ESD.84 Doctoral Seminar – Session 2 Notes
Guests Presenting: Dave Mindell

Draft Session Design:

Welcome and Overview and Introductions (5-10 min.)
Engineering Systems Learning Center Overview (5-10 min.)
Syllabus Analysis and Dialogue (30-45 min.)
Book Reviews – *Networks of Power* and *Rescuing Prometheus* (10-15 min.)
Break (15 min.)
Historical Perspective on Engineering Systems as a Field (30-45 min.)
Analysis of Uncertainty and Complexity as Core Concepts (20-30 min.)
Next Steps (10-15 min.)

Book Review – Networks of Power by Thomas Hughes – review by Heidi Davidz

- Thomas Edison as inventor of incandescent lamp and as system architect of lighting system
- Concept of "reverse salience" for lagging system elements
- Critical choice points – AC/DC, generating source, political context, etc.

Discussion:

- What is it about electric power that drove a systems perspective?
- How to make the transition from delivering a lighting system to a power delivery system – a key transition
- Networks are one type of architecture – there are also studies of railroads as systems in the same historical time frame
- Emergent understanding after WW I of the need for the network to be interconnected rather than modular or localized
- Disjointed experience in London reflects challenge in shifting mindsets to see the system as a whole
- Focusing on large, complex systems is a key choice by the author
- On the methods – note the focus on the many technologies that failed and the use of historical methods
- Note the emergence of the concept of a modern Research and Development lab at GE as integral to the system
- A difficult issue concerns the system boundaries for electrification since the economic model primarily works in urban environments – it took the rural electrification act to reach to these areas neglected by the quasi-private utilities

Book Review – Rescuing Prometheus by Thomas Hughes – Review by Tom Speller

- Value of historical analysis of four complex, large-scale systems projects
- What are the catalysts for launching complex, large-scale systems – does it take threats to our way of life?
- Key contrast between modern and post modern systems – with contrasting lists of key terms
- Would like more critical analysis of managerial lessons and implications – as well as comparisons across leadership styles (preponderance of brash, arrogant styles)
- Would like more of an assessment of legacies of projects, including success in meeting goals, robustness, failure mode analysis
- Would like more on implications for smaller, short-term projects
- What of other such projects, such as human genome project

Discussion:

- Discussion – Why not pick as one of the four systems that raises strong equity concerns? It is an issue with internet access today, but not as much in the systems selected and the time periods covered
- How do we know when one of these complex systems is a success – how do what know how it compares to what might have been alternative approaches?
- If there is a single charismatic leader – is it really a complex engineering system structure – what have we really learned in these four cases? Methods such as Pert charts and other organizational tools are valuable – but how to understand these systems beyond the one-off idiosyncratic historical context
- Curious oversight around the Apollo program
- Key issue around distributed knowledge in these systems – some tools now available that were not available at these times
- The book makes a valuable contribution in describing complex systems – making them visible
- How do we understand the limited reception that systems dynamics received – a key set of ideas that emerged out of one of the cases highlighted
- Key role of momentum in systems – rules that have self-reinforcing properties that are hard to turn off
- Role of systems that can magnify and otherwise increase the impact of leaders – or should leaders be focusing on the driving the systems themselves and have the systems be the source of a more distributed form of leadership?

Historical Perspective on Engineering Systems as a Field – by Dave Mindell

- Key issues around the boundaries of the systems methods – example of Forester's finding that urban revitalization depended on clearing out low-income housing and replacing it with industry, which was roundly rejected – Is this a failure due to politics or a limitation of the method?
- Interesting issue of the importance of history in military training – as a way of building appreciation for complex systems
- Value of Hughes' work in bringing systems to light, but enduring issues around the celebration of systems techniques and language and the use of this approach in creating a systems approach to history
- Tension between the forward progress over the last 100 years in systems thinking and the core set of methods that are of enduring value (which can be applied retrospectively for historical analysis)
- Logic of reduction of dependence on the human element as a historical motivation for engineering systems – which contrasts with some of the motivations today in ESD
- Contrast between the use of the word "system" in English as compared to other languages and at other points in time – Be sure to look on-line at the OED 14 page etymology on "systems" (systems of philosophy, biological/physical systems, technical/dynamic systems)
- Systems of palaces, systems of trade, systems of writing and other dimensions that emerge from the archeology of ancient Minoan culture around 1600 BC – interesting questions around the degree to which this ancient culture depended on systems thinkers – see a natural human progression of making links and connections – how much have we really changed (similar for understanding the pyramids as complex engineering systems)
- One thing that is new is the level of self-consciousness about systems – intentional use of the term and methods
- Contrast between an architected system as compared to an emergent system – with questions around the efficiency of emergent versus designed architecture
- What is new about systems thinking – a key contrast includes the tools for analysis – requires a prior leap in thinking of the systems as an abstraction and drives the concept of simulation

Syllabus Discussion:

- What is an ESD thesis? What is the responsibility to describe or represent a system – with what methods and at what level of detail? Will these topics support the types of theses that will be written by doctoral students focusing on systems in various ways?
- Contrast between dominant problem-focused thesis in TMP versus what may be more of a core theory orientation within the pilot ESD program
- Preparation of a subject can take 4-5 times the allocated presentation time – and more if it is a new area
- Recommended load – two major class presentation topics and two book reviews or equivalent