SI 541/741
Prof. Paul N. Edwards
University of Michigan, Fall 2001
Thursday, 1-4 PM, 412 West Hall
SI 541 (masters level)
SI 741 (doctoral level)

Systems, Networks, and Webs:

History of Infrastructure

This course offers historical, comparative, and theoretical perspectives on the evolution of major infrastructures from the 19th century to the present. We will explore three main types of infrastructures: transportation, electric power, and communications/information systems.

The purpose of the course is to draw out structural similarities and differences among the historical trajectories of major systems that lie at the foundation of the industrialized world. For example, transportation infrastructures face their most difficult problems at the interface between different transport modes, as in ports (where shipping connects with trucking and rail) and airports (where air transit connects with automobile, truck, bus, subway, train, pedestrian, and other modes). These intermodal problems in transport systems have significant analogies in information infrastructures, where data conversion (from analog to digital, or from one digital format to another) creates difficult problems for system designers and users.

An important goal of the course is to examine the unintended consequences of infrastructure development. For example, better highway systems often produce, rather than relieve, traffic congestion in inner cities. Similarly, using computer networks for coordination can create unplanned dependencies *among* infrastructures such as telephone, power, and Internet. Another goal is to underscore the importance of user innovation in changing the trajectory of technological development. A third is to trace interactions among engineering, politics, and culture. Social concerns, such as infrastructure security, usability, and monopoly power, will be explored.

A major focus will be the role of standards (e.g. for railroad track gauge, alternating current voltages, and TCP/IP) and standard-setting bodies in creating “ground rules” for infrastructure development. Concepts such as “technological momentum” (the tendency of large technical systems to become increasingly resistant to change as they mature) and “load factor” (maximizing the use of available system capacity) will be explored. We will try to articulate the differences between systems, networks, and webs (or internetworks) as both technological and social phenomena.

Prerequisites: none.

Limitations: 541 limited to 25; 741 limited to 7.

Requirements and assignments

This course is "front-loaded" with reading that will prepare you for about one month of independent research activity at the end of the course. This means you will need to budget your time carefully, especially near the end when other demands on your time may increase.

Students in the masters-level version of the course (541) have a somewhat different set of requirements from doctoral-level (741) students. Please read the following carefully:

Requirements for all students

- At least one in-class ***presentation*** of course readings.
- ***Group/pair project.*** Working in groups of two or three, students will create case studies comparing the development of two dissimilar infrastructures. This project should be based on your term paper research.

  The project will culminate in 2 products:

  1. A class presentation, delivered during one of the last two class sessions. (15 percent of course grade).

  2. A medium-length paper (2500-3500 words for pairs, 3000-4000 words for triples) OR a website including the same amount of text. While this paper should be considerably different from the term paper — focusing on comparative analysis — you need not research an entirely new topic. Due in class on December 6th. (25 percent of course grade).

- ***Class participation*** will be taken strongly into consideration, but is not graded separately.

Additional requirements for 541 students (ONLY):

- A 1250-1750 word "think piece" on the concept of infrastructure. Due in class October 4th. (15 percent of course grade.)
- ***Term research paper:*** over the course of the semester, students will research and write a 3500-4500 word paper on an infrastructure issue of their choice This can be a traditional paper, or a hypermedia project including the equivalent amount of text. 541 students may use course texts as the primary basis for this project, but must conduct at least some additional research as well. In all cases, the assignment has three parts. (45 percent of course grade).

  (a) A 400-word *prospectus,* clearly describing your topic, your approach, and the sources you plan to use, is due October 11th.

  (b) A *full-length, high-quality draft* is due November 15th. This will be returned by November 29th, with comments and suggestions for revisions. NO LATE PROJECTS.

(c) The *final version,* edited, revised, and proofread, is due at my office by 12:00 noon on Thursday, December 13th. NO LATE PROJECTS.

Additional requirements for 741 (doctoral) students (ONLY):

- A 2500-3500 word essay on theories of infrastructure development. Due in class October 11th. (20 percent of course grade).
- ***Term research paper:*** over the course of the semester, students will research and write a 4000-5000 word paper on an infrastructure issue of their choice This can be a traditional paper, or a hypermedia project including the equivalent amount of text. 741 students may use course texts as one source of information, but must also conduct substantial independent research. In all cases, the assignment has three parts. (40 percent of course grade).

  (a) A 400-word *prospectus,* clearly describing your topic, your approach, and the sources you plan to use, is due October 4th.

  (b) A *full-length, high-quality draft* is due November 15th. This will be returned on November 29th, with comments and suggestions for revisions. NO LATE PROJECTS.

  (c) The *final version,* edited, revised, and proofread, is due at my office by 12:00 noon on Thursday, December 13th. NO LATE PROJECTS.

Required Texts (available at Shaman Drum):

Copies of all course texts (except the coursepack) are on 2-hour reserve at the library.

Abbate, Janet, *Inventing the Internet* (Cambridge, MA: MIT Press, 1999).

Chandler, Alfred Dupont and James W. Cortada, *A Nation Transformed by Information* (New York: Oxford University Press, 2000). This book may only be available in hardback, but I recommend purchase if you can afford it. A copy is on reserve at the library.

Goddard, Stephen B., *Getting There: The Epic Struggle between Road and Rail in the American Century* (New York: Basic Books, 1994).

Standage, Tom, *The Victorian Internet: The Remarkable Story of the Telegraph and the Nineteenth Century's On-Line Pioneers* (New York: Walker and Company, 1998).

Coursepack (available at Excel, 1100 S. University Ave., and also online at the Coursetools website.

Course website:

https://coursetools.ummu.umich.edu/2001/fall/si/541/001.nsf/

Instructor:

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Course Schedule

Readings marked (R) will be part of the coursepack. They will also be available on the course website as PDF page-image files. I strongly recommend purchase of the coursepack.

Sept. 6 — **Introduction**

Edwards, Paul N., "How to Read a Book." Available at http://www.si.umich.edu/~pne/PDF/howtoread.pdf.

— Final paper and group/pair project guidelines distributed —

Sept. 13 — **What is Infrastructure?**

Bowker, Geoffrey C. and Susan Leigh Star, *Sorting Things Out: Classification and its Consequences*, (Cambridge, Mass.: MIT Press, 1999), pp. 33-50.

Mason, Richard O., James L. McKenney, and Duncan G. Copeland, "An Historical Method for MIS Research: Steps and Assumptions," *MIS Quarterly* 21:3 (1997), 307-320.

Hanseth, Ole and Eric Monteiro (1998), *Understanding Information Infrastructure*, unpublished manuscript, University of Oslo, Norway, Chapters 3-6. http://www.ifi.uio.no/~oleha/Publications/bok.html. Skim chapters 7-9 if you have time.

President's Commission on Critical Infrastructure Protection, *Critical Foundations: Protecting America's Infrastructures* (Washington, D.C.: US GPO, 1997), Part I (Chapters 1-4). Available on WWW at http://www.si.umich.edu/~pne/PDF/PCCIP/pccip.part1.pdf

Sept. 20 — **Telegraph**

Misa, Thomas J., "Retrieving Sociotechnical Change from Technological Determinism," in Merrit Roe Smith and Leo Marx, eds., *Does Technology Drive History?* (Cambridge, MA: MIT Press, 1994), 115-141.

Standage, Tom, *The Victorian Internet: The Remarkable Story of the Telegraph and the Nineteenth Century's On-Line Pioneers* (New York: Walker and Company, 1998).

Friedlander, Amy, *Natural Monopoly and Universal Service: Telephones and Telegraphs in the U.S. Communications Infrastructure, 1837-1940* (Reston, VA: Corporation for National Research Initiatives, 1995), first part (on telegraph) (R)

Sept. 27 — **Railroads and Highways**

Friedlander, Amy, *Emerging Infrastructure: The Growth of Railroads* (Reston, VA: Corporation for National Research Initiatives, 1995). (R)

Goddard, Stephen B., *Getting There: The Epic Struggle between Road and Rail in the American Century* (New York: Basic Books, 1994).

Roman roads mythology (R)

Oct. 4 — **Information Infrastructure before Computers**

Chandler, Alfred Dupont and James W. Cortada, *A Nation Transformed by Information* (New York: Oxford University Press, 2000), chapters 1-5.

— 541: first paper due in class —

Oct. 11 — **Electric Power**

Hughes, Thomas P., *Networks of Power: Electrification in Western Society, 1880-1930* (Baltimore, MD: Johns Hopkins University Press, 1983).

— 541 and 741: Prospectus for final project due in class —

— 741: First paper due in class —

Oct. 18 — **Computerizing America**

Chandler, Alfred Dupont and James W. Cortada, *A Nation Transformed by Information* (New York: Oxford University Press, 2000), chapters 6-9.

— 541 and 741: Choose group/pair project partners —

Oct. 25 — **Intermodalism**

Robl, Ernest H., "The Intermodal Container FAQ," http://www.robl.w1.com/Transport/intermod.htm

Forster, Paul W. and John Leslie King, "Information Infrastructure Standards in Heterogeneous Sectors: Lessons from the Worldwide Air Cargo Community," in Brian Kahin and Janet Abbate, eds., Standards Policy for Information Infrastructure (Cambridge, MA: MIT Press, 1995), 148-177.

Alt, Rainer; Forster, P. W.; King, John L., "The Great Reversal: Information and Transportation Infrastructure in the Intermodal Vision," in: Transportation Research Board (Hrsg.): Setting the Intermodal Transportation Research Framework, Proceedings of Conference held in Irvine, 11-13 December 1995.

Browse: The National Transportation Library (try a search on "intermodal"), http://www.bts.gov/NTL/

Nov. 1 — **The Internet**

Abbate, Janet, *Inventing the Internet* (Cambridge, MA: MIT Press, 1999).

Recommended:

A quirky, but interesting history of the Internet (including especially its interaction with UNIX development) is *Netizens: On the History and Impact of Usenet and the Internet.* The book exists in a print edition, but it is also available online at http://www.columbia.edu/~rh120/

Nov. 8 — **The World Wide Web as an Intermodal Information Infrastructure**

Please explore the CERN (European Laboratory for Particle Physics) web site on CERN and the history of the WWW. http://www.cern.ch/Public/ACHIEVEMENTS/web.html.

Nov. 15 — **TBA**

— 541 and 741: Term project drafts due —

Nov. 22 — **NO CLASS — THANKSGIVING BREAK**

Nov. 29 — **Project Presentations**

Dec. 6 — **Project Presentations**

— Group/pair project paper due in class. NO LATE PROJECTS —

Dec. 13 — *541 and 741: Final draft of term project due at 301D West Hall.*

— NO LATE PROJECTS —