

**U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE AND TECHNOLOGY
SUBCOMMITTEE ON RESEARCH AND SCIENCE EDUCATION**

HEARING CHARTER

From the Lab Bench to the Marketplace: Improving Technology Transfer

June 10, 2010

10:00 a.m. – 12:00 p.m.

2318 Rayburn House Office Building

1. Purpose:

The purpose of the hearing is to examine the process by which knowledge and technology are transferred from academic researchers to the private sector, and to identify best practices, policies, and other activities that can facilitate the commercialization of federally funded research for the benefit of society and the economic competitiveness of the United States.

2. Witnesses:

- **Dr. Thomas W. Peterson**, Assistant Director, Directorate for Engineering, National Science Foundation
- **Ms. Lesa Mitchell**, Vice President of Advancing Innovation, Ewing Marion Kauffman Foundation
- **Mr. W. Mark Crowell**, Executive Director & Associate Vice President for Innovation Partnerships and Commercialization, University of Virginia
- **Mr. Wayne Watkins**, Associate Vice President for Research, University of Akron
- **Mr. Keith L. Crandell**, Co-founder and Managing Director, ARCH Venture Partners
- **Mr. Neil D. Kane**, President and Co-founder, Advanced Diamond Technologies, Inc.

3. Overarching Questions:

- What are the challenges to increasing the transfer of knowledge and technology from university researchers to the private sector? Are there best practices, training, or policies that should be put in place at universities, federal agencies, and industry to facilitate the commercialization of federally funded research?

- How does the National Science Foundation (NSF) foster the transfer of knowledge and technology from U.S. universities to the private sector? What is the appropriate role of NSF beyond its role of supporting basic research in the “innovation ecosystem”? What changes, if any, should NSF make to its portfolio of programs?
- What are the key elements of successful university-industry commercialization collaborations? How do university technology transfer programs vary across institution type? What type of education, training, and support are universities offering professors, postdoctoral fellows, and graduate students interested in the commercialization of their research discoveries? How are universities engaged in local, state, and regional innovation initiatives?

4. Background:

While there is no single agreed upon definition, innovation is generally considered to describe the process by which new scientific and technical knowledge is converted into a useful product or service that generates economic growth and job creation and/or that improves individual and societal well being. Whether or not one includes basic research, from which new knowledge is generated, as part of the definition of innovation, it is often the necessary first step in the process of commercialization of products.

U.S. economic strength has long been attributed, at least in part, to investments in research and development (R&D) by both the federal government and the private sector, and to its nearly unparalleled research universities. In recent years, an increasing number of countries have begun to adapt their R&D activities to the U.S. innovation model. For example, China increased their investment in R&D by 500 percent between 1991 and 2002, from \$14 billion to \$65 billion. Similarly, European Union leaders have urged their members to increase their investment in R&D to 3 percent of their GDP by 2010. In addition to significantly increasing funding for R&D activities directly, U.S. competitors have also started to invest heavily in improving their higher education systems and have begun supplying the funds for startup companies and incubation centers for product development¹. In recognition of the critical role that venture capital plays in supplementing investments in R&D and in the technology transfer process, emerging economies have also made great efforts to attract and stimulate venture capital activity in their countries.

This hearing is largely focused on one part of the entire “innovation ecosystem”: the process by which the results of academic research are transferred out of the university and into the hands of companies, including start-up companies, which seek to turn those results into useful products.

Federal Research Investments

According to the National Science Board’s 2010 *Science and Engineering Indicators* report, academic performers are estimated to account for 55 percent of U.S. basic research, and 31 percent of total (basic plus applied) research. The federal government provided 60 percent of funding for academic R&D expenditures in 2008, the universities provide approximately 20

¹ *Rising Above The Gathering Storm*; The National Academies Press 2006

percent with institutional funds, and the remainder comes from state and local government funds (7 percent), industry (6 percent) and a mix of other sources (8 percent), such as charitable foundations. The federal share has actually been declining from a peak of nearly 70 percent in the early 1970's, with colleges and universities making up for the difference using their institutional funds. Nevertheless, as has been the case since the 1950's, the Federal government is the largest source of support for basic research, and universities and colleges remain the largest performing sector, with federal laboratories and the private sector nearly tied for a distant second.

Measuring Technology Transfer

Currently, the effectiveness of any single university's ability to transfer knowledge and technology is often measured against a set of metrics that include: the number of research articles published and cited, the number of invention disclosures filed, the number of patents issued, the number of licenses offered, formation of startup companies, and the number of products released. A survey by the Association of University Technology Managers (AUTM)² indicates that invention disclosures filed with university technology transfer offices grew from 15,510 in 2003 to 19,827 in 2007 and the number of new U.S. patent applications filed increased from 7,921 to 11,797 over the same period of time. Additionally, AUTM reported a growth in the formation of startup companies from 348 in 2003 to 555 in 2007, with a cumulative total of 3,388 startup firms associated with university patents and licenses. Although a number of factors are evaluated in the AUTM survey, many consider the money generated as a result of licensing income to be an adequate indicator of a university's technology transfer success. According to the 2007 survey, the license income for select institutions ranged from \$0 to almost \$800 million with the total license income reported for the 194 institutions at \$2.7 billion. These data highlight the wide range of success in technology transfer occurring at institutions across the country and suggest that perhaps the successes of some institutions could serve as useful models for other institutions.

These results may also suggest that a more comprehensive set of metrics should be established in order to accurately determine the success of knowledge and technology transferred from colleges and universities and to quantify the return on federal investment in academic research. The National Science Foundation and the National Institutes of Health are currently collaborating on a project known as STAR METRICS (Science and Technology for America's Reinvestment: Measuring the Effect of Research on Innovation, Competitiveness and Science), which is the first national federal and university partnership to document the outcomes of science investments for the public. This project is in its initial proof of concept phase in partnership with a handful of regionally and otherwise diverse institutions. The National Academy of Sciences is also in the early stages of a study to outline a framework by which research impact can be quantified.

² AUTM® U.S. Licensing Activity Survey 2007:
http://www.autm.net/AM/Template.cfm?Section=Licensing_Surveys_AUTM&CONTENTID=4518&TEMPLATE=/CM/ContentDisplay.cfm

The Role of NSF in Fostering University-Industry Partnerships

NSF generally promotes knowledge and technology transfer from universities to the private sector by increasing the number of university-industry partnerships and collaborations. The primary agency-wide programs are *Grant Opportunities for Academic Liaison with Industry (GOALI)*, *Partnerships for Innovation (PFI)*, and *Small Business Innovation Research & Small Business Technology Transfer (SBIR/STTR)*. The *GOALI* program (\$18.6 million in FY 2011) seeks to improve industry-university research linkages in the design and implementation of products and processes and funds fundamental research and novel collaborations between universities and industry that focus on education and knowledge transfer between the two entities. The *PFI* program (\$19.2 million in FY 2011) establishes collaborations between the private sector, state and local governments, and colleges and universities in order to support innovation in regional communities and to develop innovation infrastructure for economic growth. In the FY 2011 budget, NSF has requested \$12 million to implement a new “innovation ecosystem” component within the program; to date the details of the new component have not been outlined.

NSF also supports a number of research center programs that focus specifically on increasing university-industry collaboration and transferring university developed ideas, research results, and technology to U.S. industry. For example, the *Industry/University Cooperative Research Centers Program (I/UCRC)* supports partnerships between universities and industry that feature industry-relevant research and leverages federal investments by requiring strong industrial support of and collaboration in research and education. Additionally, the goal of the *Engineering Research Centers (ERC)* program (\$65.7 million in FY 2011) is to train engineering graduates in an intensive research setting that focuses on fundamental engineering systems research to create the country’s future innovations and innovators.

The Division of Industrial Innovation and Partnerships within NSF’s Engineering Directorate houses the SBIR/STTR programs, which seek to support regional innovation and economic growth by funding translational research at small businesses; SBIR/STTR has a requested budget of \$142.9 million in FY 2011, a 14 percent increase over FY 2010. The SBIR program, created by the Small Business Innovation Development Act of 1982, requires that any federal agency that supports extramural R&D activities over \$100 million allocate 2.5 percent of its R&D obligations for projects with small businesses. The STTR program was established in 1992 to promote collaborations between small businesses and nonprofit organizations such as colleges and universities or other federally funded research and development centers. Federal agencies that have extramural R&D budgets over \$1 billion are required to participate in the STTR program and must allocate 0.3 percent to the program activities. The SBIR/STTR program is split into three phases that progress from determining whether an innovation has sufficient technical and commercial merit, to conducting research to develop the innovation, to the formulation and the implementation of a commercialization plan. The Technology and Innovation Subcommittee has held numerous hearings on the SBIR and STTR programs in recent years.

In May 2010 the *i6* prize program was announced to bring innovative ideas to the marketplace. The \$12 million challenge is sponsored by the U.S. Economic Development Administration, the National Institutes of Health (NIH), and NSF. In the first step of the challenge, six teams that

determine the most creative ways to spark entrepreneurship, innovation and technology commercialization in their regions will be awarded \$1 million. In the second phase, NIH and NSF will use SBIR funds to award a total of up to \$6 million in supplemental funding to the phase I winners.

Current Law Related to Technology Transfer

In the late 1970s, Congress began to examine ways in which to foster technological advancement and commercialization in industry of federal R&D activities, resulting in the enactment of two major laws in the 1980s, the Stevenson-Wydler Technology Innovation Act (P.L. 96-418) and the Government Patent Policy Act of 1980 or the “Bayh-Dole Act” (P.L. 96-517). Both of these laws were intended to encourage increased innovation-related activities in the business community and to remove barriers to technology development, allowing market forces to operate. The Stevenson-Wydler Act outlines the assignment of patent rights to inventions resulting from collaborative work between federal laboratories and outside entities where direct federal funds are not involved. The Bayh-Dole Act addresses the distribution of patent rights resulting from federally-funded R&D performed by outside organizations, primarily U.S. universities, stating:

“It is the policy and objective of the Congress to use the patent system to promote the utilization of inventions arising from federally-supported research and development; . . . to promote collaboration between commercial concerns and nonprofit organizations, including universities; . . . to promote the commercialization and public availability of inventions made in the United States by United States industry and labor; [and] to ensure that the Government obtains sufficient rights in federally-supported inventions to meet the needs of the Government and protect the public against nonuse or unreasonable use of inventions. . . .”³

The Technology and Innovation Subcommittee intends to carry out a comprehensive review of the Bayh-Dole and Stevenson-Wydler Technology Innovation Acts later this year. For the purposes of today’s hearing, witnesses have been asked to testify on the infrastructure, policies and practices that promote successful knowledge and technology transfer from universities, and the role of the National Science Foundation in helping to support the innovation ecosystem.

5. Questions for Witnesses:

Dr. Thomas W. Peterson

- Please describe how the National Science Foundation fosters the transfer of knowledge and technology from U.S. universities to the private sector. What specific programs include knowledge transfer either as an explicit goal or as a regular outcome of the program? Has NSF identified best practices for achieving knowledge transfer based on those programs? If so, how is NSF applying those best practices across its broader portfolio of research programs?

³ 35 U.S.C § 200

- How is NSF planning to implement the new “innovation ecosystem” component of the Partnerships for Innovation (PFI) program proposed in the FY 2011 budget? Please describe any outcomes or recommendations that resulted from the recent workshop on the PFI program.
- How is NSF supporting knowledge transfer through its education and training programs? Which programs, if any, provide an opportunity for students and faculty to build the knowledge and skills necessary to participate successfully in knowledge transfer, including through entrepreneurship?
- Beyond NSF’s traditional role of supporting basic research, what is the unique role of the agency relative to universities and to the private sector in promoting regional innovation and strengthening U.S. economic competitiveness?
- How does the NSF assess the long-term economic impact of both its knowledge and technology transfer programs and of its basic research programs?

Ms. Lesa Mitchell

- Please provide an overview of the Ewing Marion Kauffman Foundation efforts to advance innovation and promote entrepreneurship. What are the challenges to increasing the transfer of knowledge and technology from university researchers to the private sector? Are there best practices, training, or policies that should be put in place at universities, federal agencies, and industry to facilitate the commercialization of federally funded research?
- What are the key components of a successful university-industry collaboration? How can federal investments in basic research be more fully leveraged to promote regional innovation and economic growth?
- Do you believe the National Science Foundation (NSF) has a role to play in the “innovation ecosystem” beyond its traditional role of supporting basic research? If so, what is that role? What changes or recommendations, if any, do you have regarding NSF’s portfolio of technology transfer and university-industry collaboration related programs, including its process for evaluating the potential for technology transfer through those programs?

Mr. W. Mark Crowell

- Based on your experience at both the University of North Carolina and the University of Virginia, what are the challenges to increasing the transfer of knowledge and technology from university researchers to the private sector? What type of education, training, and services are offered by the University of Virginia to professors, postdoctoral fellows, and graduate students interested in the commercialization of their research discoveries?
- Are there best practices or policies implemented by the institutions that you have been affiliated with that could serve as a model for other universities interested in increasing the commercialization of federally funded research?
- What are the key elements of a successful university-industry collaboration? To what extent does the University of Virginia rely on university-industry research partnerships to facilitate

knowledge and technology transfer? What other aspects of university-industry collaboration are most critical to enhancing technology transfer? Is the University of Virginia engaged in local, state, and/or regional innovation initiatives?

- Do you believe the National Science Foundation (NSF) has a role to play in the “innovation ecosystem” beyond its traditional role of supporting basic research? If so, what is that role? What changes or recommendations, if any, do you have regarding NSF’s portfolio of technology transfer and university-industry collaboration related programs?

Mr. Wayne Watkins

- What type of education, training, and services are offered by the University of Akron to professors, postdoctoral fellows, and graduate students interested in the commercialization of their research discoveries? What are the challenges to increasing the transfer of knowledge and technology from university researchers to the private sector? Are there unique challenges faced by mid-sized universities such as yours in the commercialization of federally funded research?
- What are the key elements of a successful university-industry collaboration? Are there best practices or policies implemented by the University of Akron that could serve as a model for other universities interested in increasing the commercialization of federally funded research? Specifically, what is the role the University of Akron’s Research Foundation? How is the University of Akron engaged in local, state, and regional innovation initiatives?
- Do you believe the National Science Foundation (NSF) has a role to play in the “innovation ecosystem” beyond its traditional role of supporting basic research? If so, what is that role? What changes or recommendations, if any, do you have regarding NSF’s portfolio of technology transfer and university-industry collaboration related programs?

Mr. Keith L. Crandell

- Please provide a brief overview of ARCH Venture Partners, including a description of how the company interacts with researchers and identifies investment opportunities, the stage within the “innovation ecosystem” at which the company becomes engaged, and the company’s role in the development and commercialization of a research discovery.
- What are the challenges to increasing the transfer of knowledge and technology from university researchers to the private sector? How do the barriers to commercialization vary across geographic region?
- Are there best practices, training, or policies that should be put in place at universities, federal agencies, and industry to facilitate the commercialization of federally funded research? What recommendations, if any, would you offer to university technology transfer offices to improve the commercialization of their researchers’ discoveries? Are there training and/or educational opportunities that are missing at universities that would benefit entrepreneurial minded scientists and increase commercialization?
- Do you believe the National Science Foundation (NSF) has a role to play in the “innovation ecosystem” beyond its traditional role of supporting basic research? If so, what is that role?

What changes or recommendations, if any, do you have regarding NSF's portfolio of programs that promote knowledge and technology transfer through university-industry collaboration or other means?

Mr. Neil D. Kane

- Please provide a brief description of Advanced Diamond Technologies, Inc., including a description of the research and activities supported by the National Science Foundation. Based on your experience forming start-up companies around university developed technologies, what are the challenges to increasing the transfer of knowledge and technology from university researchers to the private sector?
- Are there best practices, training, or policies that should be put in place at universities, federal agencies, and industry to facilitate the commercialization of federally funded research? What recommendations, if any, would you offer to university technology transfer offices to improve the commercialization of their researchers' discoveries? Are there training and/or educational opportunities that are missing at universities that would benefit entrepreneurial minded scientists and increase commercialization, including access to mentors and advisors from the private sector?
- Do you believe the National Science Foundation (NSF) has a role to play in the "innovation ecosystem" beyond its traditional role of supporting basic research? If so, what is that role? What changes or recommendations, if any, do you have regarding NSF's portfolio of programs that promote knowledge and technology transfer through university-industry collaboration or other means, including NSF's Small Business Innovation Research & Small Business Technology Transfer programs?