The Science of Science Policy:
A Federal Research Roadmap

Report on The Science of Science Policy To The
Subcommittee on Social, Behavioral and Economic Sciences
Committee on Science National Science and Technology Council
Office of Science and Technology Policy

November 2008
The National Imperative

It is imperative to advance the scientific basis of science policy so that limited Federal resources are invested wisely.

- Rigorous Tools, Methods, Data For Analysis Must be Developed
  - Given the importance of federal science investments, it is imperative that science policy decision makers have at their disposal the most rigorous tools, methods and data that will enable them to develop sound investment strategies.
- Federal Government’s Investment Strategy Must be Effective and Meet National Needs
History of the Interagency Task Group (ITG)

The ITG Completed 4 Tasks:

- Literature Review & Synthesis
- Questionnaire to Federal S&T Agencies
- Review of Data Issues
- Roadmap
The Road to the Roadmap

- Literature Review, Questionnaire, Data Investigations, and NSF’s SCISIP Effort Provided the Data and Analysis
- Presentations at AAAS, AEA, WREN and Elsewhere Provided Context and Critiques
- Roadmap is Based on Three Key Themes that Emerged Over and Over Again During ITG Discussions and Analysis:
  - Understanding Science and Innovation
  - Investing in the Innovation Process
  - Using the Science of Science Policy to Address National Priorities
SoSP Roadmap

• Results

  – Two years of effort by 17 Federal Agencies
  – Has undergone an extensive interagency concurrence process
  – This Workshop is the first opportunity for the public to provide comments and advice

Primary Conclusion: “Expert judgment” remains the best available decision support tool for science policy makers, but a nascent community of practice is emerging in the science policy arena that holds enormous potential to provide rigorous and quantitative decision support tools in the near future. Support and development of this emerging community of practice can provide the Federal government with these much-needed decision tools.
Structure of The Roadmap

**The National Imperative**

**Themes**

**Theme 1:** Understanding Science and Innovation

**Theme 2:** Investing in Science and Innovation

**Theme 3:** Using the Science of Science Policy to Address National Priorities

**Science Questions**

1. What Are The Behavioral Foundations Of Innovation?
2. What Explains Technology Development, Adoption And Diffusion?
3. How And Why Do Communities Of Science And Innovation Form And Evolve?
4. What Is The Value Of The Nation’s Public Investment In Science?
5. Is It Possible To “Predict Discovery”?

1. Is It Possible To Describe The Impact Of Discovery On Innovation?
2. What Are The Determinants Of Investment Effectiveness?
3. What Impact Does Science Have On Innovation And Competitiveness?
4. How Competitive Is The U.S. Scientific Workforce?
5. What Is The Relative Importance Of Different Policy Instruments In Science Policy?

**Findings**

**Recommendations**
Theme 1: Understanding Science and Innovation

- What are the behavioral micro-foundations of innovation?
- What explains technology adoption and diffusion?
- How and why do communities of innovation form and evolve?
Theme 1: Key Findings

- Well developed body of social science knowledge: not applied to the study of science and innovation
- Study of technology adoption and diffusion largely confined to academia. Stronger links between academic and practitioner community needed
- Although each agency has its own community of practice, the collection and analysis of data about the scientists and the communities supported by those Federal agencies is heterogeneous and unsystematic. There is little analysis of the way in which the practice of science has become distributed across space, time, and disciplines as a result of computational advances. As a result, there is little understanding of how scientific communities respond to changes in funding within and across disciplines and countries, or to changes in program focus.
Theme 2: Investing in Science and Innovation

• What is the value of publicly funded knowledge?
• Is it possible to predict discovery?
• Is it possible to describe the impact of discovery?
• What are the determinants of investment effectiveness?
Theme 2: Key Findings

- Although determining the value of publicly funded knowledge is the critical outcome measure for Federal scientific agencies, the analysis is largely agency specific.
- Agencies are using very different approaches and tools designed to develop scenarios that anticipate the effects of discovery and innovation.
- Agencies are using a wide variety of approaches to describe the impact of discovery.
- Approaches that are used by Federal agencies to determine program effectiveness span the spectrum from mature to those in the pilot stage, but there are many open research questions.
Theme 3:
Using the Science of Science Policy to Address National Priorities

• What impact does science have on innovation and competitiveness?
• How competitive is the US scientific workforce?
• What is the relative importance of policy instruments in science policy?
Theme 3: Key Findings

• The ITG finds that there is a real opportunity to develop new tools and data sets that could be used to quantify the impact that the scientific enterprise has had on innovation and competitiveness.

• Many critical questions about the quality and global nature of the STEM workforce cannot be answered due to a lack of data. While the models and tools exist to study flows of workers within and across disciplines and nations, lack of data means that the science policy community cannot answer important questions about the scientific enterprise.

• There has been very little investment in the U.S. and in other countries in understanding the relative importance of policy instruments. While the models and tools exist to examine the effectiveness of different approaches, there are gaps in the analytical structure, the data infrastructure, and a way of conveying information to policymakers.
Recommendations

• Create an interagency research program to address the 10 scientific challenges
  – Invest in research data infrastructure
  – Invest in models, tools and metrics using ITG Evaluation Template
• Develop a National Innovation Framework
  – Explain benefits and effectiveness of S&T investments
  – Provide scenarios and options
• Create interagency entity to develop and sustain science policy analysis efforts
  – Synthesize and provide guide to current policy analysis practice
  – Nurture the nascent community of practice consisting of researchers and practitioners
The ITG also examined tools, methods and data that are either in use or could be used to do rigorous analysis. They were analyzed using two criteria:

- **Potential Value**
  - Relevance to Vision
  - Breadth of Use
  - Scientific Rigor

- **Potential Cost**
  - Maturity
  - Resource Intensity
  - Availability of Inputs

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<th>Potential Cost</th>
<th>Main Missing Element</th>
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Purpose of the Workshop

- Comments on the Roadmap
- Begin Implementation of the Roadmap
- Promote the Nascent Community of Practice
Purpose of Pre-Assessment Activities

• Understand the Contents of the Roadmap
• Begin Thinking About Implementation Issues, Particularly in Relationship to Your Current Role in the Science of Science Policy Community
• Identify Members of the Science of Science Policy Community
Structure and Purpose of Breakout Groups

The Breakout Groups have been designed to promote critical thinking and discussion:

– Development of Electronic Decision Support Tools
– Assignments to the Breakout Groups
– Paper Copies

• Facilitators and Dialog

• Results of the Breakout Sessions
  – Posting Next Day
Theme 1

Tool Question 1: High Level input on Questions, Findings and Recommendations

This tool is intended to get your input on the relative importance of the science questions identified by the ITG as well as invite alternative suggestions. We have allocated 10 minutes to collect your input on this topic, to be followed by 10 minutes of group discussion.

Please record your view on the importance of the following questions for understanding science and innovation. Then also rank the priority from 1 to 3.

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<th>Importance</th>
<th>Priority Rank (1-3, 1 being highest)</th>
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<td>High</td>
<td>Med</td>
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Question 1: What are the behavioral micro-foundations of innovation?

Question 2: What explains technology adoption and diffusion?

Question 3: How and why do communities of

Do you have alternative suggestions for scientific questions?

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Save & keep me in this screen
Theme 4

Workshop Decision Tool: Theme 4:
Identifying Data Needs for Implementing SoSP

We have developed five sets of exercises within this tool to get input from workshop participants. These results will be used to help guide the next steps and recommendations of the SOSP Interagency Group (ITG). Of course, your input will be kept confidential – only summary statistics will be produced. You will have an opportunity to fill the tool out now as well as to log on to update your responses online later.

The five sets of exercises cover the following topics the ITG has identified as being necessary to establish an empirical platform for implementing the science of science policy.

- Tool Question 1: Measuring and tracking federal funding of science
- Tool Question 2: Measuring and tracking the scientific workforce
- Tool Question 3: Measuring and tracking scientific outcomes
- Tool Question 4: Measuring competitiveness
- Tool Question 5: Analytical Access by researchers and federal government agencies

Each section begins by identifying broad research questions, then possible ways in which the data infrastructure should be established (e.g. surveys, administrative records or web-scraping). Each section concludes by identifying possible data elements that could be collected and then asks for your open-ended input.
Conclusion: Where We Are Headed

• WIKI will be Promoted
  – Support A Community of Practice
• Workshop Results Implemented
  – Roadmap Modification
  – Development of Roadmap Implementation
  – Plan for the ITG
• Search For Low Hanging Fruit
  – Tools, methods and data that could support the National Imperative
• Create Tools, Methods and Data to Support Emerging National Imperatives

“Invest $150 billion over the next ten years to enable American engineers, scientists and entrepreneurs to advance the next generation of biofuels and fuel infrastructure, accelerate the commercialization of plug-in hybrids, promote development of commercial-scale renewable energy, and begin the transition to a new digital electricity grid. This investment will transform the economy and create 5 million new jobs.”
http://change.gov/agenda/technology_agenda/