

---

ESD.83 – Fall 2011  
Session 1  
*Some ideas and framing  
questions*  
J. Sussman

# Joe\_Sussman.101

PhD, MIT 1967-- Civil Engineering Systems

Appointed to CE faculty, 1967

Transportation Systems

Freight railroad operations--reliability, productivity.....

Intelligent transportation systems (ITS)

Network operations/ traveler information

Institutional issues

Passenger rail-- High-Speed Rail/ Japan/Portugal/U.S.

Transportation and Regional Development

ESD founded in 1998/ moved to dual CEE/ESD appointment

Complex Systems/ CLIOS Process

August 2011-- ESD Interim Director

# A salient systems quote

“General systems theory says that each variable in any system interacts with the other variables so thoroughly that cause and effect cannot be separated. A simple variable can be both cause and effect. Reality will not be still. And it cannot be taken apart! You cannot understand a cell, a rat, a brain structure, a family, a culture if you isolate it from its context. Relationship is everything.”

--Marilyn Ferguson

The Aquarian Society—from Ali Mostashari's Chapter 3

# Framing questions for ESD.83 I

- What is a complex system?
  - Our interests--complex, sociotechnical systems
- What are our ways of thinking about these complex sociotechnical systems?
- What kinds of research questions do we want to **ask** in the field of Engineering Systems and how do we **answer** them?

# Framing questions for ESD.83 II

- What are the historical roots of the field of Engineering Systems and what is their relevance to contemporary engineering systems issues and concepts?
- What does “practicing” Engineering Systems mean?

# Framing questions for ESD.83 III

- What are the **design** principles for Engineering Systems?
- What does it mean to advance the field of Engineering Systems and how do we accomplish it?

# Framing questions for ESD.83 IV

- How do we integrate engineering, management and social science in Engineering Systems?
- And how do we do it without being superficial?

# Two Kinds of Depth

---

- Disciplinary depth
- Integrative depth

Is thinking about systems (integrative depth)  
“deep thinking”

# Words/ Phrases/ Strings

---

Words

Rigorous

Phrases

The “Micro-Macro” Question

Strings

Descriptive, Normative, Prescriptive

# Strategies for Advancing Engineering Systems as a Field

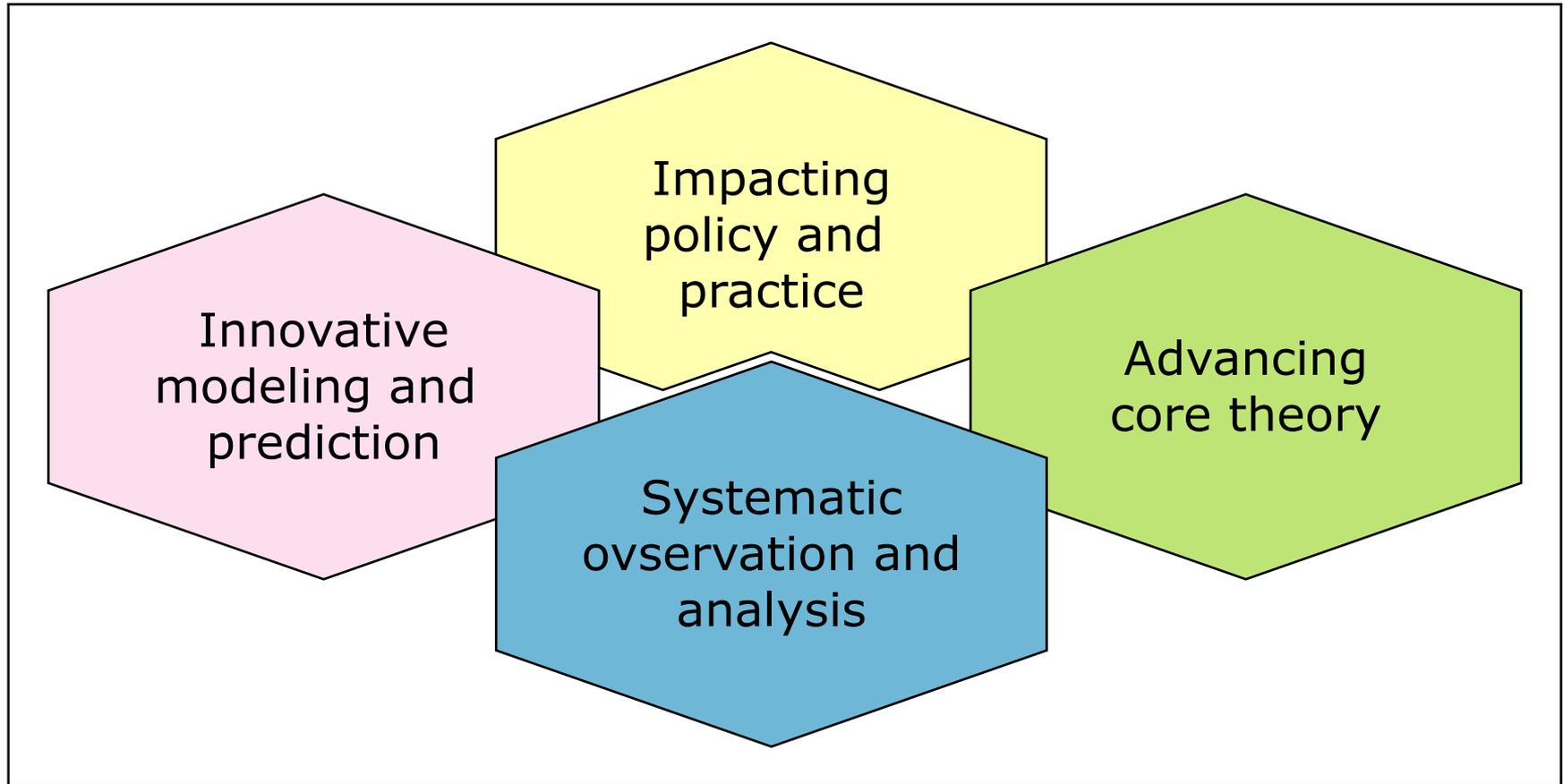
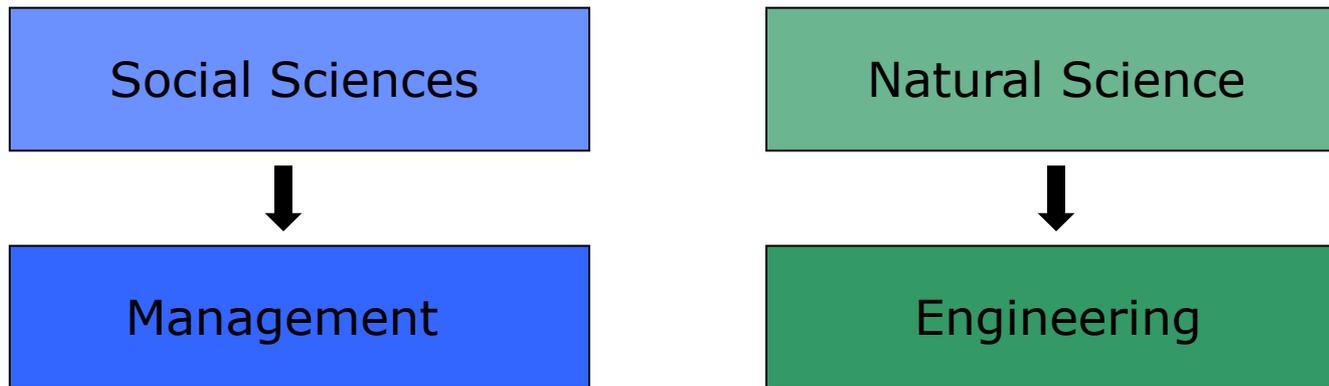


Image by MIT OpenCourseWare.

# Engineering Systems as an integrated field

## □ Engineering/Social Science/Management

*A view of these fields*



**What do you think?**

# Engineering Systems Overview

## Nested Complexity: Considering Both Technological and Social Complexity

Professor Joseph Sussman, ESD Interim Director

---

# Dean Tom Magnanti in early days of ESD:

*How can ESD help make MIT great?*  
That's a great question!

---

**What is distinctive about ESD?  
“Everyone” does systems?**

**That’s another great question!**

# **Critical Contemporary Issues (CCI):**

- 1. Their nature requires an interdisciplinary approach**
- 2. Usually stemming from Complex, Sociotechnical Systems (CSS)**
- 3. Complexity on various dimensions --technological/social/organizational**

# To answer Dean Magnanti:

*ESD is the unit at MIT that helps make MIT great by dealing with critical contemporary issues in a rigorous, interdisciplinary manner through research and in its educational programs.*

**Engineering/ Social Science/ Management/ Planning**

- **ESD has created a vibrant PhD program: On September 16<sup>th</sup>, 2011 we celebrate the “first 100 ESD PhDs”. Collectively, these represent a major intellectual contribution, and help us advance engineering systems as a field of study**
- **The ESD PhD program is how we build a field of study**

---

*Questions? Comments?*

MIT OpenCourseWare  
<http://ocw.mit.edu>

ESD.83 Doctoral Seminar in Engineering Systems  
Fall 2011

For information about citing these materials or our Terms of Use, visit: <http://ocw.mit.edu/terms>.