Ethics and the New Engineer: Teaching, Research and Practice

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ABET Engineering Criteria 2000

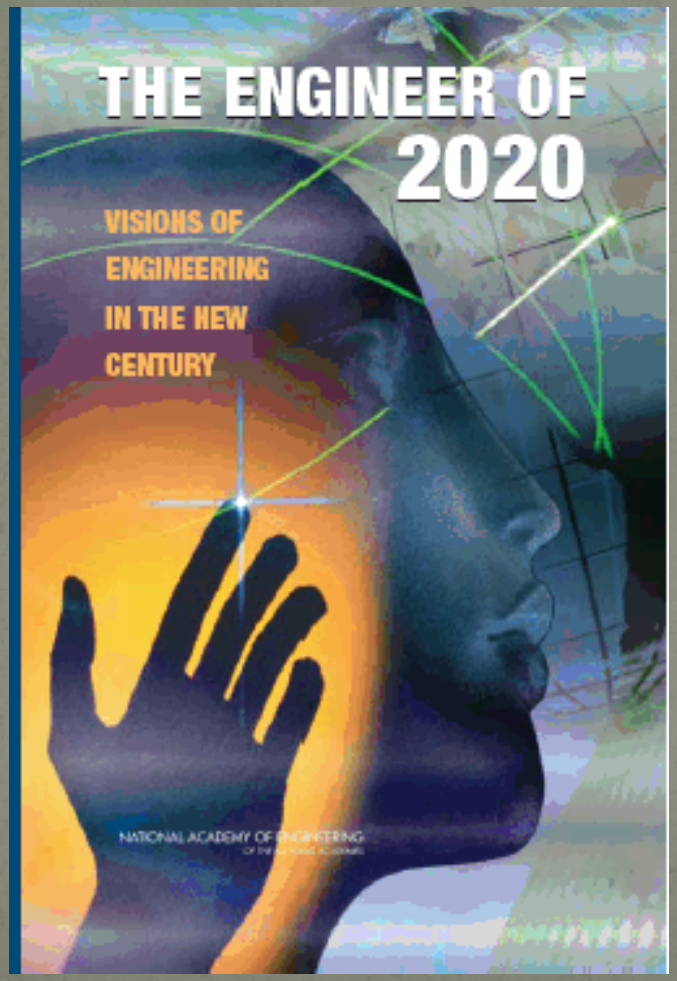
General Criterion 3. Student Outcomes

The program must have documented student outcomes that prepare graduates to attain the program educational objectives.

(f) an understanding of professional and ethical responsibility

(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

National Academy of Engineering (NAE)



Attributes of the Engineer of 2020

...the need to ... possess a working framework upon which high ethical standards and a strong sense of professionalism can be developed.... Successful engineers in 2020 will, as they always have, recognize the broader contexts that are intertwined in technology and its application in society.

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Grand Challenges: Social indicators

- Sustainability [Environmental]
- Health
- Vulnerability
- Joy of Living
- Justice?
- Peace?
- Education?
- Self-governance?
- ETC…

Grand Challenges: Attributes of engineers

- Reason
- Science
- Art
- Creative imagination

"…engineers will continue the tradition of forging a better future."

- Ethics (only mentioned once in entire 56 page e-book)?
- Humility?
- Empathy?
- Interdisciplinary thinking?
- ETC…

"Does Improved Technology Mean Progress?" – Leo Marx

- Enlightenment view of progress
- Improved technology as a means to achieving social progress
- Technocratic view
- Improved technology as an end in itself
- "…innovations in science-based technologies are in themselves a sufficient and reliable basis for progress."

GCE Implies:
Tech progress = social progress

Meeting all those challenges must make the world not only a more technologically advanced and connected place, but also a more sustainable, safe, healthy, and joyous — in other words, better — place.

Part of the engineering task will be discovering which approaches work best at ensuring user cooperation with new technologies.

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

	Scientific Research	**Engineering Practice**
Microethics	Integrity Fair Credit	Health & Safety Bribes & Gifts
Macroethics	Human Cloning Stem Cell Research	Sustainable Development Emerging Technologies

Bill Wulf, former NAE President

Several things have changed, and are changing, in engineering that raise macroethical questions…. The level of complexity of the systems we are engineering today, specifically systems involving information technology, biotechnology, and increasingly nanotechnology, is simply astonishing. When systems reach a sufficiently high level of complexity, it becomes impossible to predict their behavior. It's not just hard to predict their behavior, it's *impossible* to predict their behavior.

Biological (ecological) system goals
- Genetic diversity
- Resilience
- Biological productivity

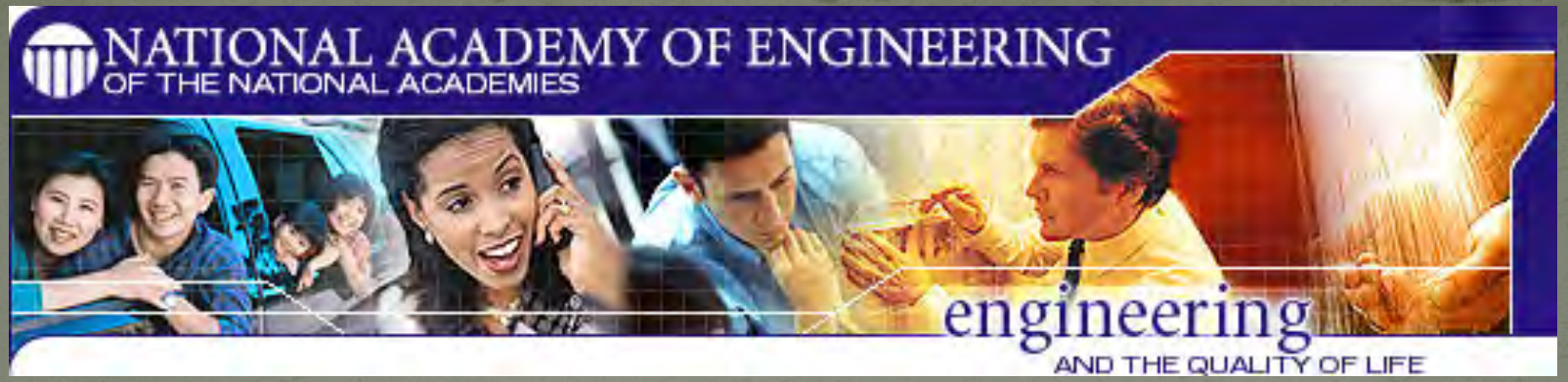
Economic system goals
- Increasing production of goods and services
- Satisfying basic needs or reducing poverty
- Improving equity

Social system goals
- Cultural diversity
- Social justice
- Gender equality
- Participation

International Institute for Environment and Development
Source: Holmberg and Sandbrook (1992)

A Declaration by the U.S. Engineering Community to the World Summit on Sustainable Development (2002)

Creating a sustainable world that provides a safe, secure, healthy life for all peoples is a priority for the U.S. engineering community. It is evident that U.S. engineering must increase its focus on sharing and disseminating information, knowledge and technology that provides access to minerals, materials, energy, water, food and public health while addressing basic human needs. Engineers must deliver solutions that are technically viable, commercially feasible, and environmentally and socially sustainable.



Engineering, Social Justice, and Sustainable Community Development Workshop

Center for Engineering, Ethics, and Society National Academy of Engineering

Co-sponsored by Association for Practical and Professional Ethics

October 2008

ASCE Sustainability Website

[Sustainability is] a set of environmental, economic and social conditions in which all of society has the capacity and opportunity to maintain and improve its quality of life indefinitely without degrading the quantity, quality or availability of natural, economic, and social resources.

ASCE Board

ASCE Code of Ethics (footnote 3)

In October 2009, the ASCE Board of Direction adopted the following definition of Sustainable Development: "Sustainable Development is the process of applying natural, human, and economic resources to enhance the safety, welfare, and quality of life for all of society while maintaining the availability of the remaining natural resources.

ASEE Code of Ethics (2012)

ASEE Board refused to include “sustainable development” in code

Code does include:

ASEE members shall:

3. Encourage students to be aware of the environmental and social impact of their solutions.

Pervasive Computing

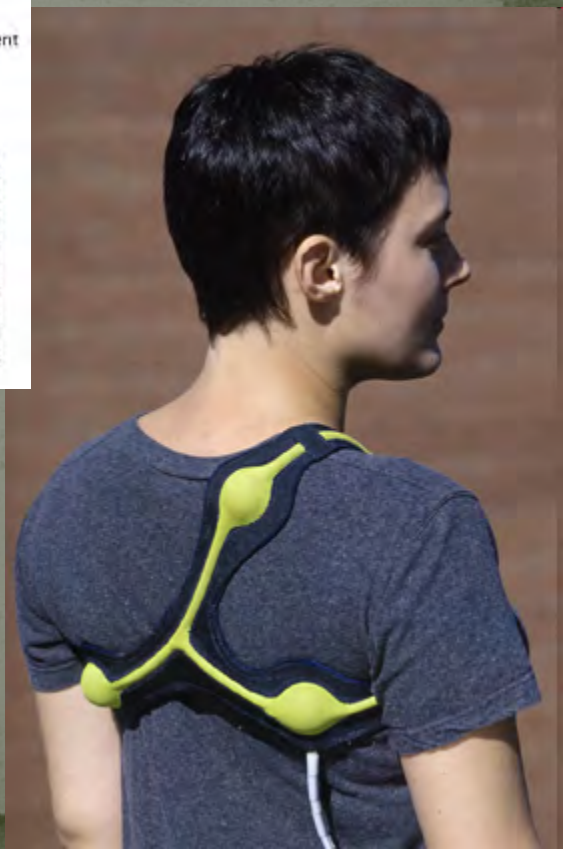
Pervasive computing is the next generation computing environments with information & communication technology everywhere, for everyone, at all times.

-Centre for Pervasive Computing (Denmark)

emag.com


BLUETOOTH MODULE
TRANSCEIVER


Body area network:
wearable computers/displays
Office network
The intelligent home
Vehicle network
Supermarket, etc.



Ethical Issues

- Environmental (resource use, waste streams)
- Health & Safety (non-ionizing radiation, psychological stress)
- Social (digital divide, freedom of choice, information overload, anonymity, privacy)

Are Emerging Technologies Unique?

- Embeddedness
- Unlimited Reach
- Engineering the Mind and the Body
- Specificity
- Convergence (process and products)
- Malleability

Nordmann 2004; Moor 2006

Who should do the ethics?

My research hypothesis is that intelligent robots can behave more ethically in the battlefield than humans currently can.

Arkin (2008)

Humans are just barely smart enough to be called intelligent. I think we're also just barely good enough to be called moral.... most of all because they will be capable of deeper understanding and be free of our blindnesses, AIs stand a very good chance of being better moral creatures than we are.

Hall (2007)

Ethicists and Emerging Technologies

…we are living in a period of technology that promises dramatic changes and in which it is not satisfactory to do ethics as usual. Major technological upheavals are coming. Better ethical thinking in terms of being better informed and better ethical action in terms of being more proactive are required.

Moor (2006)

Moor's (and others) Conclusions

- Acknowledgement that "ethics is an ongoing and dynamic enterprise" (make ethical reflection part of R&D process)
- Employing a multi-disciplinary approach that includes "better collaborations among ethicists, scientists, social scientists, and technologists" (bridge "two cultures")
- Development of "more sophisticated ethical analysis" (alter "form and character of ethical reflection")

Rethinking Ethical Concepts *and* Processes

- Moral Imagination (complexity and malleability)
- Preventive ethics (proactive rather than post hoc)
- STS/Anticipatory Ethics (embeddedness, participation)

Conclusions: New Engineer (or old engineering)?

Vision Should Attend to Both Micro- and Macro- Ethics

Vision Should Include Consideration of Societal Context of Engineering (e.g. socio-technical systems)

Grand challenges should start with identifying the social and ethical commitments of engineering (i.e., social progress), rather than the achievements of engineering, past, present, and future (i.e., technological progress)