

Engineering Systems Doctoral Seminar ESD.83—Fall 2013

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The faculty and teaching assistant welcome meetings with ESD.83 students to discuss assignments or other items of interest. Please use email to schedule such meetings in advance because their schedules are often tight.

Course Website: <https://stellar.mit.edu/S/course/ESD/fa13/ESD.83/>

Course Wiki: <https://wikis.mit.edu/confluence/display/esdDOT83fa13/Home>

Class Meeting Time: Wednesdays, 9am – 12 noon

Classroom Location: 4-253

Recitation Time: Fridays, 10am – 11am

Recitation Location: 8-205

Spirit of the Seminar

In establishing the Engineering Systems Division, MIT has embarked on a bold experiment: bringing together diverse areas of expertise into what is designed to be a new field of study. In many respects, the full scale and scope of Engineering Systems as a field is still emerging. This seminar is designed both to codify what we presently know and to give direction for future development. In this spirit, the entire syllabus should be viewed as a living document, subject to adjustment based on student and faculty input throughout the term.

While certain topics, readings and guests change from year to year in ESD.83, the focus across a broad range of topics in Engineering Systems remains the same. Throughout the term, faculty from ESD and other parts of MIT will be sitting in, either as invited guests or just as interested colleagues. We will give priority to comments from students but also be sure to tap the wisdom of those who are sitting in.

In addition to the readings assigned by the teaching staff, students might find the following resources useful:

- The ESD Working Paper Series: <http://esd.mit.edu/WPS/>
- The papers generated in ESD Symposia: <http://esd.mit.edu/resources/symposia.html> and <http://cesun2012.tudelft.nl/wiki/index.php/AllPapers>

At both the beginning and the conclusion of the seminar, the faculty instructors will meet with each student for individual feedback sessions (i.e., both instructor to student and vice versa). The initial 25-minute meetings will be conducted on Friday, September 06. The end-of-class meetings will be scheduled in 25-minute increments on Thursday, December 12 (following our last class on Wednesday, December 11).

Finally, note that the success of the Seminar depends, in part, on the richness of the in-class discussions. Therefore, in-class participation will account for a significant portion of the grade. Students are expected to inform the instructors and the teaching assistant if their attendance in any class is precluded. No more than one absence during the Semester will be granted.

ESD.83 at a Glance—Engineering Systems Doctoral Seminar (Fall 2012) (*Updated August 28, 2013*)

- Class 1 (9/4):** Introduction to Engineering Systems: Past, Present, Future
Guest: Richard Larson
Affiliation: Engineering Systems Division
Assignments 1, 2, 6 out
Assignment 3 out 9/9
- Class 2 (9/11):** Scientific Epistemology
Guest: Roger White
Affiliation: Department of Philosophy
Assignment 1 selection
Assignment 3 selection 9/13
- Class 3 (9/18):** Modeling Engineering Systems I
Guest: Stephen Graves
Affiliation: Engineering Systems Division and Department of Mechanical Engineering
- Class 4 (9/25):** Modeling Engineering Systems II
Guest: Olivier de Weck
Affiliation: Department of Aeronautics and Astronautics and Engineering Systems Division
Assignment 1 due
Assignment 4 out
- Class 5 (10/2):** Modeling Engineering Systems III
Guest: David Simchi-Levi
Affiliation: Department of Civil and Environmental Engineering and Engineering Systems Division
- Class 6 (10/9):** Energy and the Environment
Guest: Christopher Knittel
Affiliation: Sloan School of Management
Assignment 2 due
- Class 7 (10/16):** Decision Making under Uncertainty I
Guest: Munther Dahleh
Affiliation: Department of Electrical Engineering and Computer Science
Assignment 2 discussion
- Class 8 (10/23):** Decision Making under Uncertainty II
Guest: Mort Webster
Affiliation: Engineering Systems Division
Assignment 3 paper due
- Class 9 (10/30):** Networks and Complexity I
Guest: TBD
Affiliation: TBD
Assignment 5 out
- Class 10 (11/6):** Historical Roots of Engineering Systems
No Guest: Student presentations
Assignment 3 presentation due
- Class 11 (11/13):** Networks and Complexity II
Guest: TBD
Affiliation: TBD
Assignment 4 due
- Class 12 (11/20):** Product and Project Management I
Guest: Steven Eppinger
Affiliation: Sloan School of Management and Engineering Systems Division
- Class 13 (11/27):** Product and Project Management II
Guest: TBD
Affiliation: TBD
Assignment 5 due
- Class 14 (12/4):** Engineering Systems Domain (TBD)
Guest: TBD
Affiliation: TBD
- Class 15 (12/11):** Policy Design/Course Wrap-Up
No Guest
Assignment 6 due 12/09

ESD Doctoral Seminar Pro-Forma—Typical Class Format and Learning Objectives

Class Session Pro-Forma (3 hours):

The order of the elements is notional.

- 1) Overview (5-30 minutes), Faculty—The theme for the week
- 2) Guest presentation and discussion (55 minutes)
- 3) Student-led presentation and discussion of the faculty-provided readings (30-45 minutes)
- 4) Break (10 minutes)
- 5) Teaching time by ESD.83 teaching staff (30-60 minutes)
 - a) Report from the Front, facilitated by ESD.83 teaching staff—news article from the popular press sent out to class on the Monday before class, in some weeks.
 - b) ESD teaching staff-led discussion, and integration of materials
 - c) Next Week's Class Preview

Learning Objectives:

The overriding top level objectives are twofold:

1. Increasing the student understanding of research in complex systems so as to allow them to develop a framework for further learning about how to do research in this field;
2. Fostering a wide understanding of the knowledge content in engineering systems so that the students begin to establish a structure for learning more about the broad front of knowledge that is termed Engineering Systems.

At a more detailed level, the learning objectives are:

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

Inter-disciplinary 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

Engineering Systems Methodologies: Understanding of historical/intellectual roots of key methods, 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

Critical Analysis: Ability to critically assess research and scholarship aimed at furthering knowledge in engineering systems; development of defensible 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

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

Cohort Building: Understanding of how the class fits together as a scholarly group in the field of Engineering Systems

Note to Doctoral Students:

This seminar is designed to help facilitate the transition from being a “student” taking courses from “experts” to being a doctoral candidate and then a colleague with your own distinctive “voice” as a scholar. There are few issues covered in the seminar in which there are simple right and wrong answers—in most cases it is critical thinking and constructive engagement of the issues that will be most important to your success.

ESD Doctoral Seminar Assignments

NOTE: Students are reminded that the assignment descriptions below are a summary. Complete assignment descriptions can be found on the course website.

General summary of readings

- Each week, students will be expected to read and comment on one or two guest-provided papers and two ESD.83-faculty-provided papers/chapters. This will usually total less than 100 pages.
- Each student is expected to read the selected book (*The Signal and the Noise: Why So Many Predictions Fail – but Some Don’t* by N. Silver) and review it—see Assignment 2 below.
- Implicit in several assignments are readings
- In some weeks, the teaching team will be sending out a link to a news article from the popular press that illustrates important engineering systems concepts: we call this the “Report from the Front.” Students will be expected to have read and be ready to discuss that article.

Weekly assignments (considered part of class participation)

A) Redactor Role (500-750 word executive summary for the guest)

For each guest, one (or two) student(s) will serve as the redactor for Wednesday’s class. Students must sign up at <https://wikis.mit.edu/confluence/display/esdDOT83fa13/Assignment+A+--+Redactor>.

Each student (including the redactor(s) for the week) is asked to provide a not-more-than 300-word comment (which may include questions to the guest) that directly engages **the guest’s assigned paper**. Each student will post these comments to the ESD.83 Wiki site by **the Sunday preceding class at 6pm**. The redactor then will organize the comments for the guest and produce a 500-750 word executive summary of the students’ comments that will be emailed to guest on the Monday preceding class by 6pm (please cc: the teaching staff). In addition, the redactor will post this executive summary to the Wiki. **All students are expected to read the executive summary prior to Wednesday’s class.** The redactor will not be required to present anything during class.

Guidelines for the email to the guest: Introduce yourself as the redactor for ESD.83. Indicate that the redaction and class comments are attached. Format the redaction and all comments into a single document and include this as an attachment. CC the teaching staff.

Guidelines for the summary: Draw out themes and questions. You are summarizing various comments into a coherent response. You need not attribute comments to individual students. (The raw comments should, however, remain attached to the student author name).

In the event that discussion with the guest is slow to emerge, the redactor is expected to ask initial questions.

B) Discussion Leader Role

For each class, one (or two) student discussion leader(s) will lead the class in a critical analysis of ESD.83-faculty-provided readings prepared for that Wednesday. Students must sign up at <https://wikis.mit.edu/confluence/display/esdDOT83fa13/Assignment+B+--+Discussant>.

Similar to the response to the guest paper, each student (including the discussion leader(s) for the week) is asked to provide a not-more-than-300-word-comment that engages **the assigned papers**. Only one comment paragraph is required per student per week and should cover the assigned papers. Each student will post these comment paragraphs to the ESD.83 Wiki site by *the Tuesday preceding class at 9am*. **All students are expected to read their peers' comments prior to Wednesday's class.**

The role of the discussion leader is to lead a thoughtful discussion of the required readings. The focuses should be a critical analysis of the readings, how the readings relate to each other, and how they relate to the larger field of ES.

To achieve this, we strongly recommend the discussant start with their peers' comments. What themes did the class latch onto in their responses? Were there any differences in interpretation or opinion? All class members are expected to come to class prepared to expand on their written comments.

Each week, the discussant should attempt to draw out of the class answers to the some of the following questions: How do the readings relate to the guest's remarks? How do they relate to each student's research interests (methods and/or domains)? How do these readings relate to previous readings in the class? Is there a sense of accumulation of knowledge, in a sense filling in a mosaic of the field of Engineering Systems? The number and scope of discussion questions should be appropriate to guide a 30-40 minute discussion.

Note: If PowerPoint slides are to be used, the student discussion leader should email their presentation to the teaching staff by 7am on the Wednesday they are presenting. No presentation is required.

C) ESS Research Presentation and/or Brainstorming Session

During TA-led recitation sessions, each student will be given an opportunity to share their research plans with their colleagues. 30 minutes will be allotted to each student over the Semester. We understand that each student will be at a different maturity in their research, and therefore, the 30 minutes can be spent presenting a formal research presentation, presenting an ESS-poster, or perhaps brainstorming about the student's intended use of tools or methodologies in pursuit of research. This is the chance for each student to seek the feedback and commentary of their peers in a constructive and productive way. Students who identify themselves as fairly far along in their research may be asked to do the first few TA sessions.

Individual or group assignments

The following section presents the assignments for the class. Please note that much more detailed stand-alone assignment documents for these assignments are uploaded to Stellar.

1) Observations, Data Sources and Data Reduction Assignment (no more than 1000 word paper, 10% of the grade)

Students will be expected to select and read an NBER working paper from a faculty-provided list and to prepare a no more than 1000 word paper, performing a critical analysis on the author's choice(s) and use(s) of observations as well as the assumption(s) required by, and conclusion(s) drawn from such observations.

Assigned: September 04; Selected: September 11; Due: September 25

2) Book Review (750 word book review, 10% of the grade)

Students will be expected to prepare a book review of about 750 words of *The Signal and the Noise: Why So Many Predictions Fail – but Some Don't* by N. Silver (2012). Each book review should be written in a format comparable to a published book review in a professional journal—conveying the key message of the book and providing appropriate critical analysis as well.

Assigned: September 04; Due: October 09

Read all book reviews before class on October 16 when there will be a discussion of the book by the students and teaching staff.

3) Historical Roots and Contemporary Methodologies of Engineering Systems Paper and Presentation (Approx. 5000 words, 30% of the grade)

Students will work in three-person teams to create a single jointly submitted paper that serves as a review paper, which carefully constructs the connection between a historical root of Engineering Systems and a contemporary methodology in Engineering Systems. Student teams will construct this connection by both tracing the historical root forward in time to the development of contemporary methodologies and by “backcasting” from the contemporary methodology to its antecedent historical root(s). In addition, the use of the historical root and of the contemporary methodology in the field of Engineering Systems will be studied through a more detailed analysis of one or two recent papers. The three-person teams will be selected by the teaching staff, and the historical root-contemporary methodology combination will be nominated by the three-person team and approved by the faculty. All student papers will be read by the entire class in preparation for a day of student-led presentations on their papers. Each presentation should teach the findings from the literature review, make use of interesting visualization techniques, and emphasize the contribution to Engineering Systems at large. Each presentation will be allotted 30 minutes (25 for presenting, 5 for Q&A).

Assigned: September 09; Selected: September 13; Paper Due: October 23; Presentation Due: November 06

(NOTE: These papers should be posted to Stellar by 11:59pm on October 23 and will then be available to all students. Presentations should be emailed to the teaching staff by 7am on November 06.)

4) Practicing Systems Concepts (Approx. 1500 words, 10% of the grade)

Students will individually examine a complex sociotechnical system of their choosing through one or more systems thinking perspectives presented during the semester. More details to be provided when the assignment is distributed.

Assigned: September 25; Due: November 13

5) Developing a Well-Posed Research Question (750 words, 10% of the grade)

A major challenge of all research and particularly so in engineering systems research is the well-posed research question. This assignment is to provide practice. More details will be provided when distributed.

Assigned: October 30; Due: November 27

6) Learning Summary (750 word paper, 10% of the the grade)

Document 2-3 key lessons learned that represent new or important insights into Engineering Systems as a field that originated in your mind during this term in ESD.83. Also, document 2-3 key lessons learned that represent new or important insights relevant to your doctoral thesis.

Assigned: September 5; Due: MONDAY December 09, by 6pm.

7) Seminar Participation (regular attendance and contributions, 20% of the grade)

It is assumed that regular preparation (i.e., ability to show intimate knowledge of all assigned reading materials through weekly comment paragraphs—see descriptions in Assignments A and B), attendance and contributions to discussions will be driven by a shared interest in the subject material. Still, a portion of the course grade is allocated to our evaluation of the effectiveness of your seminar participation to highlight just how central this is to the success of the seminar.

In this context, it is your responsibility to inform the instructors and the teaching assistant if some unforeseen issue arises that precludes your attendance in any class. We specifically note that the class WILL meet on Wednesday, November 20, the day before Thanksgiving.

Finally, in order to cover a large amount of material in only 15 class sessions, students are expected to arrive promptly on time, which for this class is 9:00 (not 9:05).