Overview

This course provides a comprehensive overview of the policy issues related to the support, use, management, and regulation of science and technology. It addresses US domestic as well as international issues, is concerned with governmental policies as well as non-governmental decisions, and it is focused on both the economics and politics of science and technology issues.

In today’s world, scientific discoveries and technological innovations influence almost every aspect of human existence. Many changes induced by these innovations have been extremely positive, bringing advances in health, communications, material wealth, and quality of life. At the same time, Science and Technology have helped create apparently intractable problems, including new risks to human health, pollution of the natural environment, and the existence of weapons capable of mass destruction. Given all of these impacts, making effective and fair choices regarding technologically complex issues is one of the most challenging tasks of modern governance.

Especially demanding is policy-making for international economic competition, which is increasingly defined in terms of technological competence. The diffusion of centers of technological excellence around the world and the progressive convergence of local markets in terms of consumer tastes and preferences have obliged actors to adopt a more global outlook: not only do firms compete internationally, but they also depend on each other’s technological, organizational, financial, and marketing strengths to stay afloat. In this course we examine a number of important characteristics of the new international context that are currently related to the technological competence of firms and nations.
Goals

This course is intended to impart: knowledge of the institutions that shape international science and technology policy, with a focus on the U.S. institutions surrounding the George Washington University; familiarity with policy research and key indicators that shape science and technology policy; an overview of historical and current science and technology policy issues, with a focus on issues under consideration by policymakers in institutions surrounding GW; the skill of policy analysis – the ability to dissect a problem in science and technology and connect the elements of that problem to the relevant institutions; and the skill of policy formulation – the ability to craft a science or technology policy in a way that might promise success, drawing on historical and/or international experience.

These goals are assessed in the two major exams and the policy exercise. Each exam will have questions that are intended to assess mastery of the categories of knowledge, described above, that are developed in the class. The exams are cumulative, in the sense that they make use of the lectures, reading material, and class discussions. They may also introduce new material as well. In general, they consist of a series of short essay questions with short essay answers. They are take-home exams.

Learning Outcomes

Students will be able to critically analyze science and technology policy proposals and supporting data with reference to historical trends and key policy institutions.

Students will be able to formulate science and technology policy proposals, support proposals with relevant data or indicators, and critically evaluate their potential effectiveness.

Students will be able to evaluate the economic, political, and social contexts of actual or proposed science and technology policy actions in terms of historical and contemporary settings.

Out of Class and Independent Learning Expected per Week

For this 3-credit graduate class students are expected to spend at least 350 minutes per week outside the classroom on preparation and class assignments.
Grades

The final grade will be computed in the following way:

Policy Memo: 15%
Midterm Exam: 25%
Final Exam: 50%

Class Participation 10%

Class participation is graded in a subjective manner. The professor will award credit to those students who helped to shape the discussion, identified good questions, raised interesting points, and found clever insights. All members of the class can potentially receive full credit for participation.

Examinations

One policy exercise and two take-home examinations. They will be posted on Blackboard and should be submitted via email to the professor. No paper submissions will be accepted.

The policy exercise will require you to write a brief (1-2 page) memorandum on a specific policy concern. It will be posted a week we complete the United States’ material. The memorandum must be prepared within a 2-day period.

The examinations will be a collection of short essays that are based on the class discussions and readings. Grades will be based upon the full set of attributes that are important to good policy papers, including accuracy, clarity, logic, relevance, brevity, and so on. The policy memorandum will be posted on week 4 of the course. The mid-term examination will be posted on week 6 of the course. The final examination will be posted at the end of the course. The policy memorandum will be due two days after posting. The midterm and final exams will be due one week after posting.

Class Policies

Class attendance is expected. There will be no allowance for late work, except by prior arrangement with the instructor. Arrangements for make-up work must be made with the instructor. The instructor has the discretion to grant or refuse requests for late work or make-up work. Students are always welcome to discuss grades with the Professor. However, students wishing to formally contest a grade are required to write a memo outlining their case, along with supporting examples from the submitted assignment.
University Policies & Services

**Academic Integrity Code.** Academic dishonesty is defined as cheating of any kind, including misrepresenting one's own work, taking credit for the work of others without crediting them and without appropriate authorization, and the fabrication of information. For details and complete code, see: studentconduct.gwu.edu/code-academic-integrity

**Sharing of Course Content.** Unauthorized downloading, distributing, or sharing of any part of a recorded lecture or course materials, as well as using provided information for purposes other than the student’s own learning may be deemed a violation of GW’s Student Conduct Code.

**Use of Student Work (FERPA).** The professor will use academic work that you complete during this semester for educational purposes in this course during this semester. Your registration and continued enrollment constitute your consent.

**Accommodations for Students with Disabilities.** Any student who may need an accommodation based on the potential impact of a disability should contact the Disability Support Services office at 202-994-8250 in the Rome Hall, Suite 102, to establish eligibility and to coordinate reasonable accommodations. For additional information see: disabilitysupport.gwu.edu/

**Religious Observances.** In accordance with University policy, students should notify faculty during the first week of the semester of their intention to be absent from class on their day(s) of religious observance. For details and policy, see: students.gwu.edu/accommodations-religious-holidays.

**Mental Health Services 202-994-5300.** The University's Mental Health Services offers 24/7 assistance and referral to address students' personal, social, career, and study skills problems. Services for students include: crisis and emergency mental health consultations confidential assessment, counseling services (individual and small group), and referrals. For additional information see: counselingcenter.gwu.edu/

**GW Security and Safety Policy.** In the case of an emergency, if at all possible, the class should shelter in place. If the building that the class is in is affected, follow the evacuation procedures for the building. After evacuation, seek shelter at a predetermined rendezvous location.
Readings

You are requested to purchase the book:


An extensive report by UNESCO (900 pages) provides excellent background material on various countries/regions around the world, difficult to find elsewhere in such a comparative manner:


*All other readings will be posted on Blackboard, except for selective large reports that you can locate on the internet.*
# Schedule of Meetings

## COURSE INTRODUCTION

<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
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| 9/1  | Course Introduction  
Megatrends / Technology Trends in Context of Future Research Policy  
Pandemics in Human History |

## SCIENCE, TECHNOLOGY AND INNOVATION (STI) POLICY

<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
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</table>
| 9/8  | U.S. STI System:  
Foundations of STI Policy – Historical Overview of STI Development  
Current and Evolving Issues |
| 9/15 | Institutions – R&D Funding |
| 9/22 | National Defense – Civilian Public Procurement |
| 9/29 | STI Policy in Europe:  
European Union, Framework Program  
European Union Country Members |

<table>
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<tr>
<th>Date</th>
<th>Topic</th>
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<tbody>
<tr>
<td>10/6</td>
<td>STI Policy in Emerging Economies</td>
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</table>

## CORE TECHNOLOGY AREAS

<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
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</table>
| 10/13| Digital Economy:  
The New Knowledge-Driven Socio-Economic Paradigm;  
4th Industrial Revolution; Advanced Manufacturing |
| 10/20| Artificial Intelligence; The Data Economy;  
Distributed Ledger Technologies |
| 10/27| Energy, Environment, Climate |
| 11/3 | Pharmaceuticals, Public Health |
| 11/10| Space:  
Space Futures  
Low Earth Orbit |

## SYSTEM MANAGEMENT AND THE FUTURE

<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
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<tbody>
<tr>
<td>11/17</td>
<td>STEM Education, S&amp;E Workforce, Jobs</td>
</tr>
<tr>
<td>11/24</td>
<td>Entrepreneurship, Innovative SMEs</td>
</tr>
<tr>
<td>12/1</td>
<td>The Future of STI Policy: Globalization, Grand Challenges, Other Challenges</td>
</tr>
</tbody>
</table>
Analytical Schedule of Meetings and Readings
Readings marked with an asterisk (*) are recommended. Core readings are unmarked.

COURSE INTRODUCTION

9/1

COURSE INTRODUCTION

(i) Course Introduction


(ii) Megatrends / Technology Trends in Context of Future Research Policy

[Ch1] “Megatrends Affecting Science, Technology and Innovation”
[Ch2] “Future Technology Trends”

(iii) Pandemics in Human History


SCIENCE, TECHNOLOGY AND INNOVATION (STI) POLICY

9/8

U.S. STI SYSTEM I

(i) Foundations of STI Policy – Historical Overview of STI Development


(ii) Current and Evolving Issues

Neal, Homer A., Tobin L. Smith, and Jennifer B. McCormick (2008), op.cit. [Chs 3-5]
9/15  U.S. STI SYSTEM II

(i) Institutions – R&D Funding

Neal, Homer A., Tobin L. Smith, and Jennifer B. McCormick (2008), op.cit. [Chs 6-9]
[8] “Industry”

“R&D: National Trends and International Comparisons”
https://ncses.nsf.gov/pubs/nsb20203/


9/22  U.S. STI SYSTEM III

(i) National Defense – Civilian Public Procurement

Neal, Homer A., Tobin L. Smith, and Jennifer B. McCormick (2008), op.cit. [Chs 11, 13, 18]
[18] “Science and Homeland Security”


*Policy Exercise (Memorandum) posted*
STI POLICY IN EUROPE

(i) European Union, Framework Program

United Nations Educational, Scientific and Cultural Organization
UNESCO Science Report: Towards 2030, UNESCO Printing, 2015. (Revised 2016) [Ch. 9]
http://en.unesco.org/USR-contents

European Commission Horizon 2020 - the Framework Programme for Research and Innovation.
http://ec.europa.eu/research/horizon2020/index_en.cfm

(ii) European Union Country Members

[ES] “Executive Summary”
[Ch2] “Innovation Performance and Trends”
[Ch4] “Innovation Dimensions”
[Ch5] “Benchmarking Innovation Performance with non-EU Countries”
[Ch7] “Country Profiles”
https://ec.europa.eu/growth/industry/policy/innovation/scoreboards_en

STI POLICY IN EMERGING ECONOMIES

United Nations Educational, Scientific and Cultural Organization (2015), op.cit. [Chs 1, 8, 13, 16, 22, 23, 25]
http://en.unesco.org/USR-contents
Ch1: Global Overview
Ch8: Brazil
Ch13: Russian Federation
Ch16: Israel
Ch22: India
Ch23: China
Ch25: Republic of Korea


Midterm Examination posted
CORE TECHNOLOGY AREAS

DIGITAL ECONOMY I

(i) The New Knowledge-Driven Paradigm; 4th Industrial Revolution

https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/

(ii) Advanced Manufacturing


* “A Printed Smile”, The Economist, April 30, 2016b.

DIGITAL ECONOMY II

(i) Artificial Intelligence; The Data Economy;


(ii) Distributed Ledger Technologies

ENERGY, ENVIRONMENT, CLIMATE

(i) Energy

“R&D and New Technologies”

(ii) Environment, Climate Change


Climate Brief, The Economist, 2020 (various)
[5] “Burn”, May 23


PHARMACEUTICALS, PUBLIC HEALTH


SPACE

(i) Space Futures


(ii) Low Earth Orbit


SYSTEM MANAGEMENT AND THE FUTURE

STEM EDUCATION, S&E WORKFORCE, JOBS

Neal, Homer A., Tobin L. Smith, and Jennifer B. McCormick (2008), op.cit. [Chs 15, 16]


[16] “The Science and Engineering Workforce”

National Science and Technology Council (NSTC), Committee on STEM Education “Charting a Course for Success: America’s Strategy for STEM Education”, Executive Office of the President of the United States, December 2018.

ENTREPRENEURSHIP, INNOVATIVE SMEs


THE FUTURE OF STI POLICY: GLOBALIZATION, GRAND CHALLENGES, OTHER CHALLENGES

Neal, Homer A., Tobin L. Smith, and Jennifer B. McCormick (2008), op.cit. [Chs 17, 19]
[19] “Grand Challenges for Science and Society”


* United Nations Educational, Scientific and Cultural Organization (2015), op.cit. [Ch1]
[Ch1] “A World in Search of an Effective Growth Strategy”
http://en.unesco.org/USR-contents

*Final Exam posted*
Useful Resources

I. Organizations (selectively)

AAAS R&D Budget and Policy Program
       http://www.aaas.org/spp/rd/

White House Office of Science and Technology Policy (?????)
       http://www.ostp.gov

The National Academies (NAS, NAE, IOM, NRC)
       http://nas.edu/

National Science Foundation (NSF)
       http://www.nsf.gov
especially National Science Board
       http://www.nsf.gov/nsb/
NSF Science and Engineering Statistics

Organization for Economic Cooperation and Development (OECD)
       http://www.oecd.org/

United Nations Conference on Trade and Development (UNCTAD)
       http://unctad.org/en/Pages/Publications.aspx

United Nations Industrial Development Organization (UNIDO)
       http://www.unido.org/

The World Bank
       http://www.worldbank.org/
especially The Science, Technology and Innovation Program
       http://web.worldbank.org/WEBSITE/EXTERNAL/TOPICS/EXTEDUCATION/0,,contentMDK:20457068%7EmenuPK:1011218%7EpinodePK:148956%7EtheSitePK:282386,00.html

The European Union (EU)
especially Directorate-General (DG) Research and Innovation
       http://ec.europa.eu/research/index.cfm?pg=dg
DG Connect
       http://ec.europa.eu/dgs/connect/en/content/dg-connect
DG Enterprise and Industry
       http://ec.europa.eu/enterprise/index_en.htm
European Space Agency
       http://www.esa.int/ESA
Core Academic Journals (selectively)

Science and Public Policy
http://spp.oxfordjournals.org/

Research Policy
http://www.journals.elsevier.com/research-policy/

Journal of Technology Transfer
http://link.springer.com/journal/10961

Technovation
http://www.journals.elsevier.com/technovation/

Economics of Innovation and New Technology
http://www.tandfonline.com/toc/gein20/current#.UhgjquD9Y0M

Industrial and Corporate Change
http://icc.oxfordjournals.org/

Research Evaluation
http://rev.oxfordjournals.org/

Issues in Science and Technology (National Academy of Sciences)
http://www.issues.org/

IEEE Transactions on Engineering Management
http://www.andromeda.rutgers.edu/~ieeetem/

R&D Management
http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1467-9310

Technology Analysis and Strategic Management
http://www.tandfonline.com/toc/ctas20/current#.UhhMTOD9Y0M

Technological Forecasting and Social Change

GW’s Aladin system (Gelman Library) typically offers remote access to such organizations and journals and extensive download privileges to publications.