conscientiousness** provisions requiring.

Any public statements they make be both **Truthful** and
**Objective**.

The first thing must to do for **Reliability** is;
Acceptance of **Uncertainty of Action Results**.
However, the **Sense of Security** which can't be provided
by researches such as Cost-Benefit Analysis should be
abandoned.

In order to leave so-called certainties, the **ethical code**
that **the engineers will be based on should be
Deontological**, not with the expectations of the result,
but act with the '**Principles of Behavior**'.

# Ethics and Engineering

The natural state of man with the assumption of Hobbes; if all people have unlimited freedom they live in distrust.

Since everyone wants their own welfare and security by nature, a war environment emerges and the human contradicts himself. If every person has the right to do what he wants, this war environment will never end.

Engineering solutions; contains "Information and Plural Values" which require Ethical, Political and Aesthetic decisions to be used together.

It mustn't suggest that **technical standards** have nothing to do with **ethics standards**. For any profession, part of acting ethically is satisfying technical standards.