National Science Foundation
Industry/University Cooperative Research Centers
Annual Meeting

Emerging Innovation-Focused Science & Technology Policy

Robert S. Boege
ASTRA Executive Director

www.usinnovation.org and www.aboutastra.org

January 14, 2010
Today’s Topics

Your Materials (Appendix and hand outs)

- A Bit About ASTRA (See handout)
- ASTRA’s Innovation Vital Signs Project (Case History)
- ASTRA’s Innovation Index®

Key Policy Issues:

- Emerging Obama Innovation Agenda — Agency Highlights
- S&T Budget Situation — Congressional Perspective
- The 2011 Cliff — “Bump-up” or Sustainable Increases?
- The “3% Solution” — How Realistic?
- Is “Industry” Adequately Involved — or better, Who is Not at the Table, and Why Not?
- Do we have the right Tools to Inform Policy Decisions?

Innovation Policy Landscape, Players, and Resources
Framework: Coherence in Federal Innovation Policy

- "Innovation" as a Concept — Art, Science or both?
- Implicit Tension in Defining Role of Government
- Complex Interplay between Administration & Congress ($$$)
- Flawed Government Metrics are Being Worked on
- Why Does Measuring Innovation Seem so Difficult?
- Federal Innovation Policy is under Development and Evolving Rapidly — President’s Innovation Agenda, OSTP, DOC, NSF, many Agencies
Policy Environment:

- Obama Innovation Policy Agenda is Evolving…
- S&T Budget Situation — Congressional Perspective
- The 2011 Cliff — “Bump-up” or Sustainable Increases?
- The “3% Solution” — How Realistic? Who Pays?
### Key COMPETES ACT Research Agencies

<table>
<thead>
<tr>
<th>Agency</th>
<th>FY 08</th>
<th>FY 09</th>
<th>ARRA</th>
<th>FY 10</th>
<th>% Increase from FY 09 levels in PBR</th>
<th>President's Budget Request (PBR) (millions)</th>
<th>House (millions)</th>
<th>% Change from 09</th>
<th>Senate (millions)</th>
<th>% Change from 09</th>
<th>Final Confederation (millions)</th>
<th>% Change from 09</th>
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<tbody>
<tr>
<td>National Science Foundation R&amp;D</td>
<td>$6,084</td>
<td>$6,490</td>
<td>$3,002</td>
<td>$7,045</td>
<td>8.6%</td>
<td>$6,937</td>
<td>5.9%</td>
<td>$6,917</td>
<td>6.6%</td>
<td>$6,927</td>
<td>6.7%</td>
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</tr>
<tr>
<td>Dept. of Energy Office of Science R&amp;D</td>
<td>$3,959</td>
<td>$4,773</td>
<td>$1,600</td>
<td>$4,942</td>
<td>3.5%</td>
<td>$4,944</td>
<td>3.6%</td>
<td>$4,899</td>
<td>2.6%</td>
<td>$4,904</td>
<td>2.7%</td>
<td></td>
</tr>
<tr>
<td>National Inst. of Stand. &amp; Tech. R&amp;D</td>
<td>$549</td>
<td>$550</td>
<td>$580</td>
<td>$637</td>
<td>15.8%</td>
<td>$575</td>
<td>4.5%</td>
<td>$625</td>
<td>13.6%</td>
<td>$603</td>
<td>9.6%</td>
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<td><strong>TOTAL COMPETES Act Agencies</strong></td>
<td>$10,592</td>
<td>$11,813</td>
<td>$5,182</td>
<td>$12,624</td>
<td>7.4%</td>
<td>$12,456</td>
<td>5.4%</td>
<td>$12,441</td>
<td>5.3%</td>
<td>$12,434</td>
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### Other ASTRAPriority Research Agencies

<table>
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<tr>
<th>Agency</th>
<th>FY 08</th>
<th>FY 09</th>
<th>ARRA</th>
<th>FY 10</th>
<th>% Increase from FY 09 levels in PBR</th>
<th>President's Budget Request (PBR) (millions)</th>
<th>House (millions)</th>
<th>% Change from 09</th>
<th>Senate (millions)</th>
<th>% Change from 09</th>
<th>Final Confederation (millions)</th>
<th>% Change from 09</th>
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<tbody>
<tr>
<td>DOD  Defense Basic Research 6.1 Spending Only</td>
<td>NA</td>
<td>$1,822</td>
<td>NA</td>
<td>$1,798</td>
<td>-1.3%</td>
<td>$1,931</td>
<td>5.0%</td>
<td>$1,785</td>
<td>-2.0%</td>
<td>$1,882</td>
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<tr>
<td>DOD S&amp;T Total S&amp;T ( 6.1-6.3+Medical )</td>
<td>NA</td>
<td>$14,357</td>
<td>NA</td>
<td>$12,263</td>
<td>-14.6%</td>
<td>$14,433</td>
<td>0.5%</td>
<td>$13,317</td>
<td>-7.2%</td>
<td>$14,801</td>
<td>3.1%</td>
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<tr>
<td>Dept. Homeland Security (DHS) Total R&amp;D</td>
<td>NA</td>
<td>$1,095</td>
<td>NA</td>
<td>$1,125</td>
<td>2.6%</td>
<td>$1,124</td>
<td>2.6%</td>
<td>$1,162</td>
<td>6.0%</td>
<td>$1,166</td>
<td>6.4%</td>
<td></td>
</tr>
<tr>
<td>Nat. Aeronaut. &amp; Space Admin. Total R&amp;D</td>
<td>NA</td>
<td>$10,547</td>
<td>NA</td>
<td>$11,194</td>
<td>6.1%</td>
<td>$10,586</td>
<td>0.4%</td>
<td>$11,197</td>
<td>6.2%</td>
<td>$11,066</td>
<td>4.9%</td>
<td></td>
</tr>
<tr>
<td>Nat. Institutes of Health Total R&amp;D</td>
<td>NA</td>
<td>$29,668</td>
<td>NA</td>
<td>$30,118</td>
<td>0.8%</td>
<td>$30,605</td>
<td>2.5%</td>
<td>$30,118</td>
<td>0.8%</td>
<td>$30,361</td>
<td>1.7%</td>
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<td><strong>TOTAL ASTRA Priority Agencies</strong></td>
<td>NA</td>
<td>$57,650</td>
<td>NA</td>
<td>$56,498</td>
<td>-6.3%</td>
<td>$58,679</td>
<td>11.9%</td>
<td>$57,579</td>
<td>-0.2%</td>
<td>$59,276</td>
<td>2.7%</td>
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For more information, including the ability to download PDF files of specific agency budgets, see also [http://thomas.loc.gov/home/approp/app10.html](http://thomas.loc.gov/home/approp/app10.html)
A New “Innovation World” is Emerging...

- First Year of Obama Administration
- Serious Discussion / Debate over Innovation Policy
- Administration Commitment to Innovation Agenda
- Congressional Commitment to Innovation Agenda (?)
- Agency Efforts Proliferating — Ongoing “Experiments”
  - OSTP Role & NFI Concepts
  - SciSIP at NSF, Other NSF engagement w. U/I
  - New Office of Innovation & Entrepreneurship at U.S. Dept. of Commerce (also TIP, MEP)
  - DOE “Hubs” — 3 Funded 12/09
  - SBA, SBIR Component
  - DOD, DARPA, NIH
- Other Cross-Agency Activities
Innovation Policy Landscape, Players and Resources

Presidents Council of Advisors on Science & Technology (PCAST)

PCAST updates on specific Agency Progress from Jan. 7, 2010
Innovation Policy Landscape, Players and Resources

- Great attention to the topic, blossoming of “expertise”
- Less Attention in Congress, therefore adequate funding is always the issue
- What is the Number? 3% of GDP? Who pays?
- Why not Industrial and Innovation Policies?
- Can a National Innovation Foundation Work?
NSF Example:

Improving Alignment Between Continuum of Academic Research and Broader Private Sector Needs
Key Questions:

1 - Are enough real “innovators” involved in the development of innovation policies and/or the many new outreach efforts?

2 - Can government policy experts, statisticians and most economists detect innovation in the data they process / analyze? Lack of a rigorous “innovation” theoretical structure since few incentives exist to create “innovation” economics. Compare w. monetary policy, etc.

3 - Is there a normative model of innovation that works everywhere, and if not, what approaches should be taken?

4 - Can proprietary & confidentiality concerns be addressed?

5 – How to engage small business and individual entrepreneurs without overwhelming them?

6 - “As compared to what? i.e., What are the ultimate goals?”
Key Questions:

1 – Does Congress “get” What the Administration is Trying to do?

2 - Will Cloud Computing become the “Atom Smasher” of Innovation Measurement and Drive Policy?

3 – What are we learning from other countries’ experience? e.g. Biopolis, KAUST, Gwangju, Tekes, etc.

4 - Why do Geography and Connectedness play such a large role in Innovation and how can Virtual Models level the Geographic Advantage?

5 - What unknown dynamics are at play in social networks that affect Innovation?

6 – Given “globalization” dynamics, what changes are needed in federal innovation policies to foster U.S.-based competitiveness and national interests? This means U.S. jobs, U.S. IP, U.S. economy.
Appendix
Defining “Innovation”

- Innovation is “the commercial or industrial application of something new—a new product, process or method of production; a new market or sources of supply; a new form of commercial business or financial organization.” (Schumpeter, *Theory of Economic Development*)
- Innovation is the intersection of invention and insight, leading to the creation of social and economic value. (Innovate America, *National Innovation Initiative Report*, Council on Competitiveness, 2004)
- Innovation—the blend of invention, insight and entrepreneurship that launches growth industries, generates new value and creates high value jobs. (Ahead of the Curve, The Business Council of New York State, Inc. 2006)
- Innovation covers a wide range of activities to improve firm performance, including the implementation of a new or significantly improved product, service, distribution process, manufacturing process, marketing method or organizational method. (European Commission, *Innobarometer 2004*, November 2004)
- An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations. Innovation activities are all scientific, technological, organizational, financial and commercial steps which actually, or are intended to, lead to the implementation of innovations. (*Oslo Manual*, 3rd Edition, OECD).
- Innovation success is the degree to which value is created for customers through enterprises that transform new knowledge and technologies into profitable products and services for national and global markets. A high rate of innovation in turn contributes to more market creation, economic growth, job creation, wealth and a higher standard of living. (21st Century Working Group, *National Innovation Initiative*, 2004)
Key U.S. Innovation Elements: What are they and how do they interact?

U.S. innovation indicators tend to focus on measurable data sets which have been readily collected by governmental and private entities for many years. While policy makers have traditionally looked at patent production, R&D spending, science & engineering degrees conferred and scientific article citation, the U.S. “innovation ecosystem” is a more complex series of interrelated phenomena. ASTRA has created a **Periodic Table of Innovation Elements** suggesting how key innovation elements interact and seem to affect one another. The more recognized innovation elements depicted below are organized according to eight “element” groups: **Inputs, Process, Outputs, Impact, Macro-Economy, Policy, Infrastructure** and **Mindset**. The key innovation elements selected by ASTRA are organized and color-coded depending upon their primary role.
**IVS: What We Think We Learned**

### Periodic Table of Innovation Elements

<table>
<thead>
<tr>
<th>R&amp;D Expenditures</th>
<th>R&amp;D Capital</th>
<th>Expenditures</th>
<th>Impact</th>
<th>Impact</th>
<th>MacroEcon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patents</td>
<td>Gross Capital Formation</td>
<td># Innovative Enterprise</td>
<td>Birth Rate New Enterprises</td>
<td>Average Hourly Earnings</td>
<td></td>
</tr>
<tr>
<td>Talent</td>
<td>Capital</td>
<td>Process</td>
<td>Outputs</td>
<td>Impact</td>
<td>MacroEcon</td>
</tr>
<tr>
<td># Researchers</td>
<td>ICT Investment</td>
<td>SAT Employment</td>
<td>Net Change Enterprises</td>
<td>Gross Private Investment</td>
<td></td>
</tr>
<tr>
<td>No. with Higher Education</td>
<td>Initial Public Offerings</td>
<td>Broadband Penetration</td>
<td>SMEs with Cooperation Arrangements</td>
<td># Business Incubators</td>
<td></td>
</tr>
<tr>
<td>Verbal SAT</td>
<td>Angel Networks</td>
<td>Computer Use per Capita</td>
<td>Inter'l Alliances</td>
<td># Internet Domains</td>
<td></td>
</tr>
<tr>
<td>Math SAT</td>
<td>SBIR Funding</td>
<td>Internet Use by Business</td>
<td>Federal Lab CRADAs</td>
<td>Shareholder Value</td>
<td></td>
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<tr>
<td>Pop with Life Long Learning</td>
<td>Investment Risk</td>
<td>Broadband Costs</td>
<td>University Spinouts</td>
<td>Customer Satisfaction</td>
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### Innovation Element Groups (Families)*

<table>
<thead>
<tr>
<th>Innovation Elements</th>
<th>Policy</th>
<th>Infrastructure</th>
<th>Mindset</th>
<th>Impact</th>
<th>MacroEcon</th>
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<tbody>
<tr>
<td>Inputs</td>
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<tr>
<td>Process</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Outputs</td>
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<tr>
<td>Macro-Economy</td>
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<tr>
<td>Policy</td>
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<td></td>
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<tr>
<td>Infrastructure</td>
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<td>Mindset</td>
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<tr>
<td>Future</td>
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<tr>
<td>New Metrics</td>
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</table>

*The periodic table format serves as a vehicle for presenting innovation indicators in a structured context. A sampling of available indicators has been provided in this table to stimulate thinking and discussion.*
IVS: What We Think We Learned

ASTRA’s Innovation Vital Signs Project Findings

• Nomenclature and Taxonomy Possible

• Private Sector Data Availability Problematic in U.S.

• Dashboard, Other Data Visualization Possible

• More Research and Tweaking needed

• See IVS Final Report at www.usinnovation.org
Innovation Mapping — What Would it Look Like?

Sectoral Approach by CCR

Innovation Mapping — What Would it Look Like?

Geospatial Approach by Indiana University

Mapping Indiana’s Intellectual Space

Geospatial/Network Analysis
2001-2006, BioMed, IN Scope
Academic-Industry collaborations and knowledge diffusion
Interplay of industry and academia
Innovation Mapping — What Would it Look Like?

Temporal/Network Analysis by Indiana University et al

Mapping the Evolution of Co-Authorship Networks

Evolving co-author networks and author impact

Legend:
- Node Color Code:
  - 0 - 5: Red
  - 6 - 10: Orange
  - 11 - 15: Yellow
  - 16 - 20: Green
  - 21 - 25: Blue
- Edge Color Code:
  - 0 - 9: Red
  - 10 - 19: Orange
  - 20 - 29: Yellow
  - 30 - 39: Green
  - 40 - 49: Blue
  - 50 - 59: Black

Temporal/Network Analysis
1986-2004, US, InfoVis Scope
Evolving co-author networks and author impact