Technology, Science, and Innovation: Institutions and Governance
PUBP-820

Spring 2018

Professor David M. Hart
Schar School of Policy and Government
George Mason University

Times, Places, and Contact Information
Class meetings: Wednesdays, 4:30-7:10 p.m., Founders Hall TBA
Office hours: Wednesdays, 2-4 pm or by appointment
Office location: Founders Hall 609
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Learning Outcomes
New technologies present extraordinary opportunities for achieving major public policy objectives, such as economic growth, environmental sustainability, public health, international security, and the advancement of knowledge. Yet, they may also place the very same objectives in jeopardy. Whether the public benefits from technological innovation depends on how well the innovation process is governed.

This course acquaints doctoral students with what social scientists know about technological innovation and its governance. By "governance" I mean the influence exerted by cultural and economic institutions as well as by public policies on the technical and scientific communities that are the immediate sources of new technologies. While technology and science are themselves institutional complexes that have substantial "internal" momentum, they are constantly interacting with these "external" institutions. These interactions can be conceptualized at multiple temporal (years, decades, centuries, etc.) and geographical scales (regional, national, supranational, and global).

We will engage with classic works that introduced essential concepts in this field of inquiry and explore recent developments in the state-of-the-art. The course's purposes are to hone the student's ability to engage critically with challenging texts (and express herself in this regard) and to identify promising fields and questions for dissertation research.

Participants
PUBP-820 welcomes all SPGIA doctoral students and aims to support their progress toward field exams and dissertation proposals. The course is open to students enrolled in other programs as well, if they have a deep interest in and appropriate background for it, space permitting and subject to the instructor's approval.

Course Texts and Materials
Course readings will be made available through the course Blackboard website or through open source files linked to this syllabus.

Format
Each class meeting will have two distinct components. The first half of the class will revolve around short papers prepared by the students, as described below, that focus on concepts introduced in the previous week. The second half will be composed primarily of a lecture that lays out core concepts, building on the readings and augmented by clarifying and critical discussion among all participants.

Assignments and Grading
Each student will prepare five essays of approximately 1500 words each. The class will be divided into two groups, each writing an essay every other week on a staggered basis, so that approximately half of the students will have an essay to share each week. The essays will not require research, but rather will be critical assessments of theoretical concepts, evidence offered by the readings, and related scholarly questions. Detailed guidance for these essays will be provided in the first class. The essays will be weighed equally in the semester grade.

Participation
This class depends vitally on preparation and active participation. No formal weight in the semester grade will be assigned to participation, but failure to participate adequately will result in lowering of assignment grades. Students in risk of this penalty will be given adequate notice and generous opportunity to avoid it.

Students with Special Needs
If you are a student with a disability and you need academic accommodation, please see the instructor and contact the Disability Resource Center (DRC) at 993-2474. All academic accommodations must be arranged through the DRC.

Read the plagiarism policy attached to the end of this syllabus. Ignorance of or failure to understand the policy will not lead to lenience in case of violation.

Reading List

I. Technology, Science, and Innovation: The Inner Workings

1. Technology, Science, and Innovation: Autonomy, Momentum, and Control
January 24

- Bill Joy, "Why the Future Doesn't Need Us," *Wired*, April 2000.
- Kevin Kelly, "Choosing the Inevitable," ch. 9 in *What Technology Wants* (Viking, 2010), pp. 175-188.
- Alvin M. Weinberg, "Can Technology Replace Social Engineering?," *Bulletin of the Atomic Scientists* 22:12 (December 1966): 4-8.
- Amory B. Lovins, "Energy Strategy: The Road Not Taken," *Foreign Affairs* 55(1):65-96 (1976).
- Unruh, Gregory C., "Escaping Carbon Lock-In," *Energy Policy* 30:317-325 (2002).

2. Science: Norms and Other Incentives
January 31

- Robert K. Merton, "The Normative Structure of Science," (1942) in Merton, *Sociology of Science* (University of Chicago Press, 1973).
- Michael Mulkay, "The Mediating Role of the Scientific Elite," *Social Studies of Science* 6(3-4):445-470 (September 1976).
- Daniel J. Kevles, "Cold War and Hot Physics: Science, Security, and the American State, 1945-1956," *Historical Studies in the Physical and Biological Sciences* 20:239-264 (1990).
- Henry Etzkowitz, "The Norms of Entrepreneurial Science: Cognitive Effects of the New University–Industry Linkages," *Research Policy* 27(8):823-833 (December 1998).
- Sanjay Jain, Gerard George, and Mark Maltarich, "Academics or Entrepreneurs? Investigating Role Identity Modification of University Scientists Involved in Commercialization Activity," *Research Policy* 38:922–935 (2009).

3. Technology and Innovation: From Invention to Use
February 7

- Stephen J. Kline, "Innovation Is Not a Linear Process," *Research Management*, July/August 1985, 36-45.
- Philip Anderson and Michael Tushman, "Technological Discontinuities and Dominant Designs: A Cyclical Model of Technological Change," *Administrative Science Quarterly* 35:604-633 (December 1990).
- Mike Hobday, "Product Complexity, Innovation and Industrial Organisation," *Research Policy* 26:689-710 (1998).
- Paul David, "The Dynamo and the Computer: An Historical Perspective on the Modern Productivity Paradox," *American Economic Review* 80(2):355-361 (May 1990).
- Bronwyn Hall, "Innovation and Diffusion," National Bureau of Economic Research working paper 10212, January 2004.

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II. "Background" Governance Institutions

4. Firms and Markets

February 14

- Joseph A. Schumpeter, "Plausible Capitalism" and "The Process of Creative Destruction," chapters 6-7 in *Capitalism, Socialism, and Democracy* (Harper, 1942), 72-86.
- Alfred D. Chandler, Jr., "Evolution of the Large Scale Corporation: An Evolution of the Transaction Cost Approach," paper presented to the Business History Conference, 1982.
- David J. Teece, "Profiting From Technological Innovation," *Research Policy* 15: 285-305 (1986).
- Walter W. Powell, "Learning from Collaboration: Knowledge and Networks in the Biotechnological and Pharmaceutical Industries," *California Management Review* 40:228-240 (1998).
- Eric von Hippel and Georg von Krogh, "Open Source Software and the "Private-Collective" Innovation Model: Issues for Organization Science," *Organization Science* 14:209-223 (2003).

5. Intellectual Property

February 21

- Naomi R. Lamoreaux and Kenneth L. Sokoloff, "Long-term Change in the Organization of Inventive Activity," *Proceedings of the National Academy of Sciences* 93:12686-12692 (12 November 1996).
- Robert Merges and Richard R. Nelson, "On Limiting or Encouraging Rivalry in Technical Progress: The Effect of Patent-Scope Decisions," *Journal of Economic Behavior and Organization* 25:1-24 (1994).
- Dosi, Giovanni, L. Marengo, and C. Pasquali, "How Much Should Society Fuel the Greed of Innovators," *Research Policy* 35:1110-1121 (2006).
- Ashish Arora, Andrea Fosfuri and Alfonso Gambardella, "Markets for Technology in the Knowledge Economy," *International Social Science Journal* 54:115-128 (2002),
- Andrei Hagiu and David B. Yoffie, "The New Patent Intermediaries: Platforms, Defensive Aggregators, and Super-Aggregators," *Journal of Economic Perspectives* vol. 27, no. 1, pp. 45-66 (Winter 2013).

6. Financial Institutions

February 28

- Ragu Rajan and Luigi Zingales, "Financial Systems, Industrial Structure, and Growth," *Oxford Review of Economic Policy* 17:467-482 (2001).
- Martin Kenney, "How Venture Capital Became a Component of the US National System of Innovation," *Industrial and Corporate Change* 20:1677-1723 (2011).
- William R. Kerr and Ramana Nanda, "Financing Innovation," National Bureau of Economic Research working paper no. 20676, November 2014.
- Guy Ben-Ari and Nicholas S. Vonortas, "Risk Financing for Knowledge-Based Enterprises: Mechanisms and Policy Options," *Science and Public Policy* 34:475-488 (2007).

- Elisabeth B. Reynolds, Hiram Samel and Joyce Lawrence, "Learning by Building: Complementary Assets and the Migration of Capabilities in U.S. Innovation Firms," MIT Industrial Performance Center working paper 13-001, January, 2013.

7. Culture

March 7

- Douglass C. North, "Economic Performance Through Time," *American Economic Review* 84(3):359-368 (1994).
- Jared Diamond, "Why Did the Vikings Vanish?," *New York Review of Books*, April 11, 2002.
- Joel Mokyr, "Entrepreneurship and the Industrial Revolution in Britain," in David S. Landes, Joel Mokyr, and William J. Baumol, eds., *The Invention of Enterprise: Entrepreneurship from Ancient Mesopotamia to Modern Times* (Princeton, 2010), pp. 183-210.
- Mark Elam, "National Imagination and Systems of Innovation," in Charles Edquist, ed., *Systems of Innovation* (Pinter, 1997), pp. 159-173.
- David M. Hart, "Understanding Immigration in a National Systems of Innovation Framework," *Science and Public Policy* 34:45-53 (2007).

MARCH 14 – NO CLASS – SPRING BREAK

III. National Innovation Systems, Public Policy, and National Goals

8. Economic Prosperity

March 21

- Adam B. Jaffe, "Measurement Issues" in Lewis M. Branscomb and James H. Keller, eds., *Investing in Innovation* (MIT Press, 1998), pp. 64-84.
- Moses Abramovitz, "Catching Up, Forging Ahead, and Falling Behind," *Journal of Economic History* 46:385-406 (1986).
- Aleksander Gerschenkron, "Economic Backwardness in Historical Perspective" ch. 1 in *ibid*. (Belknap, 1962).
- Jan Fagerberg and Martin Srholec, "National Innovation Systems, Capabilities, and Economic Development," *Research Policy* 37:1417-1435 (2008).
- Wan-Wen Chu, "How the Chinese Government Promoted a Global Automobile Industry," *Industrial and Corporate Change* 20:1235-1276 (2011).
- Zheng Wan, Daniel Sperling, and Yunshi Wang, "China's Electric Car Frustrations," *Transportation Research Part D: Transport and Environment* 34:116–121 (2015).

9. Health and Well-Being

March 28

- Susan E Cozzens, "Quality of Life Returns from Basic Research," *Health Research Policy and Systems* 2010, 8:18 (13 pp.)
- Andrew A. Toole, "The Impact of Basic Research on Industrial Innovation: Evidence from the Pharmaceutical Industry," *Research Policy* 41:1-12 (2012).
- Iain Cockburn, Rebecca Henderson, Luigi Orsenigo, and Gary Pisano, "Pharmaceuticals and Biotechnology," in *U.S. Industry in 2000* (National Academies Press, 2001), pp. 363-398.

- Bhaven Sampat and Michael Drummond, "Another Special Relationship? Interactions between Health Technology Policies and Health Care Systems in the United States and the United Kingdom," *Journal of Health Politics, Policy and Law* 36:119-139 (2011).
- Aaron S. Kesselheim, "An Empirical Review of Major Legislation Affecting Drug Development: Past Experiences, Effects, and Unintended Consequences," *Milbank Quarterly* 89:450–502 (2011).

10. National Security
April 4
- David C. Mowery, "National Security and National Innovation Systems," *Journal of Technology Transfer* 34:455-473 (2009).
- John A. Alic, "Managing U.S. Defense Acquisition," *Enterprise and Society* 14:1-36 (2013).
- Manuel Trajtenberg, "Defense R&D in the Anti-Terrorist Era," *Defence and Peace Economics* 17(3):177–199 (2006).
- Erica Fuchs, "Rethinking the Role of the State in Technology Development: DARPA and the Case for Embedded Network Governance," *Research Policy* 39:1133-1147 (2010).
- P. W. Singer, "Military Robotics and Ethics: A World of Killer Apps," *Nature* 477:399–401 (22 September 2011).

IV. The Emerging Global Innovation System and Global Public Policy Goals

11. Low-Carbon Energy
April 11
- S. Pacala,and R. Socolow, "Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies," Science 305:968-972 (13 August 2004).
- Steven J Davis, Long Cao, Ken Caldeira, and Martin I Hoffert, "Rethinking Wedges," *Environmental Research Letters* (2013) (8pp) doi:10.1088/1748-9326/8/1/011001
- Björn A. Sandén and Christian Azar, "Near-Term Technology Policies for Long-Term Climate Targets—Economy Wide versus Technology Specific Approaches," *Energy Policy* 33:1557-1576 (2005).
- Thomas Hale and Johannes Urpelainen, "When and How Can Unilateral Policies Promote the International Diffusion of Environmental Policies and Clean Technology?," *Journal of Theoretical Politics* 27:177–205 (2015).
- Joern Huenteler, Tobias S. Schmidt, Jan Ossenbrink, and Volker H. Hoffmann, "Technology Life-Cycles in the Energy Sector – Technological Characteristics and the Role of Deployment for Innovation," SSRN 2566463, February 2015.
- Charlie Wilson, Arnulf Grubler, Kelly S. Gallagher, and Gregory F. Nemet, "Marginalization of End-Use Technologies in Energy Innovation for Climate Protection," *Nature Climate Change* 2:780-788 (November 2012).

12. Inclusive Innovation
April 18
- Organization for Economic Cooperation and Development, "Innovation for Development: The Challenges Ahead," in *STI Outlook 2012* (OECD, 2013), pp. 115-142
- Raphael Kaplinsky, "Bottom of the Pyramid Innovation and Pro-Poor Growth," in *Making Innovation Policy Work: Learning from Experimentation* (OECD, 2014), pp. 49-70.

- Theo Papaioannou, How Inclusive Can Innovation and Development Be in the Twenty-First Century?," *Innovation and Development* 4:187–202 (2014)
- Don Tapscott, "Introducing Global Solution Networks: Understanding the New Multi-Stakeholder Models for Global Cooperation, Problem Solving and Governance," *Innovations*, Winter-Spring 2014, pp.3–46.
- Jeffrey D. Sachs. "From Millennium Development Goals to Sustainable Development Goals," *Lancet* 379:2206-11 (9 June 2012).

13. TBD
April 25

14. Wrap Up
May 2
- Ben R. Martin, "Twenty Challenges for Innovation Studies," draft of February 2015.

SPGIA Policy on Plagiarism

The profession of scholarship and the intellectual life of a university, as well as the field of public policy inquiry, depend fundamentally on a foundation of trust. Thus, any act of plagiarism strikes at the heart of the meaning of the University and the purpose of the School of Policy, Government and International Affairs. It constitutes a serious breach of professional ethics and it is unacceptable. Plagiarism is the use of another's words or ideas presented as one's own. It includes, among other things, the use of specific words, ideas, or frameworks that are the product of another's work. Honesty and thoroughness in citing sources is essential to professional accountability and personal responsibility. Appropriate citation is necessary so that arguments, evidence, and claims can be critically examined.

Plagiarism is wrong because of the injustice it does to the person whose ideas are stolen. It is also wrong because it constitutes lying to one's professional colleagues. From a prudential perspective, it is shortsighted and self-defeating, and it can ruin a professional career.

The faculty of the School of Policy, Government, and International Affairs takes plagiarism seriously and has adopted a zero tolerance policy. This may lead to failure for the course, resulting in termination from the program and possible termination from SPGIA. This termination will be noted on the student's transcript. For foreign students who are on a university-sponsored visa (eg. F-1, J-1 or J-2), termination also results in the revocation of their visa.

To help enforce the SPGIA policy on plagiarism, all written work submitted in partial fulfillment of course or degree requirements must be available in electronic form so that it can be compared with electronic databases, as well as submitted to commercial services to which the School subscribes. Faculty may at any time submit a student's work without prior permission from the student. Individual instructors may require that written work be submitted in electronic as well as printed form. The SPGIA policy on plagiarism is supplementary to the George Mason University Honor Code; it is not intended to replace it or substitute for it.
(http://policy.gmu.edu/honorcode)

Professor Hart's Addendum

I believe deeply that intellectual integrity is a fundamental element of learning. I firmly support the School's zero tolerance policy on plagiarism and will enforce it stringently. Ignorance is not an excuse. To avoid plagiarism, a simple rule of thumb may be of help: when in doubt, include a citation. Citations, including those to web sources, should include sufficient information to allow a reader to verify the source. Further details on when and how to cite sources will be discussed in class. However, providing a citation to a block of text taken with minimal change from a source is not sufficient to avoid plagiarism. You must put the block in quotation marks, thereby acknowledging the source's contribution of specific words as well as ideas in the block.