ESD.84 Doctoral Seminar – Session 1 Notes
Guests Presenting: Dan Roos

Draft Session Design:

Welcome, Overview and Introductions (20-30 min.)
Engineering Systems as a Field of Study: An Institutional Leadership Perspective (10-15 min.)
Seminar Logistics (10-15 min.)
The Doctoral Seminar on Engineering Systems: Context and History (10-15 min.)
Engineering Systems Learning Center Overview (10-15 min.)
Break (15 min.)
Review and Dialogue on Key Themes from ESD Internal Symposium (30-45 min.)
Critical Review of Seminar Syllabus – Small Groups and Full Group (30-45 min.)
Next Steps (10-15 min.)

Dialogue on ESD:

- How do ESD faculty manage their roles in a matrix structure?
    - Particular issues of risk for junior faculty – need for strong mentoring support and attention to systems for promotion and tenure – but it is often junior faculty who will drive new frontiers
- What other schools have similar programs?
    - Stanford merged operations research, IE and another department to form a systems engineering group
    - There are many "systems engineering" departments
    - There are engineering and public policy programs at Carnegie Mellon, Delft, Cambridge, and other schools
- How is this seen by Sloan?
    - The are strong participants in ESD from Sloan and strong institutional support, but there is also concern that this not become a second rate or alternative management program
    - ESD is also about to appoint the first dual faculty member with social sciences
- Is the field of biology represented?
    - Not yet – an important future issue – raises questions around where the boundaries lie for Engineering Systems as a field
- This is the first new organizational unit in the school of engineering in 25 years – a leading edge development in the field – but still a fragile experiment
- Will the degrees of freedom for ESD increase in the years to come – or will it always require complex negotiations?
    - There were complex negotiations at start-up, but the degrees of freedom have increased since then

Experience to Date – Engineering Systems Doctoral Seminar:

- Understand ESD as part of a 50 year, post-WWII journey of emerging interest in systems – defined various ways
- Appreciate the significance of the multi-disciplinary dialogue that is already occurring within ESD as a community
- Engineering Systems is "the big problem" in engineering – this is the issue of what it means to do engineering in the 21st Century – beyond the specific point / local design work that has historically characterized engineering work
- There are roots in the 1920s and 1930s for much of what we now think of as ESD
- Post WWII focus on engineering science at MIT and on a global basis shifted the focus away from systems and more around specific disciplinary scientific research
- Engineering systems will not replace engineering science, but there are many issues such as climate change which can't only be addressed on the basis of engineering science theory and methods
- Fundamental epistemological issues around what we mean by the concept of a "system"
- It is important to articulate the difference between engineering systems and systems engineering (which is a subset of the field of engineering systems)
- Link to Kuhn's notions of paradigms and languages that are associated with paradigms – what is the role of grammars, language, and cognitive science within ESD?
    - Contrast in a concept such as feedback in control systems for mechanical engineering, electrical engineering, systems dynamics, etc.

General Dialogue:

- What is it that determines which engineering systems will have a long life – even longer than was originally anticipated?
- How powerful is the real options approach for reducing uncertainty?
- Dialogue on common terms and concepts within engineering systems:
    - What is the need for common terms and concepts – where does this need come from?
    - What are the benefits and risks associated with defining common terms and concepts?
    - Clearly there are pressing social / technical engineering systems challenges that don't fit within existing boundaries – which points to the need for a common language, but freezing the concepts is also limiting
    - Is it even feasible to define common terms and systems? Your definition of complex systems depends on who you are and what you are doing – what is complex for some is relatively simple from other perspectives
    - Do we even need the term "complexity"? It might be more helpful if we could quantify different levels of complexity
    - Having the list of definitions is helpful as an orientation to the domain of ESD
    - It is predictable that language will emerge out of social interaction around engineering systems – it may be a localized or purpose dependent language, but it will encounter conflicts with interactions in other contexts (where the same terms may be used in other ways or where different terms are used in the same way)
    - When is the terminology a useful short-hand and when do the terms trigger new thoughts (such as "sustainability")?
    - Note the way people become deeply invested in particular terms – such as terms like "architecture" or "platform"
    - Communication theory points to Levels A, B and C for different degrees of transmission of concepts and underlying desired meanings – with précised mathematical formulations possible
    - The language is a living domain – a moving target