George Mason University
SYST 100 – Spring 2012
Engineering Systems in a Complex World
Thursdays, 4:30-7:10pm
Blueridge Hall Rm. 127

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Course Syllabus

Course Goals and Objectives: This course introduces students to the engineering profession and its place in global society. Students will use historical case studies and critical analyses to think strategically and globally about the management and execution of engineering systems in the context of politics, organization, economics, technology and society (POETS), and learn how to employ such historical analyses as engineering decision-making tools. Students will be required to critically analyze articles and books, and will work in groups to investigate and present topics of current national and international relevance. At the conclusion of this course, the student will have demonstrated:

- A strategic understanding of the mutual impact, interaction and interconnectedness between systems engineering and society, accounting for political, organizational, economic, technological and societal issues at a global scale;
- The ability to critically analyze how different societies and cultures apply the tenets of systems engineering to their specific challenges and needs.

This course fulfills the following objectives:

- ABET (formerly Accreditation Board for Engineering and Technology) criteria 3h (http://www.abet.org/eac-current-criteria), "the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context."
- The GMU Global Understanding portfolio (http://provost.gmu.edu/gened/general-education-requirements), which requires students to "develop understanding of global patterns and processes and their interaction with society; demonstrate understanding of the interconnectedness, difference, and diversity of a global society; identify, evaluate and properly cite resources appropriate to the field, such as audio/visual/online/print materials, or artifacts; apply awareness of global issues to a consideration of individual or collective responsibilities within a global society; and devise analytical, practical, or creative responses to global problems or issues."

Methodology: The course is conducted in a student-led, Harvard-style case study format. It consists of: lectures; extensive reading of books and articles on historical case studies; in-class discussions with both small and large groups; independent book reviews; group research projects and presentations. The student-led case-study method is particularly effective for analyzing and synthesizing complex subjects. These case study discussions will require each student to come prepared with their written responses to questions on assigned reading, and to participate by sharing their understanding and interpretation of the material. A typical class will consist of about 45 minutes lecture, 45 minutes of small-group discussion, and 45 minutes large-group discussion.

As with almost all university-level courses, you should expect to spend a considerable amount of time on your homework assignments. The general rule of thumb for university courses has traditionally been at least two hours of homework per week for every class hour. You should therefore not be surprised to spend six or more hours per week outside class on your SYST 100 assignments.

Prerequisites: None

Grading *(Note that there are no quizzes, midterm or final):*

Homework:	30%	Book Review and Presentation:	20%
Class Participation:	10%	(5% preview, 10% final report, 5% presentation)	
Lead Large-Group Class Discussion:	10%	Team Project:	30%
		(5% proposal, 5% preview, 20% final presentation)	

Letter Grade	Grade Point	Remark
A	4.00	Excellent
A-	3.67	Excellent
B+	3.33	Good
B	3.00	Good
B-	2.67	Good
C+	2.33	Competent
C	2.00	Competent
C-	1.67	Unsatisfactory
D	1.00	Unsatisfactory
F	0.00	Failing

Class Attendance: You are expected to attend classes in order to effectively participate in the discussions and presentations. At the university level, it is a generally-recognized tenet that you will learn as much from your fellow students as you will from any individual professor. In this course, much of your learning will occur through the group discussions of readings, presentations by your fellow students, and through the interactions in your team project. This cannot happen if you are not in class. Therefore, both your attendance and how active you are in discussions will be taken into account for grading.

All students experience events that may prevent them from attending class – personal circumstances, religious holidays, etc. If you can't attend a class, or if you must arrive late or leave early, let me know as far ahead of time as possible. If you are assigned to lead a discussion or make a presentation and you have to miss class, you MUST tell me well ahead of time, in order that I can make adjustments. If you fail to do so, I may not be able to make adjustments and you may not receive credit.

Materials**:** There is no course textbook and you are not required to buy any books for class. I will provide readings for class assignments on GMU's BlackBoard system. Students will use the GMU Library or other library resources for books to review, and for performing group research and presentations. You will need access to the GMU BlackBoard system on a continual basis, and I will be communicating with you via GMU e-mail. Your devices (computer, laptop, tablet, etc.) need to be configured to the latest versions of these systems, so check with GMU's Computing and Technology resource page for those requirements.

Class Schedule and Assignments

Class	Topics	HW to be completed	Class Assignment
1	**Course Introduction; Introduction to Systems Engineering**	None	Introduction and course objectives Lecture: What is systems engineering?
2	**Origins of Complex Systems Engineering:** The rise of modern systems engineering post-World War II and in the early Cold War	1. Johnson , "Three Approaches to Big Technology" 2. Sato, " Local Engineering and Systems Engineering" 3. Johnson, *Secret of Apollo* -- ESRO ***Provide professor with book selection for individual book review***	Readings: Presentations and discussion Lecture: Origins of SE
3	**Computers and Communications:** The societal shaping of information technologies in the global context	1. Balbi, "Radio before Radio" 2. Light, "When Computers were Women" 3. Hughes, "ARPANET"	Readings: Presentations and discussion Lecture: Organizing Complex Systems
4	**Military Systems and Society:** The shaping function of the military on systems engineering, and how it is applied to the larger society	1. Hughes, "SAGE" 2. Sapolsky, *Polaris Missile Development* ***Form teams to select project topic***	Readings: Presentations and discussion Lecture: What do we mean by POETS? Book Reviews: Previews
5	**Transportation as a Complex System:** The societal shaping of transportation systems technologies in the global context	1. Schrag, "Mapping Metro" 2. Ibsen, "Boeing vs. Airbus"	Readings: Presentations and discussion Lecture: SE vs PM
6	**Energy as a Complex System:** Globa considerations of energy systems, including supply production, transport infrastructure and users.	1. Nye, *Electrifying America* 2. Hecht, "Politics and Reactors in France" ***Provide professor with team project proposal*** ***Submit individual book review***	Readings: Presentations and discussion Lecture: *Vasa* case study
7	**The Environment as a Complex System:** How differing global perspectives towards the environment are reflected in the analysis and response to climate and other environmental changes	1. Edwards, "Climate Models" 2. Wesselink, "Dutch Response to Katrina"	Readings: Presentations and discussion Team Project: Present Proposal Book Reviews: Presentations
8	**The Organization as a Complex System:** How system complexity extends to the organizations that create those systems, and how both academic and business management have evolved to organize them.	1. Chandler, "Railroads and Management" 2. Seely, "Engineering Colleges"	Readings: Presentations and discussion Book Reviews: Presentations
9	**The Household as a Complex System:** How advancements in domestic technologies change the relationships between occupants (e.g., roles of men and women), and with the technologies themselves.	1. Cowan, *More Work for Mother* Ch 3 2. Cowan, *More Work for Mother* Ch 4	Readings: Presentations and discussion Team Project: Preview Book Reviews: Presentations

Class	Topics	HW to be completed	Class Assignment
10	**Safety of Complex Systems:** How differing cultural viewpoints influence social responses to anticipating and controlling the safety of complex technical systems.	1. Langewiesche, "ValuJet 592" 2. Hicks, "Normal Accidents in Military Operations"	Readings: Presentations and discussion Book Reviews: Presentations
11	**Complexity and Decision-making under Uncertainty:** Ethical dilemmas of developing and managing complex systems when many outcomes (e.g., hazards, unintended consequences) are vague or unknown.	1. Hansson, "Safe Design" 2. *Challenger* Case Study 3. *Columbia* Case Study	Readings: Presentations and discussion Book Reviews: Presentations
12	**Student Team Presentations**	***Submit team project presentation***	**Team Project Presentations**
13	**Student Team Presentations**	**None**	**Team Project Presentations**
14	**Student Team Presentations (if required)**	**None**	**Team Project Presentations**
15	**Deliver final project presentations (if required)**	***Deliver final corrected projects***	**None**

Homework and Class Discussions*:* We use the Harvard Business School case study method to analyze the homework readings (articles and book chapters) using critical, open-ended questions. This involves three steps: (1) Homework -- individual analysis of the reading by answering the questions in writing; (2) In-Class Small-Group Discussion – 3-5 individuals who discuss the questions and compare notes, and (3) In-Class Large-Group Discussion, where the whole class is led by a student in discussing the questions.

Each reading selection will be accompanied by a list of reading questions in a separate Word document. You are to complete SHORT BUT COMPLETE (2-3 paragraphs each) answers to each of these questions and submit them to before the class using BlackBoard. You will be graded on: critical thinking in answering the questions; your use of SPECIFIC examples from the readings and from other sources (which I strongly encourage you to use) in order to support your arguments; and the clarity of your writing, which includes proper spelling, punctuation and grammar. Please bring in a hard copy of your answers to class to use as a reference during group discussions.

You will submit all your homework on BlackBoard using any supported format (MS Word, PDF, etc.). Please label the file LASTNAME-CLASS X. And PLEASE use the spell-check and grammar check before submitting the work – good engineering requires good writing skills (I encourage you to visit GMU's Writing Center**:** **writingcenter.gmu.edu**). I will review the document, add my comments and grade, and then post it back to you via BlackBoard.

Students will be assigned, on a rotating basis, to lead the large-group class discussions; that is, one student will lead the discussion for each reading, 2-3 readings per class. (In other words, you may be leading class discussions several times during the course.) Each of those students leading the large-group discussion will submit and present in class a PowerPoint presentation (template is provided). If you are one of those students for that

particular class, you will be graded on how well you develop your answers, the clarity of your presentation, and how well you engage with your fellow students in eliciting their ideas and points of view. Note that, even if you are presenting, you are STILL expected to turn in the written HW for that class.

You should turn in your homework on time (i.e., by the day of the class). If you cannot, please let me know the reason and we will work out a schedule. Otherwise, I will reduce your homework score by half a grade (for example, from an A to a B+) if it is one week late, a full grade (A to B) for more than a week, and I will mark "incomplete" (equivalent to a 0) for more than two weeks late. To repeat: If you are assigned to lead a discussion and you have to miss class, you MUST tell me well ahead of time, in order that I can make adjustments. If you fail to do so, I may not be able to make adjustments and you may not receive credit.

Independent Book Review: Students will read a book from the class reading list (below), write a review of the book and present the main points to the class. You will make selection in Class 2, present a short (2-minute) preview in Class 4, and submit the review in Class 6. Book reviews will be presented during Classes 7 to 11.

In order to make certain that the entire class benefits from the wide selection of books (that is, to make sure that we don't get two or three people reading and presenting the same book), I ask the students to provide me a rank-order list of their preferred books, from 1st to 4th place. I will make every attempt to assign you your top choice. You may instead choose another, relevant book outside the list, subject to my approval.

You may choose to purchase the book, check the book out from the GMU Library or use GMU's Interlibrary Loan (ILL) system. If you are a resident of one of the local counties (e.g., Fairfax, Loudon, etc.), you may also use your local county library (including ILL).

Your 2-minute preview in Class 4 will follow the single-slide template provided.

You will complete a 3-5 page (single-spaced) review of the book, with the following: a) summary of book; b) theses and main points; c) specific lessons regarding engineering systems and complexity related to culture, politics, organization and economics. You will also submit and present in class a 10-15 minute presentation (template is provided).

<u>BOOK REVIEW – CLASS READING LIST</u>

1. Janet Abbate, *Inventing the Internet*. Cambridge, Mass: MIT Press, 1999. ISBN: 0585077975. 272pp.
2. Max Boot, *War Made New: Weapons, Warriors, and the Making of the Modern World*. New York: Gotham, 2007. ISBN: 1592403158. 640pp.
3. Martin Campbell-Kelly and William Aspray, *Computer: A History of the Information Machine*. Boulder, Co: Westview Press, 2008. ISBN: 0813342643. 360pp.
4. Paul Ceruzzi, *Internet Alley: High Technology in Tysons Corner, 1945-2005*. Cambridge, Mass: MIT Press, 2008. ISBN: 0262033749. 256pp.
5. Alfred Chandler, *The visible hand: the managerial revolution in American business*. Cambridge, Mass.: Belknap Press, 1977. ISBN: 0674940512; 0674940520. 624pp.

6. David Edgerton, *The shock of the old: technology and global history since 1900*. Oxford; New York: Oxford University Press, 2007. ISBN: 0195322835. 288pp.
7. Paul Edwards, *A Vast Machine: Computer Models, Climate Data and the Politics of Global Warming*. Cambridge, Mass.: MIT Press, 2010. ISBN: 0262013925. 552pp.
8. Kweku Ewusi-Mensah, *Software development failures: anatomy of abandoned projects*. Cambridge, Mass.: MIT Press, 2003. ISBN: 0262256087. 290pp.
9. James Gleick: *The Information: A History, a Theory, a Flood*. New York: Panteon, 2011. ISBN: 0375423729. 544pp.
10. Joshua M. Greenberg, *From Betamax to Blockbuster: Video Stores and the Invention of Movies on Video*. Cambridge, Mass.: MIT Press, 2010. ISBN: 0262514996. 232pp.
11. Katie Hafner, *Where Wizards Stay Up Late: The Origins of the Internet*. New York: Simin & Schuster, 1998. ISBN: 0684832674. 304pp.
12. David Hounshell, *From the American System to Mass Production, 1800-1932: The Development of Manufacturing Technology in the United States*. Baltimore: The Johns Hopkins University Press, 1985. ISBN: 080183158X. 440pp.
13. Thomas Hughes, *Networks of Power: Electrification in Western Society, 1880-1930*. Baltimore: The Johns Hopkins University Press, 1993. ISBN: 0801846145. 488pp.
14. Thomas Hughes and Agatha Hughes (eds.). *Systems, experts, and computers: the systems approach in management and engineering, World War II and after*. Cambridge, Mass.: MIT Press, 2000. ISBN: 0262082853. 520pp.
15. Stephen Johnson, *The secret of Apollo: systems management in American and European space programs.* Baltimore, MA: Johns Hopkins University Press, 2002. ISBN: 0801876184. 312pp.
16. Vincent Lagendijk, *Electrifying Europe: the power of Europe in the construction of electricity networks.* Amsterdam: Aksant, 2008. ISBN: 905260309X. 246pp.
17. William Langewiesche, *Fly by Wire: The Geese, the Glide, the Miracle on the Hudson*, New York: Farrar, Straus and Giroux, 2009. ISBN: 0374157189. 208pp.
18. Marc Levison, *The Box: How the Shipping Container Made the World Smaller and the World Economy Bigger*. Princeton: Princeton University Press, 2008. ISBN: 0691136408. 400pp.
19. Marc Levison, *The Great A&P and the Struggle for Small Business in America*. New York: Hill and Wang, 2011. ISBN: 0809095432. 384pp.
20. Tom McNichol, *AC/DC: the Savage Tale of the First Standards War*. Hoboken: Wiley, 2010. ISBN: 0787982679. 208pp.
21. Stephen Meyer, *The Five Dollar Day: Labor Management and Social Control in the Ford Motor Company, 1908-1921*. Albany: SUNY Press, 1981. ISBN: 0873955080. 260pp.
22. David Nye, *Electrifying America: social meanings of a new technology, 1880-1940*. Cambridge, Mass.: MIT Press, 1990. ISBN: 0262140489. 495pp.
23. Ruth Oldenziel and Karin Zachmann (eds.), *Cold War Kitchen: Americanization, Technology, and European Users*. Cambridge, Mass.: MIT Press, 2009. ISBN: 0262151191. 432pp.
24. Charles Perrow, *Normal accidents: living with high-risk: technologies*. New York: Basic Books, 1984. ISBN: 0465051448. 386pp.
25. Harvey Sapolsky, *The Polaris System Development; Bureaucratic and Programmatic Success in Government*. Cambridge, Mass.: Harvard University Press, 1972. ISBN: 0674682254. 281pp.
26. Zachary Schrag (GMU), *The Great Society Subway: A History of the Washington Metro.* Baltimore, MA: Johns Hopkins University Press, 2006. ISBN: 0801882463. 376pp.

27. Bruce Seely, *Building the American highway system: engineers as policy makers*. Philadelphia: Temple University Press, 1987. ISBN: 0877224722. 315pp.
28. Peter Singer, *Wired for War: The Robotics Revolution and Conflict in the 21st Century*. New York: Penguin, 2009. ISBN: 1594201986. 512pp.
29. Tom Standage, *The Victorian Internet: The Remarkable Story of the Telegraph and the Nineteenth Century's On-line Pioneers*. New York: Walker & Company, 2007. ISBN: 0802716040. 256pp.
30. Earl Swift, *The Big Roads: The Untold Story of the Engineers, Visionaries, and Trailblazers Who Created the American Superhighways.* New York: Houghton Mifflin Harcourt, 2011. ISBN: 0618812415. 384pp.
31. Richard White, *Railroaded: The Transcontinentals and the Making of Modern America.* New York: Norton, 2011. ISBN: 0393061264. 660pp.
32. Daniel Yergin, *The prize: the epic quest for oil, money, and power*. New York: Simon & Schuster, 1991. ISBN: 0671502484. 928pp.

Team Project: Students will form into teams of 3 individuals (or 4 where needed). You may self-select into teams, or I will assign you to a team. Your team will select (or be assigned) one of the topics under discussion in class, e.g., the environment as a complex system, or another relevant topic that I approve.

Each team will research a current systems engineering system, project or concept within that topic area, as related to culture, politics, organization and economics. You may choose the project or choose from one of the projects I suggest. Your team will use proper academic sources for your research (books, journal/newspaper articles, etc.).

Your teams will form and select topics by Class 4. In Class 6 your teams will submit to me a proposal describing the project and outlining the specific issues to be covered. In Class 7 your teams will present to the class a short (2-minute) brief outlining your proposal, using the template provided. In Class 9 your teams will present to the class a short (5-minute) preview of the project, using the template provided.

Your teams will prepare and present to the class a 20-minute brief (using PowerPoint, video or other media), following the provided guidelines. You will then have a 10-minute question / answer session. Your teams will make these class presentations during Classes 12, 13 and 14 (as needed). If required, teams will deliver final version of the presentation, with edits, in Class 15.

Class Schedule – Spring 2012

Date	Class Number	Topics
Jan 26	1	Course Introduction; Introduction to Systems Engineering
Feb 2	2	Origins of Complex Systems Engineering
Feb 9	3	Computers and Communications

Date	Class Number	Topics
Feb 16	4	Military Systems and Society
Feb 23	5	Transportation as a Complex System
Mar 1	6	Energy as a Complex System
Mar 8	7	The Environment as a Complex System
Mar 15	**NO CLASS**	
Mar 22	8	The Organization as a Complex System
Mar 29	9	The Household as a Complex System
Apr 5	**NO CLASS**	
Apr 12	10	Safety of Complex Systems
Apr 19	11	Complexity and Decision-making under Uncertainty
Apr 26	12	Student Group Presentations
May 3	13	Student Group Presentations
May 10	14	Student Group Presentations
---	15	Deliver final project reports

Administrative Notes:

Closings and cancellations: In the event of inclement weather or another major event, the university announces class cancellation, delay of classes and changes to administrative office hours through the university switchboard, 703-993-1000; the George Mason home page, www.gmu.edu; GMU-TV; and local radio and television stations. If there is any doubt as to the status of the class, contact me. If I need to cancel a particular class, I will contact the students at the earliest possible opportunity.

Emergency Preparedness: In the event of an emergency, we will follow GMU procedures. You may want to register with Mason Alert: https://alert.gmu.edu/index.php?CCheck=1

Privacy: Students must use their MasonLIVE email account to receive important University information, including messages related to this class. See ***http://masonlive.gmu.edu*** for more information.

Academic Integrity (not just about cheating!): GMU has an ***Honor Code*** with clear guidelines regarding academic integrity: "*Student members of the George Mason University community pledge not to cheat, plagiarize, steal, or lie in matters related to academic work*".

Three fundamental and rather simple principles to follow at all times are:

(1) Do not plagiarize: all work submitted must be your own (in other words, never cut and paste whole phrases from a book or from the web);

(2) Give credit when you use someone else's words: when using the work or ideas of others, including fellow students, give full credit through accurate citations; and (3) Ask if you don't know what to do: if you are uncertain about the ground rules on a particular assignment, ask me for clarification.

Plagiarism is generally thought of as a moral issue – it is dishonest to use someone else's words as your own, without properly crediting the source.

However: an equally important issue is that, when you copy someone else's words, you are not learning. You are (or someone else is) contributing valuable time and resources for you to attend university and learn stuff so you can have a bright future. If you copy and don't learn, you are wasting your time and that person's significant contribution to your future. Don't do it.

Accommodating students with specific needs: If you have a documented learning disability or other condition that may affect you academic performance you should: 1) make sure this documentation is on file with ***Office for Disability Services*** (http://ods.gmu.edu) to determine the accommodations you need; and 2) speak with me to discuss your accommodation needs.

Computers and other electronic devices in class: You are expected to pay attention to and be engaged with what is happening in class, both when your fellow students are making presentations or discussing readings, as well as when I am giving a lecture. You can't do that while surfing or texting or tweeting. It becomes very obvious to both me and to your classmates that you aren't engaged and it distracts everyone. More importantly, you are not learning! **Close your laptops and put your tablets and smartphones away**.

Common courtesy and common sense prevails. Use your phones only during breaks, and please do so outside class. Leave your phones on beep or buzz if you need to be available for emergency calls, and take the calls outside of class.

NOTE: This information is subject to change with advance notification to the class.