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## **Intention** and the Future of Engineering: Macro-Ethical Considerations

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# Three Concepts

**I.**  
**Macro Ethics**

**II.**  
**Intentionality**

**III.**  
**Unintended  
Consequences**

## Ethics

Ordering of actions and regulating power to act

### ❑ MICROETHICS

- ▶ context-specific and local

Focuses on . . .

Relationships between **individual** engineers and their clients, colleagues, and employers

### ❑ MACROETHICS

- ▶ emphasizes principles, universal claims and normative rules

Focuses on . . .

The **collective social responsibility** of the profession

# Ethical Issues in Engineering

## **Micro**

- ▶ Integrity
- ▶ Bribes and Gifts
- ▶ Fair Credit
- ▶ Honesty
- ▶ Competency and Skill
- ▶ Safety

## **Macro**

- ▶ Toxicity
- ▶ Pollution
- ▶ Sustainability
- ▶ Animal Welfare
- ▶ AI
- ▶ Nanotechnology

# Principles Guiding Macro Ethics

- ▶ Considering impact of design decisions at the scope of large systems that span across individuals and clusters of people
- ▶ Considering duty to society and expectations that society has of engineering
- ▶ Balancing potential benefits to society of advances in engineering, while avoiding negative societal consequences.

# Case of Micro-Macro Ethics Conflicts

## **Example: Volkswagen emissions scandal 2008-2015**

- ▶ Volkswagen intentionally programmed turbocharged direct injection diesel engines to activate their emissions controls to meet US NO standards during regulatory testing. However, the vehicles emitted up to 40 times more NO in real-world driving. Volkswagen deployed this software in about 11 million cars worldwide, including 500,000 in the United States.

# Macro-ethics

- ▶ **Despite individual behaviors and choices, engineering profession can sometimes cause unintentional, societal (and environmental) harm.**

# Intentionality in Action

## Intentional Action

- ▶ Taking an action based on beliefs about the character of that action
- ▶ Thinking about the action before taking it
- ▶ Looking precisely at the moral character of the action and why it might be right or wrong

## Habitual Action

- ▶ Action taken based on having done something before.
- ▶ Question of whether to take an action never is considered
- ▶ Actor fails to view action as something to ever reconsider



# Four components of Intentionality

- ▶ **Desire:** for an outcome or, the outcome as a goal, purpose, or aim
- ▶ **Belief:** or thought about consequences, or act itself, before acting
- ▶ **Intention:** to perform act; meaning, deciding, choosing, planning to act
- ▶ **Awareness:** of the act while the performing it
- ▶ **Skill:** or the ability to execute action in a controlled, replicable manner

# From Micro to Macro Ethics

## The Case of Plastics- a futuristic breakthrough

- ▶ 1839: Goodyear invented vulcanized rubber/ Eduard Simon discovered polystyrene.
- ▶ 1869: first synthetic polymer was invented by John Wesley Hyatt.
- ▶ 1907: Baekeland invented the first fully synthetic polymer
- ▶ 1933: Polyethylene discovered and synthesized as a low-density resin in 1935.
- ▶ **1954: Polypropylene discovered & commercial production began in 1957**
  - ▶ Food storage and preservation
  - ▶ Medical devices
  - ▶ Toys and games (billiards)
  - ▶ Fabrics (upholstery)
  - ▶ Pipes (household and industrial)
  - ▶ Shipping, garbage, and other containers

# Unintended Consequences of Plastics



- ▶ Humans consuming 1 million plastic drinking bottles per minute
- ▶ 5 trillion single-use plastic bags used yearly
- ▶ only 5.4% of US generated plastics recycled
- ▶ Microplastics found in organs 114 aquatic species
- ▶ 14 million metric tons of microplastic particles on ocean floor
- ▶ Micro & nano plastics in food humans consume, and in milk of lactating women.
- ▶ Plastic compounds in humans disrupt the endocrine system

# Five principle causes of unanticipated consequences

Robert K. Merton (1936)

- I. **Ignorance (We didn't know)**
- II. **Error (Oops)**
- III. **Interest which neglects longer term, potentially negative consequences**
- IV. **Values leading to non action, despite potential negative consequences**
- V. **Self-defeating prophecy: non action due to fear of negative unanticipated consequences.**

## Does Intentionality play a role in Engineering Macro Ethics?

- ▶ **Desire of Engineering Profession** for outcome as a goal, purpose, or aim
- ▶ **Belief of Engineering Profession** in considering consequences before acting
- ▶ **Intention of Engineering Profession** to perform, decide, choose, an act
- ▶ **Awareness in Engineering Profession** of the act while the performing it
- ▶ **Skill of Engineering Profession** to execute in controlled, replicable manner