COLORADO SCHOOL OF MINES
EARTH • ENERGY • ENVIRONMENT

The Socially-Responsible Engineer - Kevin Moore, Dean College of Engineering and Computational Sciences

Tau Beta Pi District 12 Conference

25 February, 2017

WELCOME TAU BETA PI MEMBERS!

- **Colorado School of Mines is pleased to host the District 12 Conference**
  - Best wishes for a successful conference
- **I personally want to thank you for inviting me to talk to you today**
  - I'm the Dean of the College of Engineering and Computational Sciences here at Mines
  - I've taught at 3 schools in District 12: Idaho State, Utah State, and Mines
  - I'm a Tau Bate myself: Louisiana Alpha (BSEE '82) and I still have my Bent from my initiate activities
- **Thank you for being here**
  - It's important to have students committed to the principles of Tau Beta Pi (more later)

Colorado School of Mines: a public university devoted to applied science and engineering

A mission-driven research intuition focused on:

Earth, Energy, Environment

- 4566 undergraduates
- 1227 graduate students
- ~300 full-time faculty
- 16 Undergraduate programs
- 50 MS/PhD programs
- Rank #18 in number of B.S. eng grads
- Rank #25 in number of PhD eng grads

COLORADOSCHOOLOFMINES
EARTH • ENERGY • ENVIRONMENT

Colorado School of Mines

Located in Golden, Colorado, USA
10 miles West of Denver

- **Discovery** and **recovery** of the Earth's resources
- **Conversion** of resources to materials and energy
- Development of **advanced processes and products**
- Fundamental knowledge and technologies that support the **physical and biological sciences**
- Economic, social and environmental systems necessary for a **sustainable global society**

Of Engineers and Engineering

- **Who/what is an engineer?**
  - Someone who does engineering?!

- **So … what is engineering?**
  - What are some words you think of to describe engineering?

Of Engineers and Engineering

- **Who/what is an engineer?**
  - Someone who does engineering?!

- **So … what is engineering?**
  - What are some words you think of to describe engineering?
  - From Wikipedia:

Engineering is the application of mathematics and scientific, economic, social, and practical knowledge in order to invent, innovate, design, build, maintain, research, and improve structures, machines, tools, systems, components, materials, processes, solutions, and organizations.

These often get lost

In favor of this

The discipline of engineering is extremely broad and encompasses a range of more specialized fields of engineering, each with a more specific emphasis on particular areas of applied science, technology and types of application.

Why Engineer?

- **Why did you chose to study engineering?**
  - Like math/science
  - Make money
  - Parents/relatives are engineers
  - What about … to make a difference
- **I would like to suggest**
  - The fundamental reason to study engineering is attain the skills needed to help make a better world
  - This concept is the fundamental notion behind the codes of ethics for all the professional engineering societies
  - Indeed, from http://www.tbp.org/about/mission:

Tau Beta Pi Vision Statement

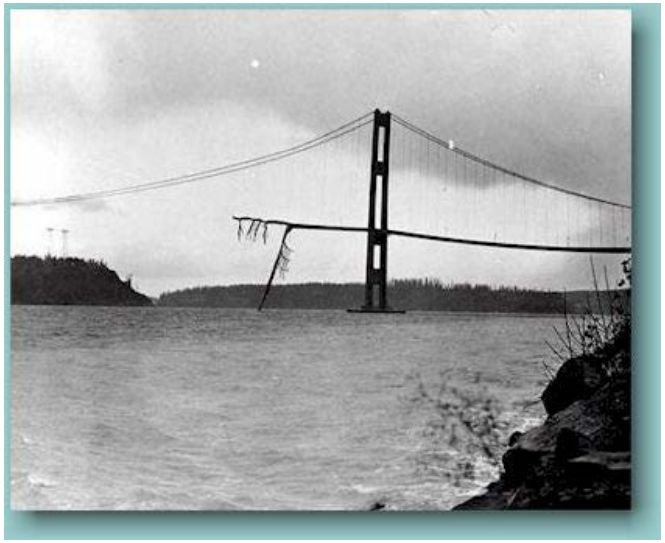
Tau Beta Pi engineers making extraordinary contributions to create a better world.

The Socially-Responsible Engineer

- **I would like to further suggest**
  - The 21st century engineer transcends the technical
- **Every engineer today, regardless of disciplinary interest or context must**
  - Be **socio-technically adept**
  - Have a **multi-dimensional mindset** that honors
    - Multi-disciplinary contributions
    - Systems thinking
    - Global perspectives
    - Diverse contributors
  - Make an impact as a **design thinker** who is
    - First a problem definer, second a problem solver (why engineer?)
    - Human-centered
    - An innovator
  - Be mindful of the **right motivation**, with intent to be
    - Socially-just
    - Corporately-responsible
    - Focused on the challenges facing society

(Socio-)Technically Adept

- **A socially-responsible engineer is … well … an engineer!**
  - The bridge can't fall down because no one knows dynamic systems theory!
  - But, every practicing engineer will tell you the technical stuff is often the easier stuff
  - In fact, engineering education promotes a **false dichotomy that separates social from technical** – but, … they can't be separated!



http://www.lib.washington.edu/specialcollections/collections/exhibits/tnb/images/over6c

A socially-responsible engineer is a socio-technical engineer

A Multidimensional Mindset -1

- **A socially-responsible engineer honors multi-disciplinary contributions**
  - So an electrical engineering, a mechanical engineer, and a computer engineer are riding in a car …
  - The sum of knowledge about the technical aspects of engineering is too great – we need disciplinary expertise
  - But, you can't be an ME/EE/etc. in a vacuum
  - And, you can't do engineering in a vacuum – in your career you will encounter and work with all manner of contributors, from doctors to lawyers to anthropologists to social workers to city planners and many, many more

https://www.google.com/search?q=broken+car+clipart&tbm=isch&imgil=LLg6GflMg8ptDM%253A%253BFF1MatTeBFeJvM%253Bhttps%25253A%25252F%25252Fclipartfest.com%25252Fcategories%25252Fview%25252Fb26989bf62cd3ced15953a94491d33960dbc5da8%25252Fold-broken-car-clipart.html&source=iu&pf=m&fir=LLg6GflMg8ptDM%253A%252CFF1MatTeBFeJvM%252C_&usg=__NfIZXkGDY8boXXMtYDsHxiv3Ixg%3D&biw=1536&bih=731

The successful engineer knows that all kinds of people with different skills are needed to do a job

A Multidimensional Mindset -2

- **A socially-responsible engineer honors systems thinking**
  - A “systems person” considers the connections and interactions between the components that make up the larger system
  - Often, the **collective behavior is more than the sum of the individual behaviors** – the *gestalt* principle
  - Today, it is essential that all engineers recognize this principle
    - The world has many more people than when the disciplinary engineering programs were being developed: there are simply **more components**
    - Due to improved roads and communication avenues, there are many **more interconnections**
    - These facts can produce **unintended consequences**

Not every engineer must be systems engineer, but every engineer must understand their work in the context of the larger systems of the world

A Multidimensional Mindset -3

- ***A socially-responsible engineer honors global perspectives***
  - It is almost certain that when you become a practicing engineer you will be influenced by global issues and considerations
    - Your company will have international offices or sales
    - Your company will compete internationally with engineers from other companies
  - You need to understand that international engineers will be
    - Smart and savvy
    - Great colleagues and contributors
  - Many engineering schools recognize this, e.g.,
    - Texas Tech global requirement
    - USC iPodia collaborative design system

A Multidimensional Mindset -4

- ***A socially-responsible engineer honors diverse contributors***
  - People are equally smart no matter their ethnic, racial, gender, or socio-economic background
  - Even non-engineers are smart!!
  - If your company or engineering team does not demographically represent that of society, then you are missing out on smart contributors who can help you make a difference
  - Diversity in the workforce is just good business!
  - We have all kinds … it takes all kinds … enough said!

Impactful Design Thinking -1

- **A socially-responsible engineer is a problem definer first and then a problem solver**
  - Design thinking is an "… approach that can be used to consider issues and resolve problems more broadly than within professional design practice, and has been applied in business and to social issues." (Wikipedia)
  - Design thinking is more than engineering design
  - Design thinking begins by asking
    - Is there a problem?
    - Is the problem what we think it is?
    - Should we even solve it?
  - Design thinkers talk with the experts of the problem: those who experience it the most (not necessarily the client)

The socially-responsible engineer asks "why engineer? and "engineer for whom?"

Impactful Design Thinking -2

- **A socially-responsible engineer is human-centered**
  - Human-centered design is a methodology and approach developed at the Stanford d.school and promoted by an organization called IDEO
  - HCD is a way of approaching design that is
    - User-focused
    - Emphasizes putting the designer in the customer's community, where solutions will ultimately live
  - HCD is fundamental is about humility: understanding that while you might be the only one at the table who knows what the right hand rule does, you're NOT the expert on the problem

The socially-responsible engineer asks "what will the impact of my design be in the users' lives and community?"

Impactful Design Thinking -3

- ***A socially-responsible engineer is an innovator***
  - … Always looking for a better way
  - Sometimes as an entrepreneur
  - Sometimes as an intrapreneur (from within your company)

Mines students brainstorming at the Posner Center, a Denver-based NGO incubator for social entrepreneurs

Right Motivation -1

- ***A socially-responsible engineer is motivated by social justice***

Engineering should be motivated by the goal of improving all people's lives by attacking the fundamental problems facing society

- **At Mines we have a program called "Humanitarian Engineering" that focuses on this motivation**

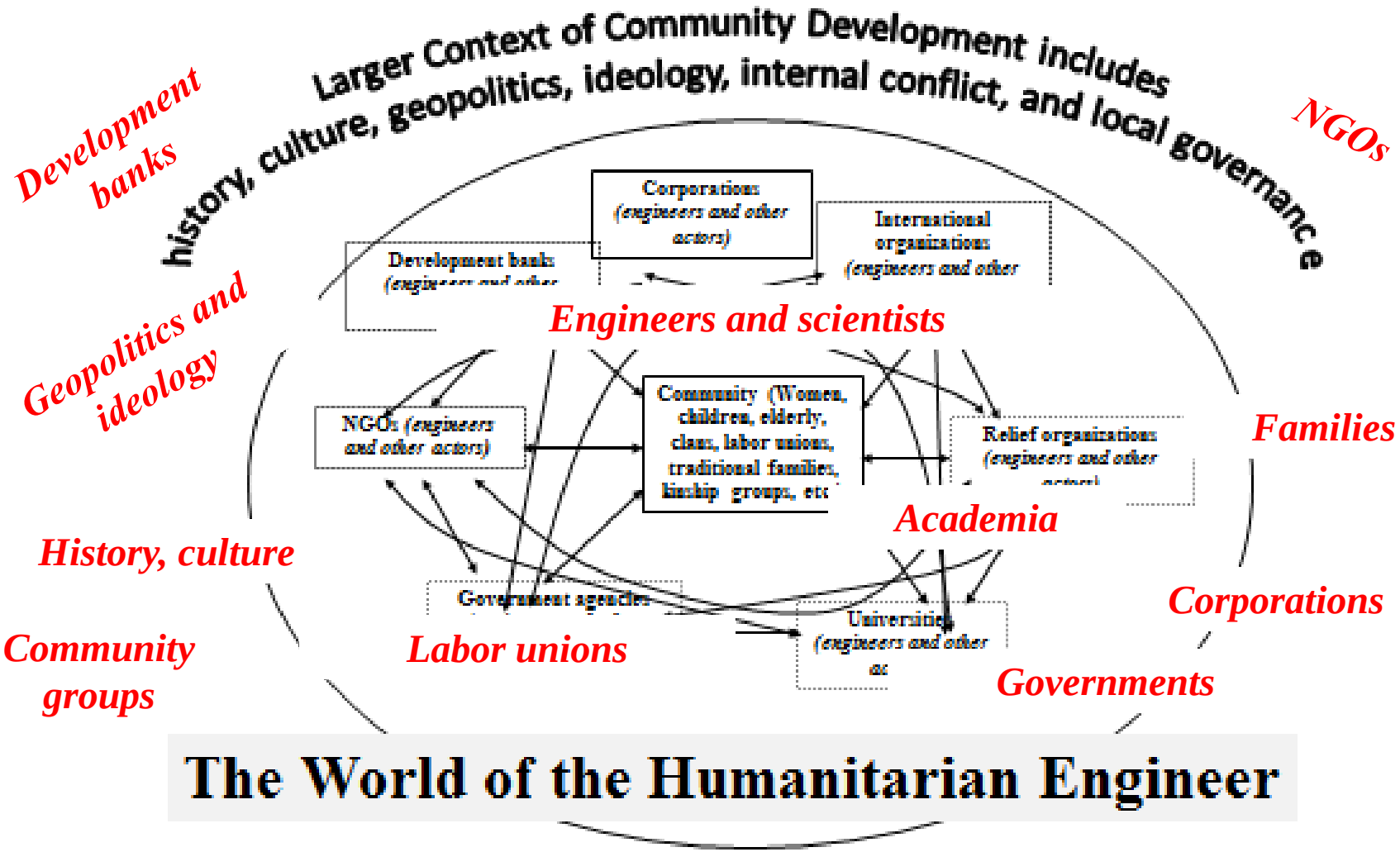
Humanitarian ENGINEERING
SOCIAL JUSTICE COMMUNITY SUSTAINABILITY

COLORADOSCHOOLOFMINES
EARTH • ENERGY • ENVIRONMENT

Humanitarian Engineering is …

…. a curricular minor for engineering students to learn about co-creating just and sustainable solutions for communities

HE teaches about the complexities around socially-responsible engineering



Right Motivation -2

- ***A socially-responsible engineer is motivated by corporate social responsibility (CSR)***
  - Not all engineering students who care about social justice can/should/will end up working in an NGO
  - Social responsibility can also be promoted by engineers who work in corporations
  - At Mines we have developed a focus on CSR within our HE program:

"Corporations that Care"

COLORADOSCHOOLOFMINES
EARTH • ENERGY • ENVIRONMENT

External to Internal: A Tale of Three "Costs[2]"

Safety

Mission of Corporations (pre-1960): Profits!

Environment

Communities

Safety, Environment, Community: external "costs" of doing business

[2]As told by Phil Clark, former VP of Resource Development, BHP Billiton

1960-1970: Safety Matters!

Mission of Corporations

Environment

Internalizing safety as a core value

Communities

1970-1980: Environmental responsibility

Mission of Corporations

Communities

What's good for the planet is good for the company

Today: A new understanding

Community is being recognized as crucial for garnering a corporation's "social license to operate"

Corporate Social Responsibility (CSR)

- Like safety and environmental consciousness CSR will become **fully internalized as a core value** in business
- This has already been embraced in
  - Mining to a large extent
  - Oil and gas to a lesser extent
  - Aerospace/defense very recently
  - Big pharma may be next
- People-Planet-Profits

The socially-responsible engineer knows that "What's good for society and the environment is good for the shareholders"

Right Motivation -3

- ***The socially-responsible engineer is focused on the challenges facing society***
  - Recently it has been recognized that the world faces really large challenges that require focused attention to the problem sector and the collaboration of cross-disciplinary teams to address
  - One effort the socially-responsible engineer should know about is the **National Academy of Engineering's Grand Challenges** program

NAE Grand Challenges

- **In 2008 the NAE identified 14 grand challenges in engineering for the 21st century**

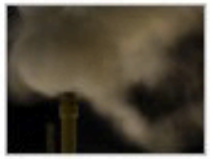
- **Soon after the Grand Challenges Scholars Program was launched at colleges and universities across the US and the world (>40 total)**

- **The GCSP has five components:**
  1. Hands-on Project OR Research Experience
  2. Interdisciplinary Curriculum
  3. Entrepreneurship
  4. Global Dimension
  5. Service Learning

NAE Grand Challenges


Make solar energy economical


Provide energy from fusion


Develop carbon sequestration methods


Manage the nitrogen cycle


Provide access to clean water


Restore and improve urban infrastructure


Advance health informatics


Engineer better medicines


Reverse-engineer the brain


Prevent nuclear terror


Secure cyberspace


Enhance virtual reality


Advance personalized learning


Engineer the tools of scientific discovery

GRAND CHALLENGES FOR ENGINEERING

United Nations Development Goals

- **In 2015 the UN General Assembly formally accepted a new set of 17 measurable Sustainable Development Goals (SDGs)**
- **The UN goals highlight the fact that**

the socially-responsible engineer of the 21st century must be broad and versatile to be an impactful contributor to solving the challenges facing society

Concluding Comments

- **As a Dean, my goal is to educate socially-responsible engineers**
- A final story I'll tell comes from the final episode of *The West Wing,* a TV show from the early 2000s …
- From my personal point of view, I try to promote programs in my college around sustainable infrastructure:

Water, energy, civil, and information infrastructure → **Sanitation, agriculture and business** → **Good health, stability and peace** → **Education and improved quality of life**

People, Planet, Profits:

Sustainable infrastructure empowers civilization

Questions?

- ***The Socially-Responsible Engineer***
  - Is **socio-technically adept**
  - Has a **multi-dimensional mindset** that honors
    - Multi-disciplinary contributions
    - Systems thinking
    - Global perspectives
    - Diverse contributors
  - Makes an impact as a **design thinker** who is
    - First a problem definer, second a problem solver (why engineer?)
    - Human-centered (engineer for whom?)
    - An innovator
  - Is mindful of the **right motivation**, with intent to be
    - Socially-just
    - Corporately-responsible
    - Focused on the challenges facing society