Engineering Systems Doctoral Seminar ESD.83-- Fall 2009

Class 6, Oct 14, 2009

Faculty: Chris Magee and Joe Sussman

TA: Judy Maro

Guest: Professor Mort Webster (ESD)

Class 6-- Overview

- Welcome, Overview and Introductions (5 min.)
- Dialogue with Professor Webster (55min)--Redaction provided by Tommy Rand-Nash and Arzum Akkas
- Break (10 minutes)
- Discussion of ESD.83 faculty-provided theme-related papers led by Jesse Sowell and John Thomas (approximately 40 min)
- Theme and topic integration: Report from the front; Teaching and Learning Time--Scenarios--Several Views (Sussman)
- Next Steps -preparation for Class 7 - (5 min.) Magee

Theme and topic integration: Class 6, Oct 14, 2009

- Report from the front-- The Economist, October 1, 2009, "Natural Disasters: A Season of Calamity"
- "Teaching and Learning Time"
- Class 7 Plan (Magee)

"Teaching and Learning Time"

- Scenarios: Several Views
- Match-up of Class 6 with
  - Framing Questions
  - Learning Objectives

Scenarios

- Introduction to concepts
- The Shell approach
- The RAND approach (already introduced in the discussant segment)

Scenarios

Introductory Concepts

What is a Scenario?

- What is a *scenario* as we will use the term here (at least initially)?
  - It's a narrative informed by information
  - It's a structured, plausible, internally-consistent, comprehensive *story* about the future
  - Based on careful research and quality thinking
  - Informed by "remarkable people" with special insights about the future

Why Scenarios?

- Create a test bed against which to check the robustness of *bundles of strategic alternatives* (where robustness is the ability of a particular bundle to perform reasonably well under "plausible" scenarios)

	Scenario 1	*Scenario 2*	*Scenario 3*
Bundle 1	+	-	+
Bundle 2	+	+	+
Bundle 3	0	0	+

Perspective on Scenarios

- Scenarios in a corporate environment
  - Assume that corporate strategies do not affect the overall future
- Scenarios in a public-sector environment
  - Assume that strategies do affect the overall future -- indeed, that's what they are intended to do

Scenarios:

- SCHWARTZ --
  THE ART OF THE LONG VIEW

Scenarios: What are the steps? Schwartz Approach

Schwartz (*The Art of the Long View*) proposes an eight-step approach:

1. Identify focal issue or decision
2. Identify key factors in local environment
   --These are the key factors -- locally -- which influence the success or failure of the decision or focal issue identified in Step 1
3. Identify driving forces in macro environment
   -- Social, economic, political, environmental and technological *macro* issues might behind the local forces

Scenarios: What are the steps? Schwartz Approach

4. Rank key factors and driving forces
   -- According to *importance* to key decision and degree of *uncertainty*
5. Select scenario logics
   -- Identifying plots that capture situational dynamics and communicate effectively
6. Flesh out the scenarios
7. Examine implications
   -- How does the focal issue/decision play out in the future?
8. Select leading indicators

Schwartz - The Art of the Long View

- Why scenarios -- "an imaginative leap into the future"
- How can you *see*, most clearly, the environment in which your actions will take place?
- How will those actions relate to prevailing forces, trends, attitudes and influences?
- HOW
  - Invent, and then consider, *in-depth* several stories of plausible futures.
- THE POINT
  - Make strategic decisions that will be sound for all plausible futures.
  - No matter what future takes place, you are more likely to be ready for it if you have thought seriously about scenarios.

- Elements of Scenario Building
  - Driving Forces
  - Predetermined Elements
  - Critical Uncertainties

The RAND Approach

- Another way to think about uncertainties through scenarios

The RAND Approach

- A lot of scenarios (thousands perhaps--rather than 2 or 3 in the Shell approach)--quantitative, rather than descriptive
- An computer-based way of generating the scenarios
- Scenarios juxtaposed with hypothesized strategies implemented "now"
- An computer-based way of navigating and learning from the scenarios/strategies

The RAND Approach

- Robust Adaptive Planning--Key Concepts
  - Multiple highly-differential views of the future better than point estimates for understanding the system of interest and its performance
  - Choose robust strategies that perform well over a range of plausible futures. Robustness dominates optimality
  - Robustness "is often achieved by strategies designed to adapt over time to new information"
  - Use human-computer collaboration for decision support

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

ESD.83 Doctoral Seminar in Engineering Systems

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