THE EVOLUTION OF U.S. S,T&I POLICY-MAKING PROCESSES

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PRESENTATION OVERVIEW

- Institutions for policy-making and policy advice in the realm of science, technology and innovation
- Analysis and research in support of S,T&I policy-making
- Academic research and education in S,T&I policy-making and advice
- Characteristics of the U.S. S,T&I system
- Contemporary challenges in policy-making for S,T&I

A LONG HISTORY OF EXECUTIVE BRANCH INSTITUTIONS

- Pre-European era: Shaman advises the chief
- 18th century and the "Founding Fathers"
  - Benjamin Franklin – America's first scientist and founder of the American Philosophical Society
  - Thomas Jefferson – scientist and inventor
  - Alexander Hamilton – 1791 Report on Manufactures
- 19th century and the age of invention
  - Abraham Lincoln – the only President with a patent
  - 1863 – National Academy of Sciences is chartered
  - 1884 – The Allison Commission on the organization and objectives of Federal scientific agencies

EXECUTIVE BRANCH CON'T.

- 20th century foundations for S,T&I institutions
  - 1914 – National Research Council of the NAS
  - 1938 – National Resources Committee writes "Research: A National Resource"
  - 1940 – National Defense Research Committee
  - 1941 – Office of Scientific Research and Development
  - 1945 – "Science-the Endless Frontier" (Bush report)
  - 1950 – NSF Act creates the National Science Board
    - To share governance of NSF with the NSF director
    - To coordinate the entire Federal government's scientific programs (generally not done)

EXECUTIVE BRANCH CON'T.

- 1957-2001 The Golden Age of Science Advice
  - 1957 – Presidential science and technology advisor, President's Scientific Advisory Committee (PSAC), and Federal Coordinating Council for Science and Technology
  - 1962 – White House Office of Science and Technology
  - 1961-1981 – Growth of R&D and of policy research and analysis units across the Federal government, with decline thereafter
  - 1964 – National Academy of Engineering
  - 1963 – Commerce Technical Advisory Board (first Federal report on innovation 1966)
  - 1972 – National R&D Assessment Program at NSF (after Magruder exercise)
  - 1974 – Elimination of OST and of President's Science Advisor by President Nixon
  - 1976 – National Science and Technology Policy and Priorities Act
    - Office of Science and Technology Policy OSTP
    - Science and Technology Advisor to the President
    - Federal Coordinating Council on Science, Engineering and Technology
  - 1989 – White House Council on Competitiveness
  - 1992 – Critical Technologies Institute created to serve OSTP
  - 1993 – National Science and Technology Council (formerly FCCSET)
  - 1994 – OMB/OSTP joint memorandum on S&T budget priorities
  - 2001 – President Bush's statement on Federal funding for stem cell research

EXECUTIVE BRANCH – CON'T.

- Developments 2002-2012
  - 2005 – NSF Science of Science and Engineering Policy Program
  - 2003 – Critical Technologies Institute at RAND becomes Science and Technology Policy Institute at IDA
  - 2009 – Involvement of National Economic Council in National Innovation Strategy
  - 2009 – Appointment of the first Chief Technology Officer in the White House

LEGISLATIVE BRANCH INSTITUTIONS FOR S,T&I POLICY

- 1959 – House Committee on Science and Astronautics (later the Committee on Science or the Committee on Science and Technology)
- 1970 – Legislative Reorganization Act creates Congressional Research Service from old LRS
  - Science Policy Research Division
  - Senior Specialists in Science and Technology (Policy)
- 1972 – Technology Assessment Act creates OTA (de-funded 1995)
- 1988 – Competitiveness Policy Council mandate (implemented in 1991)
- NOTE: GAO and CBO also do some S,T&I analysis
- NOTE: Many other congressional committees influence S,T&I policy

KEY NON-GOVERNMENTAL INSTITUTIONS IN S,T&I POLICY

- Academic institutions (more below)
- Private foundations
  - Alfred P. Sloan
  - IBM
  - Carnegie
- Scientific and technical societies
  - American Association for the Advancement of Science (AAAS)
  - American Physical Society, etc.
- Coalitions
  - Business-Higher Education Forum
  - Council on Competitiveness
  - Science Coalition
- Industry associations
  - Industrial Research Institute
  - National Association of Manufacturers
  - Semiconductor Industries Association
- Think tanks
  - American Enterprise Institute
  - Brookings Institution
  - Woodrow Wilson International Center for Scholars
- National Academies
  - Committee on Science, Engineering and Public Policy
  - Policy Division of National Research Council

ACADEMIC STUDY AND RESEARCH ON S,T&I POLICY

- 1964 – Harvard Program in Technology and Society (IBM funding)
- 1968 – NSF “Interdisciplinary Research on Problems of Our Society” and 1974 -- “Research Applied to National Needs” supports many academic study groups
- 1971 – Technology and Human Affairs Program at Washington University, St. Louis
- 1972 – Sloan Foundation program to strengthen the social science component of engineering education
- 1970s – Many new “science policy” programs at universities
- 1977 – National Bureau of Economic Research program on productivity, innovation and entrepreneurship
- 1986 – AAAS survey of graduate education and careers in science, engineering and public policy

DIVERSE ACADEMIC S,T&I PROGRAMS

- Masters degree programs in S&T policy
  - Some based on an applied social science approach
  - Others based on broadening scope of engineering
  - Some focused on policy-making processes
  - Others focused on specific societal problems
- Doctoral programs in S&T policy (not common)
- Topical focus of dissertations in economics, political science, sociology, business, engineering, physics…
- Related but somewhat different fields
  - Science, technology and society (STS)
  - Systems engineering
  - Management of technology (MOT)
  - Entrepreneurship

ACADEMIC S,T&I POLICY FOCI

- Historical studies of institutions and events
- The politics of science, technology and innovation
- Program and policy evaluation and assessment
- Modeling the dynamics of scientific research and technological innovation
- Anticipating the consequences of alternative policy actions, including investments in new technologies
- Measuring the contributions of R&D investments to human welfare
- Normative and ethical issues in the conduct of R&D and innovation

OBSERVATIONS ON U.S. S,T&I POLICY INSTITUTIONS

- The U.S. S,T&I policy-making landscape is highly decentralized
- Many and diverse institutions in and out of government play significant roles in S,T&I policy-making
- Coordination of S,T&I policies is a constant challenge
- Decentralization, diversity and coordination problems are typical of every important arena of public policy making in the United States
- Driven by particular American traditions, including:
  - Separation of powers (horizontal and vertical)
  - Limits on governmental authorities
  - Constitutional right to “petition for redress of grievances”
  - Constitutional emphasis on “due process of law”
  - Systems of accountability

NATURE OF S,T&I POLICY-MAKING IN THE UNITED STATES

- Not a top-priority issue for senior policymakers
- Policymakers are dependent on experts but skeptical of their judgment and authority
- Open and participatory
- Ad-hoc and incremental
- Redundant, with checks and balances
- Characterized by rapid turn-over of senior policymakers in Congress and the Executive Branch

THE UNIQUE ROLE OF UNCERTAINTY IN S,T&I POLICY-MAKING

- The outcome of nearly every policy decision is uncertain
- But, decisions about S,T&I policy—especially about funding for R&D—are beset by a profound uncertainty regarding whether anything of significance will result and what it will be worth
- Research is designed to produce knowledge that we don't now have. The more ambitious the research project, the less we can know in advance about its outcomes.
- In fact, if we knew or could calculate the outcomes of a research project in advance, we would not need to do the project!

THE CORE PROBLEM OF S,T&I POLICY-MAKING IS TO DECIDE WHAT DO TO UNDER UNCERTAINTY

- Criteria for decision
  - Plausibility of the proposed project
    - Consistency with known science
    - Presentation of a coherent plan
    - Analogies to previous successful work
  - “Track record” of the investigators
  - Adequacy of the available resources
  - Anticipated value of the results, if obtained
- Mechanisms for decision
  - Merit review or peer review
  - All depend on expert judgment

DISSATISFACTION WITH THE TRADITIONAL DECISION PROCESS

- There has long been dissatisfaction with expert merit and peer review
  - Elitist
  - Privileges established investigators with records
  - Is not reliable—reviewer judgments are diverse
  - Is subject to prejudices of all sorts; e.g.,
    - Disciplinary
    - Schools of thought
    - Gender, race and ethnicity of investigators
    - Location of the project
- There ought to be a better way!

SOME "BETTER WAYS" TO DECIDE

- Proposed "reforms" of the expert merit review system
  - Support investigators or institutions, not projects
  - Require proposers to pay for part of the project, thereby winnowing out weak ideas
  - Give preferences to inexperienced or disadvantaged investigators
  - Use the DARPA "strong program manager" approach
  - Support portfolios of projects and/or redundant projects
  - Pay for results, not for effort (the "innovation prize" concept)
  - Select winning proposals by lottery
- All but the last two simply relocate the locus of judgmental merit review, but do not eliminate it
- So, we still need a "better way!"

THE PROMISE OF THE "SCIENCE OF SCIENCE & INNOVATION POLICY"

- If we only had a deep understanding of the relationship between the inputs to scientific and technical effort and the resulting outputs we could use that understanding to make decisions about what to do and what to support.
- That is, we need to understand "cause and effect" in the conduct of scientific and innovative activity
- We could call the understanding of the relationship of cause and effect "the science of science and innovation policy"

THE PITFALLS OF THE SCIENCE OF SCIENCE & INNOVATION POLICY

- We have no way to build models of processes whose outcomes are profoundly uncertain and particularistic
- Hypothesis: the explanatory power of models of the scientific discovery and innovation processes is limited by our understanding of the science itself. That is, if the science is strong enough to be able to predict the outcome of a new study, then we MIGHT be able to say something relatively secure about the likely outcome of the study, if we decide to do it. But, it is under these circumstances that we are least likely to want to fund the study.
- Where science won't enable us to predict the outcomes, we must still fall back on expert judgment

"RESEARCH ON RESEARCH" CERTAINLY HAS VALUE

- Even if we can't develop models to predict the outcomes of particular S,T&I investments, we can still do very useful work; e.g.,
- Empirical studies of factors that tend to influence aggregates of outcomes, such as:
  - Funding mechanisms
  - Investigator preparation, experience, attitudes, etc.
  - Size and disciplinary make-up of research teams
  - Incentives and rewards to researchers and institutions
  - The social and spatial organization of research organizations
  - Linkages of researchers to ultimate users of results

IN SUMMARY

- Description of the incredible complexity of the U.S. system for S,T&I policy-making
- Identification of key periods of change and reform
- Role of profound uncertainty in making important S,T&I policy decisions
- How that uncertainty has been addressed through judgmental merit review
- The promise and pitfalls of the “science of science and innovation policy”

THANK YOU!

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