Lessons from Engineering Ethics for Genetic Engineering and Society

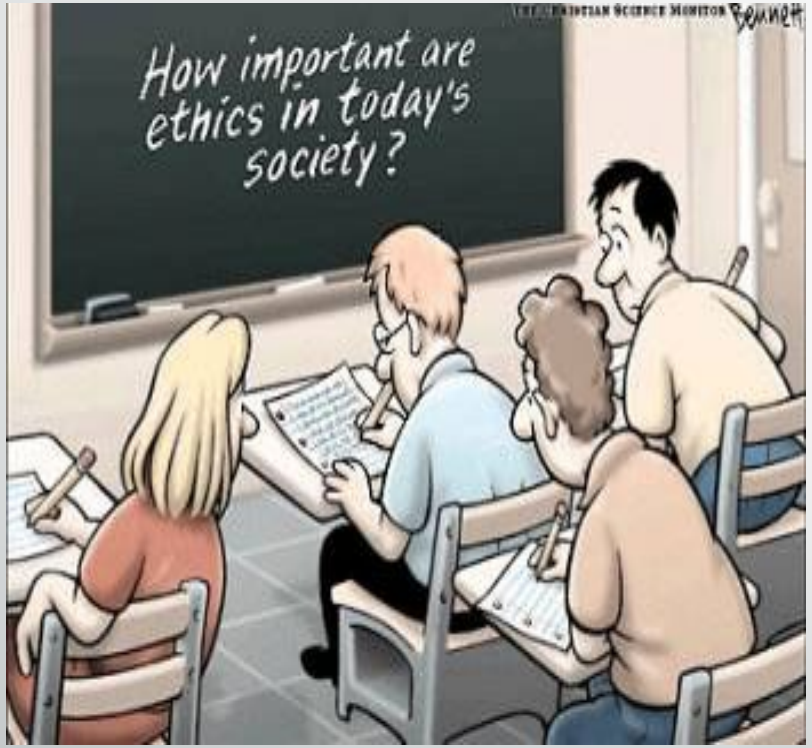
Joe Herkert
Associate Professor Emeritus of STS
North Carolina State University
jherkert@ncsu.edu

Presentation Outline

- What is Engineering Ethics?
- Brief History of Engineering Ethics
- Engineering as a Profession
- Engineering Ethics Concepts & Methods
  - Codes of Ethics
  - Microethics and Macroethics
  - Engineering as Social Experimentation
  - Ethics as Design
- Teaching Engineering Ethics
  - The Case Method
  - Thinking Like an Engineer

"The future ain't what it used to be."
~Yogi Berra

What is Ethics?



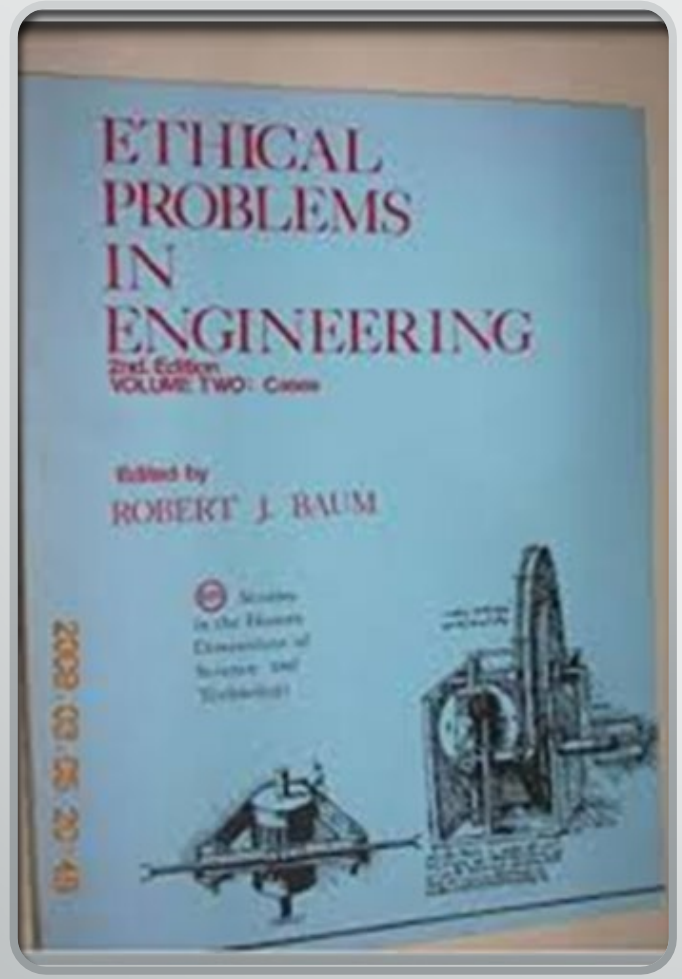
The rules and ideals for human behavior. They tell us what we ought to do.

Wujek and Johnson 1992

What is Engineering Ethics?

Engineering ethics is (1) the study of moral issues and decisions confronting individuals and organizations engaged in engineering and (2) the study of related questions about the moral ideals, character, policies and relationships of people and corporations involved in technological activity.

Martin and Schinzinger, 1996, pp. 2-3



Brief History of Engineering Ethics

- Early 1900s – First engineering codes of ethics
- 1947 – Engineers' Council for Professional Development (ECPD) – first mention of responsibility to the public
- 1974 – ECPD Code of Ethics of Engineers – first instance of "paramountcy clause"
- 1970s – Engineering ethics courses begin to appear
- Late 1990s – ABET Engineering Criteria 2000

Barry and Herkert 2014

- 2017 - Self-driving cars: ethical responsibilities of design engineers
- 2019 - Self-driving cars and engineering ethics: the need for a system level analysis
- 2020 - Autonomous vehicles and the ethical tension between occupant and non-occupant safety
- (in press) - Planes, trains, and flying taxis: ethics and the lure of autonomous vehicles
- 2020 - The Boeing 737 Max: lessons for engineering ethics

A philosopher, an engineer and a computer scientist walk into a bar…

Jason Borenstein

Keith Miller

Professional Responsibility

- Moral Responsibility: "For someone to have a *moral responsibility* for some matter means that the person must exercise judgment and care to achieve or maintain a desirable state of affairs." (Whitbeck 1998, p. 37)
- Profession: "[A] learned occupation requiring systematic knowledge and training, and commitment to a social good." (Wujek and Johnson 1992)
- Professional Responsibility: A "type of moral responsibility arising from special knowledge possessed by an individual." (Whitbeck 1998, p. 39)
- "Social good" of Engineering: "…the creation of useful and safe technological products while respecting the autonomy of clients and the public, especially in matters of risk-taking." (Martin and Schinzinger 1996, p. 42)

The New York Times

Prosecutors Say Greed Drove Pharmacist to Dilute Drugs

Aug. 18, 2001

Engineering Codes of Ethics: Paramountcy Clause

ASME Code of Ethics of Engineers (2006)

Engineers shall hold paramount the safety, health and welfare of the public in the performance of their professional duties

AIChE Code of Ethics (2015)

Hold paramount the safety, health and welfare of the public and protect the environment in performance of their professional duties

ASCE Code of Ethics (2020)

…first and foremost, protect the health, safety, and welfare of the public

IEEE Code of Ethics (2020)

…to hold paramount the safety, health, and welfare of the public, to strive to comply with ethical design and sustainable development practices, to protect the privacy of others, and to disclose promptly factors that might endanger the public or the environment

Code of Ethics for Gene Drive Research

I will conduct and apply my work on characterizing, optimizing, manipulating, or counteracting gene drives consistent with the needs and interests of humanity, with respect for human dignity and human rights, and holding paramount public health, public safety, and ecological stewardship. I am committed to the fair distribution of risks and benefits of gene-drive research, and to practicing science that is transparent and reproducible.

- Scientific responsibility
- Ecological stewardship
- Public engagement and benefit sharing

Annas et al. 2021,
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7898401/

Microethics and Macroethics in Engineering

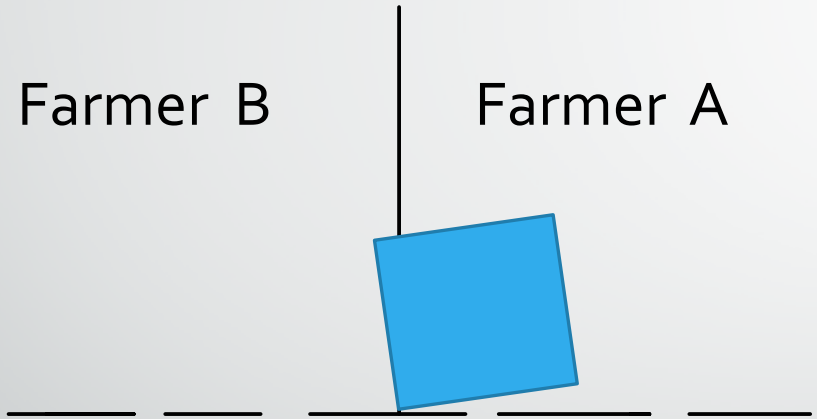
Microethics is concerned with ethical decision making by individuals and the internal relations of the engineering profession.

Macroethics refers to the collective social responsibility of the engineering profession and to societal decisions about technology.

Some Micro and Macro Issues in Science and Engineering Ethics

	Science	**Engineering**
Microethics	Integrity of Data Fair Credit	Health & Safety Bribes & Gifts
Macroethics	GMOs Dual-use Technology	Sustainable Development Autonomous Robots

Microethics



(angle exaggerated)

Should surveyor's error be disclosed?

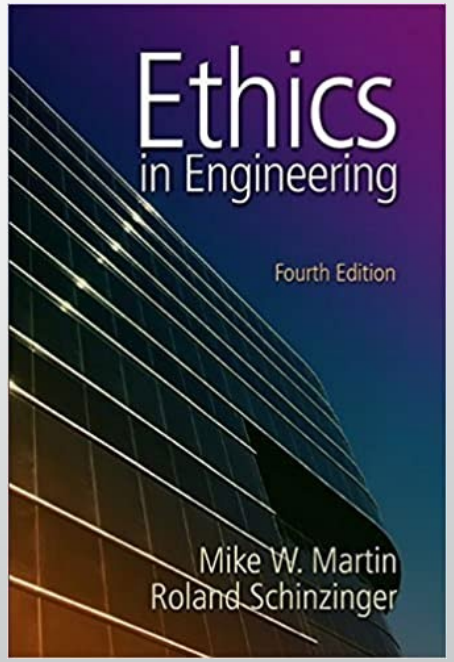
Macroethical Issues: GM Mosquitoes

- Gene Drive (Pugh 2016)
  - Sanctity of Life
  - Hubris (e.g., playing God)
- Field Trials (Resnick 2014)
  - Protecting the public and the environment from harm
  - Balancing benefits and risks
  - Collaborating with the local community
  - Avoiding exploitation
  - Safeguarding the rights and welfare of research subjects

Engineering as Social Experimentation

Characteristics of engineers as responsible experimenters:

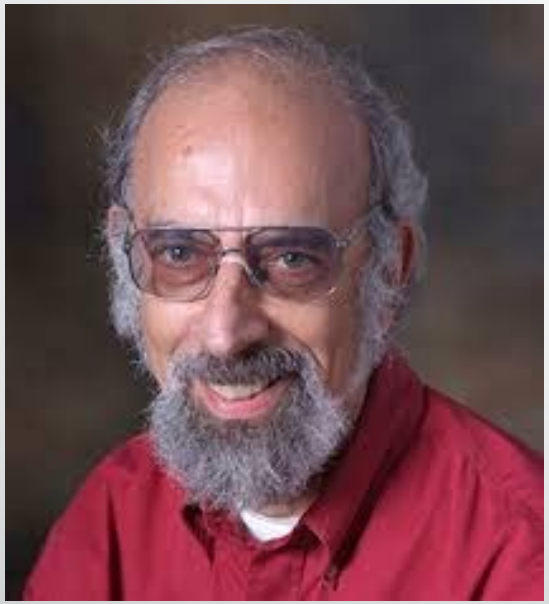
- CONSCIENTIOUSNESS: A primary obligation to protect the safety of human subjects and respect their right of consent.
- COMPREHENSIVE PERSPECTIVE: A constant awareness of the experimental nature of any project, imaginative forecasting of its possible side effects, and a reasonable effort to monitor them.
- MORAL AUTONOMY: Autonomous, personal involvement in all steps of a project.
- ACCOUNTABILITY: Accepting accountability for the results of a project.



Ethics as Design

"The multiply constrained nature of many problems in engineering design provides an excellent model of challenging moral problems… Many moral problems that are represented as conflicts are better understood as problems in which there are multiple constraints that may or may not turn out to be simultaneously satisfiable."

Engineering Ethics Education Outcomes



Michael Davis

- Increased ethical sensitivity
- Increased knowledge of relevant standards of conduct
- Improved ethical judgment
- Improved ethical will power

The Case Method

- Recognize ethical problems
- Develop analytical skills to engage in constructive ethical analysis
- Stimulate moral imagination
- Realize solutions need moral judgement not just reference to codes
- Recognize there may be unresolvable uncertainties

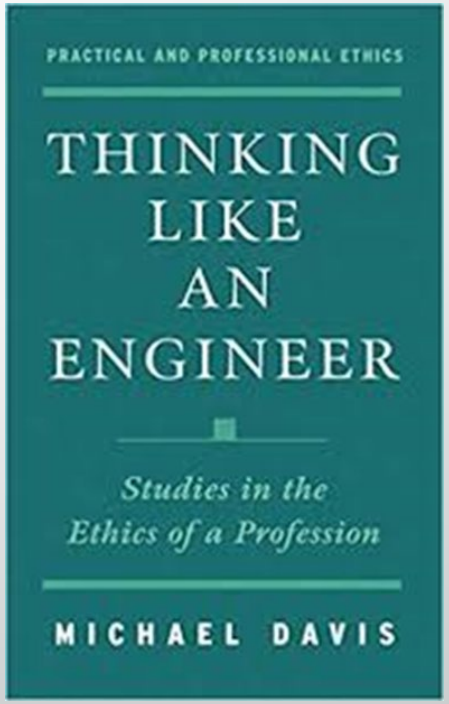
Harris, Pritchard & Rabins 1999

Some Considerations When Selecting a Case Study

- Real vs. Hypothetical
- Historical vs. Contemporary
- Complex vs. Relatively Straightforward Ethical Issues
- Discipline-Specific vs. Discipline Neutral/Outside of the Discipline

Thinking Like an Engineer

- *Professional ethics is as much a part of what members of a profession know--and others do not—as their "technical" knowledge. Engineering ethics is part of thinking like an engineer.*
- *Professional ethics…belongs neither to common sense nor to philosophy but to the profession in question.*



Some Tests for Ethical Decision-making

Harm test: Does this option do less harm than alternatives?

Publicity test: Would I want my choice of this option published in the newspaper?

Defensibility test: Could I defend choice of option before congressional committee or committee of peers?

Reversibility test: Would I still think choice of this option good if I were adversely affected by it?

Colleague test: What do my colleagues say when I describe my problem and suggest this option is my solution?

Professional test: What might my profession's governing body or ethics committee say about this option?

Organization test: What does the company's ethics officer or legal counsel say about this?

Davis 1999

Purdue University, West Lafayette, Indiana, USA, 18-20 May 2023

Conference Theme: Ethics in the Global Innovation Helix

- IEEE ETHICS-2023 will draw together the global community of technology and ethics practitioners and theoreticians from industry, academia, government, and civil society. ETHICS-2023 is a conference of the IEEE Society on Social Implications of Technology (SSIT) (series originally launched in 2014) and is co-sponsored and hosted by the National Institute for Engineering Ethics in the School of Engineering Education at Purdue University.
- Conference details and the full Call for Papers are available at the ETHICS-2023 Website, https://attend.ieee.org/ethics-2023/
- Note the following important dates:

  18 November 2022: Panel Session and Workshop/Tutorial proposals due
  16 December 2022: Poster Abstracts and Short/Long Paper submissions due

Selected Bibliography

Annas, George J., et al. "A code of ethics for gene drive research." The CRISPR Journal 4.1 (2021): 19-24.

Barry, Brock E., and Joseph R. Herkert. "Engineering ethics." Cambridge handbook of engineering education research. Cambridge University Press (2015): 673-692.

Belluck, Pam. "Prosecutors Say Greed Drove Pharmacist to Dilute Drugs." New York Times, Aug. 18, 2001.

Davis, Michael. Thinking Like an Engineer: Studies in the Ethics of a Profession. Oxford University Press (1998).

Harris, Charles E., Michael S. Pritchard, and Michael J. Rabins. Engineering Ethics: Concepts and Cases, 2nd ed. Wadsworth (1999).

Selected Bibliography (continued)

Herkert, Joseph R. "Future directions in engineering ethics research: Microethics, macroethics and the role of professional societies." Science and Engineering Ethics (2001): 551-562.

Martin, Mike and Roland Schinzinger. Ethics in Engineering, 3rd ed., McGraw-Hill (1996).

Pugh, Jonathan. "Driven to extinction? The ethics of eradicating mosquitoes with gene-drive technologies." Journal of medical ethics 42.9 (2016): 578-581.

Resnik, David B. "Ethical issues in field trials of genetically modified disease-resistant mosquitoes." Developing world bioethics 14.1 (2014): 37-46.

Whitbeck, Caroline. Ethics in engineering practice and research. Cambridge University Press (1998).

Wujek, J. W. and D.G. Johnson. How to Be a Good Engineer. IEEE United States Activities Board (1992).

Image Sources

Slide 3 - https://henrykotula.com/2017/03/14/cartoon-how-important-are-ethics-in-todays-society/

Slide 14 - https://fla-keys.com/news/article/10845/