Engineering Systems Doctoral Seminar ESD.83-- Fall 2011

Class 12

Faculty: Chris Magee and Joe Sussman

TA: Rebecca Saari

Guest: Professor Noelle Selin (ESD & EAPS)

Class12 Overview

- Welcome, Overview and Introductions (5 min.)
- Dialogue with Professor Selin (55min)--Redaction provided by Morgan Dwyer
- Break (10 minutes)
- Discussion of ESD.83 faculty-provided theme-related papers led by Jason Ryan (approximately 45 minutes)
- Theme and topic integration: Report from the front; Words; Quotes; Teaching and Learning Time-- Some views of sustainablity (Sussman)
- Next Steps -preparation for Class 13 - (5 minutes) Magee

Theme and topic integration: Class 12

- Report from the front: The Dark Side of the "Green" City by Andrew Ross, NY Times, November 6, 2011
- Words
- Quotes
- "Teaching and Learning Time"
- Class 13 Plan (Magee)

Words

- Equity

Quote I

- "Efficiency without equity and equity without efficiency is not sustainable."
  Keynote address, WCTR , Lisbon
  July 18, 2010

Quote II

- "Rules and models destroy genius and art."

--William Hazlitt,

British writer, philosopher and historian

Reference Paper

SUSTAINABILITY AS AN ORGANIZING DESIGN PRINCIPLE FOR LARGE-SCALE ENGINEERING SYSTEMS

by Joel Cutcher-Gershenfeld, Frank Field, Ralph Hall, Randy Kirchain, David Marks, Ken Oye, and Joseph Sussman

May 2004

- Overarching organizing design principles are essential for large-scale engineering systems. Organizing principles sit above quantified goals and objectives, as well as the analytic tools and methods utilized to find "optimal" trade-offs among these goals and objectives.
- In this chapter, we advance "sustainability" as a major organizing design principle for large-scale engineering systems, particularly those involving public investments, a mix of public and private stakeholders, and long-term societal impacts.

- Sustainability in this paper is defined with respect to trade-offs among economic development and social and environmental goals. It is a broad concept: "It's not just the environment and resources anymore." Systems must be sustainable on environmental dimensions, as well as on dimensions such as economic development, politics, and social equity. In advancing sustainability as an organizing principle, we are making a normative argument.....

- The normative tone of this chapter reflects what we see as a need to convince the broader engineering and technical community that sustainability is the community's responsibility and that it is an important organizing principle for systems design.....Connections between the physical systems and the institutions that "manage" them must be represented and considered. Inherent (and value-laden) trade-offs exist between various facets of sustainability (environmental, economic, social, etc.).

- *.....we assert that sustainability should be the overarching design goal for engineering systems*. These systems are driven by technological innovation and *system changes* often need to be accompanied by *institutional change* to achieve the goal of sustainability.
- Since we consider sustainability a broad concept, which extends beyond the environment to include dimensions of economic development, politics, society, equity, education, and employment, a strong case can be made that sustainability is inherently a *systems issue*.

Urban sustainability: How concepts map into what to do

TRANSPORTATION AND URBAN PLANNING (excerpts)

Seventh Annual Workshop on Mexico City Air Quality

January 2004

Recommendations

- ♦ Approaches to improving air quality and mobility should be undertaken in context of full meaning of "sustainability"—environmental, economic and social equity and fairness

Recommendations II

- Think of transportation as an integrated multimodal network
- ♦ Institutional restructuring needs to be designed, anticipating the difficult job of enacting change
- ♦ Rethink the federal role in transportation and air quality issues
- ♦ The span of policy should be the full region surrounding the Mexico City metropolitan area

Recommendations III

- ♦ Emphasize human resource development, and the need for capability for handling contemporary complex transport planning and management issues

Recommendations IV

- Consider metro expansion, but only in the context of a broader package of options to enhance accessibility
- Undertake bus rapid transit in a manner integrated with other transportation modes as an accessibility strategy
- Emphasize freight management improvement because of its importance to the economy

- This first vignette makes the case that sustainability in the MCMA must be considered multidimensionally. Environmental considerations are critical and, in fact, were the genesis of sustainability in the first place. But at the same time, we need to recognize that economic growth and social equity must be part of the equation. Mexico City is a prime example of this tripartite sustainability construct.

The Other Vignettes

- Ford Heritage Sustainable Manufacturing Model
- Hierarchy of Levels of Analysis in Automotive Aluminum
- Lean Sustainment Initiative (LSI) for the US Air Force: Tracing the Repair of an Aircraft Fuel-Pump

- Other candidates for organizing design principles for large-scale engineering systems?

Framing questions for ESD.83 I

- What is a complex system?
- What are our ways of thinking about these complex 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 of Engineering Systems?
- What does it mean to advance the field of Engineering Systems and how do we accomplish it?
- How do we integrate engineering, management and social science in Engineering Systems?

Learning Objectives

- **Basic Literacy**: Understanding of core concepts and principles - base level of literacy on the various aspects of engineering systems

- **Interdisciplinary capability**: The capability to reach out to adjacent fields in a respectful and knowledgeable way and the ability to engage with other ES scholars in assessing the importance to ES of new findings in related fields

Learning Objectives

- **Historical Roots**: Understanding of historical/intellectual roots of key concepts and principles in engineering systems

- **ES and observations, data sources and data reduction**: An appreciation of the importance of empirical study to cumulative science and its difficulty in complex socio-technical systems

Learning Objectives

- **Critical Analysis**: Ability to critically assess research and scholarship aimed at furthering knowledge in engineering systems; development of defendable point of view of important contributing disciplines in Engineering Systems Field

- **Links Across Domains and Methods**: Ability to identify links/connections across different fundamental domains and methods relevant to engineering systems

Learning Objectives

- **Scholarly Skills**
  - 1) The ability to write a professional-level critical book review;
  - 2) A beginning level ability to develop and write a research proposal in the ES field;
  - 3) The ability to present and lecture on critical analysis of material that one is not previously familiar with;
  - 4) Developing wider reading skills and habits

THE END

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