Science, Technology and Innovation: Imperatives for National and Economic Security

Co-hosted by the Center for Strategic and International Studies and the Department of Energy's Office of Health, Safety and Security

July 28, 2010

John J. Hamre, President and CEO,
Center for Strategic and International Studies

The mission of any government is to ensure the safety of its people and the prosperity of its society. The conversation taking place today is at the core of this thought.

The U.S. won the Cold War not only on the capability of military power but also the vitality of our society and economy. The U.S. countered a quantitative superiority with qualitative superiority. We invested in new technologies (with military use) and put in place a regulatory structure to keep emerging technologies from falling into the hands of our opponents.

Now we appear to have an inversion – limiting our industry from working with other nations is not working for our economy.

Becoming active investors in our future through math, science, technology, and engineering should be a priority. Jumpstarting our technology development through intentional investment to bring the creativity and vitality.

Keynote Panel

Panelists:
Steven E. Koonin
Under Secretary for Science
U.S. Department of Energy

James Short
Deputy Director
Center for Energetic Concepts Development
University of Maryland

Moderated by
Adriane Lapointe, Visiting Fellow, CSIS

Steven E. Koonin

There are 4 core missions at the Department of Energy which correlate to today's topic:

1. **Catalyze the transformation of the nation's energy system** in response to reduce our dependence on imported oil and reduce greenhouse gases. The Department facilitates the transformation through the technologies we develop, the scientific understand we provide, and our impact on the private sector (loan guarantees, grants, etc.). A challenging mission in comparison to the funding available via private industry.
2. **Maintain nuclear security** in several ways – manage a shrinking stockpile, understand the weapons as they age, maintain an expertise that the US has built up over 60 year in weapons related science and apply that expertise to nonproliferation, and the mission of securing nuclear materials around the globe.
3. **Contribute to US competititiveness** through better jobs that are the fruit of innovation and scientific discoveries.
4. **Steward of basic research** – DOE is the largest funder of physical sciences in the US government. Enhancing and stewardship of basic research is an underpinning to the other three missions.

Keynote Panel

Steven E. Koonin

DOE’s assets include 17 national laboratories, capable of basic and applied science and missions that are of a scale and complexity that cannot be undertaken in industry or academia alone.

The Department’s laboratory research differs from academic and industrial research in that DOE research is done in one or a few mission areas, has a longer term horizon, and the profit motivation is not a contributing factor.

Keynote Panel

James Short

In Tom Friedman's book, The World is Flat, there is a chapter entitled "The Quiet Crisis" - in which the idea is presented that the US could fall behind other countries in scientific discovery and innovation and therefore fall behind in economic development. This seems a distinct possibility due, in part, to a lack of research funds and the need for qualified and trained personnel to conduct the research.

Similarities have been drawn between this and the post-Sputnik era of increased funding and emphasis on achievement in science and technology. Strategies such as the national defense education act were highly successful in developing a generation of researchers. The economic benefit was impressive, the scientific and technology results were equally impressive. Today, we should look at the energy crisis and respond as we did with Sputnik.

Imagine the possibilities for achievement if this same emphasis of funding and personnel were applied now to our current issues – such as our need for energy efficiency. This is not only a consumer-driven need but also one that profoundly impacts our military and therefore, our national security.

Keynote Panel

James Short

Basic research from an agency perspective – for example, National Science Foundation (NSF) basic research and Department of Defense (DoD) basic research.

- DoD is with a mission in mind (use-inspired research), NSF does curiosity-driven research. Both are in search of new knowledge and fundamentally the same.
- Basic research creates new foundations and new technologies. A consequence is that we can solve problems today we couldn't solve yesterday, we just can't say when we will find the solution and what will take us to the solution.
- Basic research at DoD – provide scientific leadership to fulfill mission (equip military forces, defer war and protect our nation), attract the best scientists and engineers to do this basic research, seek to ensure a diverse basic research portfolio, foster connections amongst scientists and DoD users (collaborative science is effective science), and maximize the innovation potential of Defense research (design our policy for research efficiency and competitiveness - streamlined policy across agencies).
- The federal government spends approximately $30B annually on basic research, 50% of that on health (primarily NIH), then NSF, DOE, and DOD (6%) – half of DoD's going to university research, ¼ goes to labs (funded at DOE, NASA, DOE, and other national agencies).

Keynote Panel

James Short

Basic research milestones for defense use (and in many cases for the general public's benefit):

- 1940's - nuclear weapons and jet engines.
- 1950s - ICBMs and digital computer
- 1960s - airborne surveillance and satellite communications
- 1970s - STEALTH and communication networks (Internet precursor)
- 1980s - night vision and GPS
- 1990s - precision munitions and web protocols
- 2000s - unmanned vehicles

Panel 1 – America's Technology Competitiveness – the Vital Role of the Federal Laboratories

Panelists:
Katherine Ku
Director, Office of Technology Licensing
Stanford University

Joachim Kohn
Board of Governors Professor of Chemistry and Chemical Biology
Rutgers, the State University of New Jersey

John A. Montgomery
Director of Research
Naval Research Laboratory

Steve Rottler
Chief Technology Officer
Vice President of Science and Technology
Sandia National Laboratories

Moderated by
Gerald Epstein
Director, Center for Science,
Technology and Security Policy
American Association for the Advancement of Science

Gerald Epstein

This panel discussion centers on the vital role federal laboratories play in the nation's competitiveness.

While not a new topic, people look to the federal laboratories for innovations in science and technology.

How far should the government go to address commercialization in the business sector?

Panel 1 – America's Technology Competitiveness

Katherine Ku

At Stanford, we believe that we are training the next generation of researchers and scientists and this is an incredible responsibility
.
Stanford University's technology transfer program is seen as a success story in university tech transfer programs. Why does this program work so well? Especially when the area of technology transfer is quite challenging – you're asking companies to make investment in technologies that may or may not be successful for them in the commercial marketplace.

One reason for this organization's success may be that with a university –based tech transfer program such as ours there are lots of perspectives – sometimes there is a technology no one wants (yet) and we feel like caretakers of the government's funding and that we have a sense of responsibility that the technology will be transferred to someone deserving. We bridge the academic and business mindset by being, as much as possible, businesslike and adept, nurturing this embryonic idea and bringing it to fruition, while being mindful of the cost.

Another reason may be that the staff is composed of scientists and business people.

The Biotech industry understands tech transfer – researchers look several years out in their perspective. Physical sciences, not so much generally they will be more inclined to non-exclusive licensing, and energy environmental industry is a cross between the two because they like exclusivity but are a different industry with different markets.

Panel 1 – America's Technology Competitiveness

Katherine Ku

From our perspective, if we don't transfer the technology because of a dollar issue then we haven't done what we are supposed to do.

Some facts regarding our technology transfer program. We have approximately 450 inventions annually, $1.3B over 40 years. Our program is self supporting, only a handful of universities can say that, we have $8M spent on patents, Over our 40-year history, we average 80-120 deals annually. Our philosophy is that a tech transfer program can't pick the winners and losers, just getting the technology out there; let the market determine the winners and losers.

Panel 1 – America's Technology Competitiveness

Joachim Kohn

Endemic issues common to different laboratory environments

- Coordinating funding streams
- Defining technology readiness
- Dedicating moneys for these different research areas - basic, clinical trials, etc.

Panel 1 – America’s Technology Competitiveness

Joachim Kohn

Looking at the model used by the Armed Forces Institute of Regenerative Medicine (AFIRM) program – realized benefits:

- Aligning activities with the needs of the warfighter.
- Different perspective than Stanford and laboratories have noted – where you create something and wonder where and how it is going to be used – the AFIRM model targets research to a goal.
- Reward collaboration and punish (non-fruitful) competition. Basic research whittled down to applied, as the project numbers go down the funding goes up.
- Synergy – lots of institutions, industry, and the Army as a team. Coordinated structure has driven the organization to streamline the process to clinical trials. This can be adapted to other organizations.

Panel 1 – America's Technology Competitiveness

John A. Montgomery

- DoD labs have not only contributed to the military but also to the public. Global positioning satellite technology is as a result of DoD research, the first patent for this technology was awarded in 1977.

- Most defense R&D is done in academia and industry – because they can produce and deploy in large numbers. This is a well balanced partnership. At NRL, 70% of its funding is for science and technology.

Panel 1 – America’s Technology Competitiveness

John A. Montgomery

Federal laboratories, such as the Naval Research Laboratory, understand the needs of the military and take these developments and put these developments into use by the military – with great success. Our activities are to assist the military and resulted in producing explosive device technology, small unmanned aerial vehicles, biosensors, ways of predicting airborne contamination, etc. Utilizing nanoscience to develop high energy fuels, and increasing energy efficiency through equipment and sources.

Improvements can be made to the system and we have a science community excited about their work and seeking new challenges:

- infusing the art of the possible into military planning,
- maintaining the defense technology base,
- prevent technology surprise and encourage innovation,
- working as peer collaborators and working with other researchers . We currently have 1200 ongoing collaborations with colleges and universities worldwide – 200 programs in 35 countries
- responding with technologies rapidly in crisis
- retaining highly educated, trained staff - harder to keep scientists here in the US at our labs, they are returning to their home countries.

Panel 1 – America's Technology Competitiveness

Steve Rottler

Sandia has a unique perspective – a variety of research projects with funding amongst several federal agencies, a strong defense mission, and a strategic vision for expanding its horizons.

An overview of Sandia would reflect that the nuclear weapons program is a large component, but it only accounts for 40% of the Laboratory's revenue. Other revenue is derived from DoD, NNSA, DHS, and other federal agencies. This was an executive decision to move Sandia from nuke weapons to a national security laboratory. Strong cultural emphasis on science-based engineering - science with the mission in mind. Pervasive within the Laboratory is cognizance of its role and value to move technologies from the laboratory to the commercial sector.

Panel 1 – America's Technology Competitiveness

Steve Rottler

How Sandia works to invest in science and technology and create collaborations

- Investment in S&T Development is $600M/annually (1/4 of the budget)
- Licensing activities and industrial partnerships
  - For example, Goodyear Tire and Rubber – invested their money in funding Sandia after ($40M over the last 17 years) the project that when collaboration had ended, Goodyear realized the importance to their company from their investment in the laboratory.
- Entrepreneurial separation for tech transfer program – allows employees involved in technology development to allow them to commercialize it/license the technology from the laboratory. This program also allows them to return to the laboratory.
- Encouraging the retention of skilled personnel – assisting in the immigration process - employees receive a special category of permanent employee at the lab while they are pursuing their US citizenship.

Panel 1 – America's Technology Competitiveness

Steve Rottler

Technology transfer challenges

- Ambivalence/lack of clarity of the government's role in the tech transfer/commercialization process.
- Tension between the core mission and the tech transfer mission - while technology transfer is not funded, the laboratory sees value and benefit to it as it contributes to the success of the core mission
- Impedance mismatch between a federal laboratories and industries
- Need to start working with small business as well - recognize the small businesses are the engines of growth, and contribute to regional investment

Luncheon Address
Innovation and Economic Prosperity

Presented by
Robert D. Atkinson
President
Information Technology and Innovation Foundation

Innovation –why it matters

- Innovation in tradable new products and services is vital for economic regional growth
- Innovation is a driver of economic growth with a discernible return on the investment – e.g., the private return to U.S. research and development is 7% while the societal rate of return is 30%
- At least 2/3 of increase in per-capita gross domestic product is attributable to innovation

Luncheon Address

Innovation and Economic Prosperity

Robert D. Atkinson

The innovation landscape is changing

- more countries are placing a higher premium on investing in their research sectors – and it is paying dividends (more R&D awards, higher standard of living, less loss of trained personnel to other countries, etc.)

- Small- and mid-sized firms are rapidly becoming a source of innovation

- Universities are also playing a larger role; e.g., annual patent applications filed from universities increased from 7,200 in 2003 to 11,000 in 2007

Luncheon Address

Innovation and Economic Prosperity

Robert D. Atkinson

Benchmarking Innovation – the Atlantic Study

- Published in 2009, this study presented the results of comparing innovation-based competiveness of 40 nations and regions, measuring such items as economic structure, economic policy, and economic performance.

- In this study, the United States ranked #6 overall, behind Singapore, Sweden, Luxembourg, Denmark, and South Korea.

- What are some of the causes for this change? U.S. venture capital investment (seed money) for start up and fledgling firms is less than other nations, U.S. manufacturing is down and much of this manufacturing output has shifted overseas, and the U.S. lags behind other nations in a comprehensive innovation policy plan.

Luncheon Address

Innovation and Economic Prosperity

Robert D. Atkinson

Getting Back on Track: The Case for a National Innovation Policy

What is a National Innovation Policy?

- Those elements of science, technology, and economic policy that explicitly aim at promoting the development, spread, and efficient use of new products, processes, and services.

- A well-conceived, strategic approach that proactively anticipates and articulates the interactions among policies in science and technology, R&D, education, workforce training, immigration, tax, trade, intellectual property, and digital infrastructure investments in driving innovation to create social and economic welfare.

Luncheon Address

Innovation and Economic Prosperity

Robert D. Atkinson

Why is an Innovation Strategy needed?

Because technological innovation drives long-run economic growth.

Need to address complex and systemic challenges, this is a real strategic threat to the U.S.

Because, in contrast to what the conventional neo-classical economic doctrine holds, markets alone will produce societally sub-optimal levels of innovation, due to the following factors:

- High levels of risk
- Time horizons
- System interdependencies (e.g. chicken or egg)
- Externalities (e.g. spillovers from research)
- Private rate of return from research and development is 7%; but the rate of return to society from research and development is 28%
- Need for technology platforms

Luncheon Address

Innovation and Economic Prosperity

Robert D. Atkinson

Developing an Innovation Strategy Requires:

- Support factor conditions – research funding, education and skills – including highly skilled immigrants, ensure that the next generation of students are well educated to include logical, analytical, creative, and collaborative thinking – prepared for a globally competitive atmosphere
- Support an innovation environment – through tax policies and performance-based regulations
- Foster institutional arrangements to spur innovation – e.g., sector based research partnerships amongst government, industry and universities
- Support innovation platforms - i.e., sectors, functions, and technologies
- Build federal capabilities - e.g., National Innovation Foundation, Office of Innovation Review, and Innovation in Innovation policy

Panel 2 - Collaboration – What is the future for Universities, Government, and Industries to work together?

Panelists:
Yacov Shamash
Vice President for Economic Development and Dean,
College of Engineering and Applied Sciences
Stony Brook University

John Miller
Director, U.S. Army Research Laboratory

Elizabeth Weitzman
Executive Vice President
Semiconductor Research Corporation

Moderated by
Brian Darmody
Associate Vice President for Research and Economic Development
University of Maryland

Brian Darmody

“Choke points” are those challenges to collaborative relationships, for example, looking at how universities, industries and government view the question of Intellectual Property - each has a different perspective and regulations – industry and university want to own the rights and Bayh-Dole sets the standards for the federal laboratory. For many organizations there are also many layers to move products through the system and into the commercial sector

What can be done to get around these choke points? How can organizations work together to address these impedances?

- Better commercialization results from having people working physically together (technology parks)
- America Competes Act - federal government supporting planning grants for research parks
- If the technology transfer program is broken it needs to be fixed at the fundamental level
- Corporate R&D - Universities in research programs with corporations that are funded by government are required to give corporations the same license agreement as given to other corporations under Bayh-Dole - limits a corporation from negotiating a more favorable agreement .

Panel 2 - Collaboration – What is the future for Universities, Government, and Industries to work together?

Brian Darmody

What can Congress do to help?

- Support research park infrastructure and the development of Communities of Innovation (S.583)
- Improve university technology transfer: reform the federal grant and contract university funding model to encourage commercialization in the new OMB Circular A-21.1, focused on removing choke points
- Keep more corporate research and development in the U.S.
- Improve technology commercialization from federal laboratories – creating a Congressionally-chartered technology intermediary foundation to improve working with industry, based on best state/university practices
- Connect federal researchers with private companies with new Land Grant Act for federal laboratories
- Ensure new federal funding initiatives don't penalize university or state-funded startups
- Expand the corporate research and development tax credit; give extra benefit for working with U.S. universities
- Reform export controls; higher controls over smaller set of technologies; modernize rules to encourage corporate/university partnerships
- Reauthorize now the SBIR/STTR program for minimum 10 years
- Embed entrepreneurship in federal STEM initiatives

Panel 2 - Collaboration – What is the future for Universities, Government, and Industries to work together?

Yacov Shamash

- What are the federal influences on research collaboration?
  - Science is still “the endless frontier”
  - Continuing support for basic/investigator-initiated research
  - New emphasis on economic impacts:
    - NIH i6 Challenge
    - DOE Energy Innovation Hubs
    - White House Innovation RFI
- What are state influences on research collaboration?
  - Directly tied to strengthening state economies
  - Every state has a technology development strategy and related programs
  - National Governor’s Association’s Innovation America initiative
  - For example – New York
    - New York State Foundation for Science, Technology, Academic Research and Innovation
    - Empire State Development Corporation
    - New York State Energy Research and Development Authority
    - Empire State Stem Cell Trust Fund

Panel 2 - Collaboration – What is the future for Universities, Government, and Industries to work together?

Yacov Shamash

Major research universities are the growth engines of innovative, economically successful regions.

With the national downsizing of the defense industry, Long Island's economy lost its growth engine.

The region has worked together to change its research focus – moved from defense to biotechnology, micro/nano-electronics, wireless/software/IT, alternative energy.

The benefits of collaboration to industry are: partners for joint funding ventures, educated human capital resource, innovative industries for competitive advancement, educational resources at multiple levels, and a regional magnet for strategic initiatives.

The benefits of collaboration to a university are: industry resources for R&D, interesting projects/challenges for university students, establishment of good relations with industry partners, and good relationships with the public.

Tangible results for Stony Brook University include:

- 17,000 jobs created/saved
- More than $600 million in additional corporate revenues
- More than 2,200 projects completed
- More than $100 million joint federal awards
- Dozens of companies started/remain in-region

Panel 2 - Collaboration – What is the future for Universities, Government, and Industries to work together?

John Miller

Our organization has been establishing and working within partnerships as a means for accomplishing our missing since the 1990’s

The interdisciplinary nature of our research – rapidly transitioning from research to products and technologies to those who will use them

Not only rapid transition but must be affordable – and there is a role for everyone on the team

What makes a DoD laboratory different and why is collaboration important to our mission?

- DoD laboratories need to have a deep understanding of our customer – our customer being the military
- We produce products and technologies to assist the military on the battlefield, those performing the research need a deep understanding of how the technology will be used on the battlefield (i.e., the threats to it both currently and looking forward, the environment it will be employed in)
- Need the human capital capable of performing the research and developing the products
- Understanding the state of the art here and globally
- Develop the next generation of scientists and engineers and provide funding for this next generation to get the education that will be required – benefits our economic and national security
- Enable the tech transfer of our research – not only the results as enumerated earlier today but also that industry needs to take the technology, commercialize it, and make it more affordable for deployment to the military

Panel 2 - Collaboration – What is the future for Universities, Government, and Industries to work together?

John Miller

Why do we collaborate?

We have core competencies and core technical capabilities in the DoD laboratories - they fall into 2 classes (military-unique – e.g. armor, energetics), and commercial investments (e.g., electronics, information) – those are areas we're focused on as part of our business model/collaboration strategy.

Some examples of collaborative efforts:

- Research alliance – amongst industry and university participants with ARL. Helps to develop an understanding of how complex communication networks behave and develop a model for optimal communication networks. Brings together widely different skill sets that work through an inter-disciplinary research center to address a fundamental problem that has widespread implications beyond the military.

- Provides a hub for evaluating next generation materials and technology - for the military at first - brings together industry for the technology, universities working with the materials, pushes this beyond military applications

- Working with industries and universities with an international scope – an alliance focused on information technology as it applies to coalition activities.

Significance is that these research alliances (primarily in basic research) and centers of excellence are essential parts of our mission portfolio and are expected to increase in the future.

Elizabeth Weitzman

Semiconductor Research Corporation (SRC) Facts and Figures:

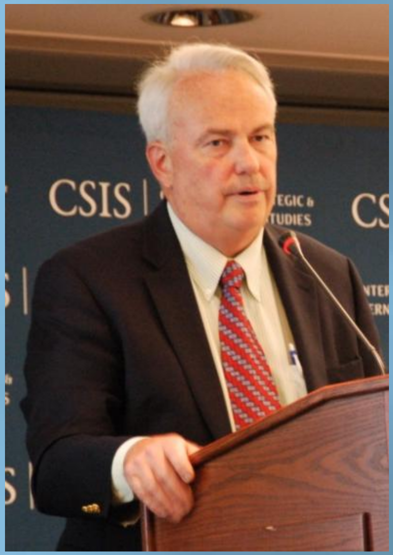
- 28 years of collaborative research for the semiconductor industry
- Since its inception, the SRC is focused on basic research
  - SRC was created as the result of industry recognizing the need for university programs to perform research, the need for programs to build a workforce, and develop the faculty to train the next generation
- Does research for the collaborative advantage of its members – pre-competitive research is funded by all members (in turn, they get the benefits of the research, and non-exclusive royalty free license)
- Expands the knowledge base and attracts the best and brightest students to work on research projects
- As the industry evolved, the SRC model had to be adapted to the nature of the research, funding levels, timelines, and the participants

Panel 2 - Collaboration – What is the future for Universities, Government, and Industries to work together?

Elizabeth Weitzman

Key attributes of SRC entities:

- Accepted IP model. SRC's model has been universally accepted by academia, industry, and government, facilitating research contract management.
- Leveraged collaboration. SRC has demonstrated ability and experience to form collaborative partnerships between industry and government to maximize research impact to both.
- Roadmapping. In consultation with stakeholders, SRC is a leader in assessing technology barriers and developing research strategies for addressing them.
- Flexibility and responsiveness. SRC's management processes offer agility and speed in the deployment of resources, allowing for targeted and timely research investments.



Closing Keynote Address
Moving the Conversation Forward

Presented by
Wayne Johnson
Member, Board of Directors
Alliance for Science and Technology Research in America (ASTRA)

What can ASTRA and like-minded organizations do?

1. Facts-based Advocacy — Talk is Cheap, Action is Precious (*COMPETES Act* example)
2. Harness Networking and Technology Platform
3. Encourage more Collaboration(s)
4. Perform Convening Role between “Silos”
5. Foster Focused Policy Research
6. Communicate Results of Research, Surveys to Those who Matter, Engage political Right more effectively
7. Put Human Dimension of S&T investment before public

Closing Keynote Address
Moving the Conversation Forward

Wayne Johnson

Key Weaknesses of an Innovation Ecology:

1. Lack of Public Education / Understanding of the Role Science and Technology plays
2. Congress/Governmental structures
3. Culture - Long-term vision lacking
4. Elites – Ignorant of the Threat or Myopic?
5. Is China a Strategic Threat – yes or no?
6. Failure <u>is</u> an Option, Fear is a Motivator
7. Asymmetrical Nature of a struggle that most Americans are not only unaware of – but the struggle may already be lost

Closing Keynote Address
Moving the Conversation Forward

Wayne Johnson

“Non-Monetary” fixes are needed given fiscal situation and impending “cliff” for discretionary spending

1. Tax Policy — fix disincentives throughout Code
2. Disincentives to venture capital
3. Capital flight to more opportune venues
4. Talent production and talent migration
5. Failure to engage small businesses and expand SBIR
6. Dysfunction, failed collaboration models
7. If key players are not at the table the results is misinformed policy (e.g. academics, statisticians, economists are fine but we also need the inventors, creators, small businesses, entrepreneurs, venture capitalists, industry, etc.)