



# The Science of Science & Innovation Policy Program

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# Overview

- Program Status
- Current Context
- Scientific Challenges and Approach
- Research and Findings
- What's New



# Program Status

- Background
  - program established in 2005, \$8-10 million/year
  - Explicitly interdisciplinary – economists, sociologists, psychologists, political scientists, anthropologists, computer scientists, domain scientists
  - Goals: Understanding (theories); measurement (models, metrics, datasets); community of practice (academics, practitioners)
- Current status
  - 100 awards made in three solicitations since 2007
  - Active engagement with Science of Science Policy Interagency group



# Current Context

- Investment in Science
  - American Recovery and Reinvestment Act
  - The National Academy of Sciences Speech, April 2009
- Openness and transparency
  - data.gov; open.gov; etc.
- Evidence based policy
  - Joint memo on “Science and Technology Priorities for the FY2012 Budget” :  
**Science of Science Policy** (is the only program listed by name – also in 2011)
- Accountability
  - ARRA Reporting Guidelines
  - Putting Performance First: Replacing PART with a new performance improvement and analysis framework





# Current Status

Agencies, in cooperation with OSTP and OMB, should develop and sustain datasets to better document Federal science, technology, and innovation investments and to make these data open to the public in accessible, useful formats. Agencies should develop and regularly update their data sharing policies for research performers and create incentives for sharing data publicly in interoperable formats to ensure maximum value, consistent with privacy, national security, and confidentiality concerns.

Agencies should develop outcome-oriented goals for their science, technology, and innovation activities, establish timelines for evaluating the performance of these activities, and target investments toward high-performing programs in their budget submissions. Agencies should support the development and use of “science of science policy” tools that can improve management of their R&D portfolios and better assess the impact of their science, technology, and innovation investments.

*FY12 Orszag-Holdren Memo, July 21 2010; reiterates August 4, 2009 memo;  
Science of Science Policy is only program mentioned by name*



# Current Status

- Interest across NSF: Co-funding with multiple Directorates and programs
  - SBE (Economics, IOS, Sociology, STS, DRMS, Science of Learning Centers)
  - OISE
  - MPS (Chem) – joint Dear Colleague Letter
  - CISE - joint Dear Colleague Letter
  - EH&R
  - ENGR
- Scientific Community
  - Very active listserv ([scisip@lists.nsf.gov](mailto:scisip@lists.nsf.gov))
  - SOSP website ([scienceofsciencepolicy.net](http://scienceofsciencepolicy.net))
- International
  - Brazil, Japan, Europe, Middle East



# Current Status: SOSP Linkages

- **Feedback from the 2008 SoSP Workshop: shaped interagency research priorities for SOSP:**
  - Developing a Data Infrastructure for Science and Innovation Policy; Modeling; Creating an Innovation Framework ; Informing and Assessing R&D Investments; Conducting Outreach to Underrepresented Populations
- **Feedback from 2009 SoSP Workshop: Best Practices in Research and Development Prioritization, Management, and Evaluation**
  - Building community of practice; Focus on link to research coming out of NSF SciSIP program
- **2010 SoSP Workshop: Metrics**
  - Economic Benefits (led by NSF); Social Benefits (led by NIH); Workforce Development (led by DOE); Technology Deployment (led by NIST).



# Research Challenges: Conceptual

- Production function framework great for aggregate impacts
  - source of result that more than 3/4 of post-1995 increase in productivity growth can be traced to science investments
- At micro level not so clear
  - Discovery – innovation highly nonlinear
  - Unit of analysis
  - Input measures
  - Dependent on organizational systems
- Outcome measures
  - Scientific; Economic; Social
- Fundamental challenge: Establishing counterfactuals
  - Selection bias
  - Random assignment not an option



# Research Challenges: Empirical

- Science Policy
  - Data Infrastructure
    - Science agencies have proposal and award administration systems => no systematic frame of individuals “touched” by science funding
    - Heterogeneous sources of outcomes
  - Scientific Attribution
    - Name disambiguation
    - Global enterprise
- Innovation Policy
  - Data Infrastructure
    - Innovation within organizations
  - Scientific Frame
  - Confidentiality
    - Getting inside firms
    - Sharing data (necessary for generalizability and replicability)
    - Multinationals



# SciSIP research approach

- Qualitative/ Case Studies
  - Describe complex processes
  - Formulate hypotheses
- Quantitative and Statistical Methods
  - Build new linked datasets on researchers, grants, patents, publications, citations and firms and workers
  - Develop new tools for describing complex outcomes
  - Develop new models to tease out marginal impact of funding
- Computational approaches
  - Cyberinfrastructure => vast amounts of heterogeneous data on individuals
  - Visual analytics



# Examples of Research

## Economics

- Azoulay/Graff-Zivin Superstar Scientists
- Hobijn/Comin Technology Adoption and Diffusion

## Sociology

- Woody Powell and others Networks
- Zucker/Darby Large scale data infrastructure

## Psychology

- Schunn Analysis of team interactions
- Gero Situated cognition views of innovation

## Visualization

- Visual Analytics
- Mapping



# Research Findings



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### Highlighted Researcher Comin, Diego

Newer technologies have been adopted faster than older ones. This acceleration in technology adoption has taken place over the two centuries covered by our data, and therefore started long before the digital revolution and the post-war globalization process...  
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### About SciSIP

The Science of Science & Innovation Policy (SciSIP) program was established at NSF in 2005 in response to a call from Dr. John Marburger III for a "specialist scholarly community" to study the science of science policy. The program has three major goals: advancing evidence based science and innovation policy decision making; building a scientific community to study science and innovation policy and leveraging the experience of other countries. A recent *Science* article highlights some of the issues addressed by SciSIP researchers.

Read more

### Recent SciSIP Awards



- RAPID: The Impact of Stimulus Spending on...
- National Survey of College Graduates (NSCG...
- Redesign of the Survey of Research and Development...
- Economic Stimulus and Innovation Capacity...
- MOD: Transmission of Tacit Skills in East...

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### Recent Research Findings



- The Twitter Effect: Why Sharing Knowledge Can Hurt...
- Predictors of success in design
- Methods for exploring multiple design alternatives
- Visits to physical sites
- Foreign student impact on publications

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2007 2008 2009 ARRA

Citation cognition **collaboration**

**collaborative research**

globalization impact

**innovation** intellectual property

rights invisible college models patent

patent grants performance curve **policy**



# Research Findings: Qualitative Research

- Walshok: Studying boundary spanning networks in Philadelphia, St. Louis, and San Diego.
  - “Input provided to National Academy of Sciences, the Brookings Institution, and the Office of Domestic Policy in the White House because of special focus given to the cultural and social dynamics issues, which the NSF grant enables us to pursue in a much more systematic manner.”
- Zak Taylor: Study of how federalism affects health care finance, health care reform, and health policy innovation.
  - The case studies show that overall decentralization, rather than federalism alone, aids technological progress by allowing its supporters to “venue shop” around political resistance.
  - Decentralization also makes the state less vulnerable to capture by status-quo interest groups. Moreover, political decentralization may have a positive effect on technological diffusion, but a far weaker effect on innovation. Thus, prior research that conflates these two effects should be revisited.

Federalism and Technological Change in Blood Products

Journal of Health Politics, Policy and Law, Vol. 34, No. 6, December 2009



# What's New: STAR METRICS

## Science and Technology for America's Reinvestment: Measuring the Effects of Research on Innovation, Competitiveness and Science



# STAR METRICS in Brief

- Data for effective understanding of U.S. Science R&D investments & the innovation process
- Inter-agency initiative NSF, NIH and White House/OSTP/OMB
- Partnership between federal agencies and universities (the Federal Demonstration Partnership)
- Rich future opportunities for research about scientific enterprise
  - Scientific interactions/networks
  - Impact of funding
  - Science Measurement
  - Interdisciplinarity
  - Emerging fields



# Core Approach: Empirical Framework

- Start with correct unit of analysis
  - Science is done by scientists. Need to identify universe of individuals funded by federal agencies (PI, co-PI, RAs, graduate students etc.)
- Include full description of input measures
- Include full description of outcomes (economic, scientific and social)
- Combine inputs and outcomes
- Create appropriate metrics that capture all dimensions of science investments



# Phase I

- Uniform, auditable and standardized measures of the initial impact of ARRA and base budget science spending on employment
  - Partnership with Federal Demonstration Partnership
  - Initial feasibility pilot with seven institutions: low burden, good quality
  - Briefed: VP's Office; OMB, CEA and science agencies
  - MOU with NIH, NSF and OSTP finalized May, 2010
  - Over 100 institutions have expressed interest in participation



## Phase II

- Capture broad variety of outcomes:
  - scientific, economic, social and workforce
- Data
  - platform to combine science inputs with outputs and outcomes from disconnected but already existing sources (publications, patents, grants)
  - Interaction with others in this arena, such as the Brazilian Lattes Platform
- Collaboration in developing common empirical infrastructure to answer stakeholder questions



# More Information

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Note that next solicitation due date is Sept 9, 2010

[http://www.nsf.gov/funding/pgm\\_summ.jsp?pims\\_id=501084&org=SBE](http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=501084&org=SBE)

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