2010 Annual Report of the

Technology Innovation Program Advisory Board

NIST
National Institute of
Standards and Technology
U.S. Department of Commerce

2010 Annual Report of the Technology Innovation Program Advisory Board

U.S. Department of Commerce
National Institute of Standards and Technology
Technology Innovation Program

March 2011

For Information regarding the Technology Innovation Program Advisory Board, contact:

Lorel Wisniewski
Acting Director
Technology Innovation Program
National Institute of Standards and Technology
100 Bureau Drive, Mail Stop 4700
Gaithersburg, MD 20899-4700

Tel: 301-975-2162
Email: tip@nist.gov

Table of Contents

TIP Advisory Board Members

Jeffrey P. Andrews (Chair)
SVP of Strategy and Business Development
Advanced Electron Beams
Wilmington, MA
(Term expires 12/31/2011)

Dr. Vinton G. Cerf
VP and Chief Internet Evangelist
Google, Inc.
Reston, VA.
(Term expires 12/31/2012)

Dr. Charles L. Cooney
Professor of Chemical Engineering
Massachusetts Institute of Technology
Cambridge, MA
(Term expires 6/18/2011)

Dr. Mauro Ferrari
Professor of Internal Medicine
University of Texas
Houston, TX
(Term expires 6/18/2012)

Dr. Martin Izzard
Vice President
Texas Instruments
Dallas, TX
(Term expires 6/18/2011)

Dr. Ray O. Johnson
Senior Vice President and Chief Technology Officer
Lockheed Martin Corporation
Bethesda, MD
(Term expires 12/31/2012)

Dr. Radia Perlman
Intel Laboratories
Redmond, WA
(Term expires 12/31/2011)

Dr. Luis Proenza
President
University of Akron, Ohio
Akron, OH
(Term expires 6/18/2012)

James E. Reeb
Director of Manufacturing R&D
Caterpillar, Inc. (Retired)
Mossville, IL.
(Term expires 6/11/2012)

Dr. William Peter Teagan
Independent Consultant
Acton, MA
(Term expires 01/30/2013)

Introduction

The Technology Innovation Program (TIP) Advisory Board is a distinguished body of experts in the field of technology innovation, including representatives from high-tech companies, the venture capital community, and universities. The TIP Advisory Board was established by statute to advise the TIP Director on programs, plans and policies, including reporting on the general health of the program and its effectiveness in meeting its legislatively mandated mission, and offering guidance on investment areas appropriate for funding[1]. TIP promotes and accelerates innovation in the United States by offering competitive opportunities for cost-shared funding for high-risk, high-reward research that has the potential to yield transformational results.

TIP funds projects only in areas of critical national need. A critical national need is defined in the TIP Rule (15 CFR Part 296) as "an area that justifies government attention because the magnitude of the problem is large, and the societal challenges that need to be overcome are not being addressed, but could be addressed through high-risk, high-reward research." A societal challenge is defined in the Rule as "a problem or issue confronted by society that when not addressed could negatively affect the overall function and quality of life of the nation, and as such justifies government attention, and can be addressed through high-risk, high-reward research." American competitiveness is an issue that has received considerable attention in recent years. The creation of TIP was a response to concerns about the need to foster technological innovation in the United States to help ensure future economic growth.

This annual report includes two calendar year 2010 TIP Advisory Board meetings:

- May 11
- November 2

During the Advisory Board meetings TIP and National Institute of Standards and Technology (NIST) staff briefed the Board on plans, recent events, and accomplishments. TIP's management raised special issues and concerns for which Board input was sought. Sometimes other experts on technology issues briefed the Board to provide additional points of view regarding the current state of the nation with regard to technology development. The meetings included open-ended discussion sessions during which the Board provided feedback to TIP.

Following each meeting, minutes were prepared, circulated to the Board members, and posted on the TIP website. Meetings of the TIP Advisory Board are open to the public.

This Advisory Board takes seriously its responsibility for guiding the course of the program. TIP staff members have welcomed advice from the Board and take it into account as plans are developed and revised.

This report documents the Board's findings and recommendations and summarizes events that transpired at the two 2010 meetings. The appendices provide additional information about progress within the program, including a list of all projects funded to date and a summary of white papers received by TIP regarding potential future investment areas.

[1]The TIP Advisory Board charter can be found on TIP's website (http://www.nist.gov/tip/adv_brd/index.cfm).

Findings and Recommendations

Findings

1. The Board is gratified that its previous recommendations have been taken seriously by TIP's management and that the program has strived for continuous improvement. The leadership transition from former TIP Director, Marc Stanley, to the current Acting Director, Lorel Wisniewski, occurred seamlessly, and both parties are to be commended for this successful hand-off. In addition, the Board is very pleased with the professionalism and thoroughness of Dr. Wisniewski and gave her that positive feedback during the November board meeting.

2. Programs such as TIP are an important part of our nation's efforts to meet societal challenges and remain competitive in a rapidly changing world economy. However, constraints on TIP program funding have limited the number and scope of competitions that can be offered in a year and also the number of projects that can be funded. Only about ten percent of the proposals submitted to TIP typically receive funding. In 2010 TIP received 110 proposals seeking $314.6 million in funding (and willing to contribute an additional $331.6 in cost share) for proposed projects. Therefore, additional TIP funding could be put to good use.

3. TIP's long-range planning is made more difficult by the high degree of uncertainty about the timing and levels of future funding. Continuing resolutions in lieu of actual appropriations are becoming increasingly common, and that situation creates challenges in managing any federal assistance program. Constraints of the federal budget process have meant that TIP proposers typically have had very little lead time to prepare proposals. TIP should seek ways to announce competitions earlier rather than wait until the funds are actually in hand.

4. TIP has done an excellent job of coordinating with other federal agencies, with states, and with interested parties in industry and at universities. TIP's process for determining critical national needs is appropriate and thorough. TIP is succeeding in encouraging interested parties to submit innovative proposals for projects that, if successful, would be likely to produce important benefits for the nation. However, TIP is a relatively new program. Undoubtedly, there are still small companies and other organizations that may be unaware of opportunities through TIP. Accordingly, efforts to publicize the program to all potentially interested parties must continue.

5. TIP has worked effectively with other parts of NIST to draw upon the broad expertise available at the Institute. The involvement of the NIST Fellows is valuable. (NIST Fellows are distinguished scientists or engineers recognized by the Institute for their accomplishments. Fellows are encouraged to attend Advisory Board meetings and participate in the discussions.)

The Smart Grid (a potential critical national need) that was discussed at the November meeting provides a good example of how TIP has effectively utilized expertise at NIST and the other agencies with which NIST coordinates. TIP has used NIST's involvement in standards work on the Smart Grid to gather in-depth information that is helping TIP determine whether Smart Grid technology constitutes a critical national need. The presentations at the November meeting reinforced the Board members' own understanding and experience that the Smart Grid is, indeed, an increasingly important area of technology for the nation. The nation's infrastructure for electric power needs modernization. If the United States is to take advantage of rapid advances in renewable energy, e.g., solar and wind, it will require upgrades to the grid and its control systems. The future grid must be able to handle, meter, and control rapidly changing bi-directional power flows. Affordable dispersed energy storage is definitely a growing need. (Last year's Annual Report also called attention to the need for low-cost reliable dispersed energy storage.) If electric vehicles become commonplace, that will require major changes in grid design. Reliable electric power is essential to an industrialized nation. For these reasons, the Board would be comfortable should the TIP determine that the technical challenges associated with the Smart Grid reach the threshold of a critical national need.

6. The presentations to the Board at the May meeting regarding water and advanced automation provided strong evidence that these two areas could also rise to the level of critical national needs. TIP must make the final decision on priorities among the candidate areas, but there is no doubt that all of the topics in contention are important to the future of the nation. The United States is not taking full advantage of advances in automation and robotics for factories and for other important applications (e.g., disaster search and rescue). In addition, there are legitimate reasons to consider elevating the need for clean water to a critical national need. This is an issue that will become more acute over time and one that has both an economic and a human impact. Therefore, it is an area where government support is both necessary and appropriate.

7. TIP is required by its statute to fund projects only in areas identified as critical national needs. The Board believes that if the scopes of critical national need areas are defined too narrowly, innovative projects with potential benefits to the nation may not get the funding they deserve.

8. The Board is pleased that TIP manages projects actively and terminates projects that do not appear likely to succeed. The Board is also pleased that TIP is systematically gathering data to quantify the degree of success of projects and the benefits resulting from them. The Advanced Technology Program which preceded TIP had established an enviable reputation for thorough project assessment, and TIP has done a good job of adopting best practices from ATP.

9. TIP runs competitions well and is authorized to do so for other agencies. When another agency has funding available to address a critical national need like those that TIP considers, it could make sense for that agency to transfer funds to TIP to manage the competition.

10. It is appropriate for TIP to check with other agencies to ensure that it is not duplicating what they are funding. Also, TIP proposers must show why funding from other sources is unavailable or inadequate. But just because another agency is providing funding in a given area does not mean that TIP should not fund proposals in that area. In the development of the Internet, R&D funding came from several federal agencies, and this helped to achieve the critical mass needed to make rapid progress. The Board believes that if a need is really a critical national need, then TIP should not hesitate to sponsor R&D even if other agencies are also providing funding in that area.

11. TIP white papers provide valuable information to industry and government about what the future may hold. Even if a company does not receive TIP funding, it can benefit from having access to the white papers that reveal technological trends and shed light on current industry thinking about the future. TIP's white paper process provides a neutral forum in which competing companies, universities and others can share their thoughts about important technology trends and needs without fear of violating anti-trust laws.

12. TIP requires proposers to show that no stone has been left unturned in seeking funding elsewhere. While the Board understands the rationale for Congress inserting that provision into the TIP legislation, the Board is concerned that such a rule, if interpreted too narrowly, will create an adverse selection problem whereby only low quality projects are eligible. This outcome is created by both the requirement that no other sources are available and by the additional burden placed on proposers to prove that no other funding sources are available. The Board therefore recommends that this funding requirement not be interpreted too tightly and that proposers are made aware that only a reasonable level of effort must be made to show that alternate sources of funds are not available.

Recommendations

1. TIP is a valuable program that is already proving itself to be an essential part of the nation's innovation infrastructure. Therefore, the Board recommends that Congress continue to fund the program and that TIP leadership continue to execute this program with the minor "course corrections" outlined in this report.

2. Setting priorities for critical national needs is a challenge because all of the areas the Board heard about during the past year (manufacturing, water, automation, Smart Grid) are important. Projects funded in any of these areas would produce benefits to the nation. The Board would support funding high quality projects in each of the topic areas discussed this year.

3. TIP should seek ways to announce competitions earlier to give proposers more time to prepare proposals. Three months is insufficient. Certain caveats indicating that the competition is contingent on having sufficient funding would be necessary. But, with that, proposers would have more time to prepare, likely resulting in more, higher quality proposals. There is precedent within the federal government for announcements of that type (e.g., DARPA).

4. TIP should define critical national needs categories as broadly as possible to encourage innovative thinking and so as not to exclude promising proposals that might fall outside the scope of a narrowly defined topic.

5. TIP should continue to devote considerable attention to publicizing the program to ensure that all interested parties are aware of this opportunity.

6. As project results become available, this annual Advisory Board report and the variety of other reports published by TIP should include descriptions of projects underway to give readers concrete examples of accomplishments of TIP sponsored R&D.

7. As noted in Finding 12, the TIP Advisory Board is concerned that an overly narrow interpretation of rules requiring the proposer to prove that alternate funding is not available may create adverse selection effects and lower quality projects. Therefore, the Board recommends that TIP leadership use its judgment to insure that project funding goes to needy and worthwhile projects and that it take appropriate steps to insure that proposers are not discouraged from submitting proposals by the onerous burden of proof in this area.

Summary of Advisory Board Meetings Held in 2010

The full minutes of these meetings are posted on the TIP website (www.nist.gov/tip). Accordingly, only the most important points are summarized here.

1. May 11 Meeting

Introduction

TIP Advisory Board Chair, Jeffrey Andrews, noted that former TIP Director, Marc Stanley, had just retired. Mr. Andrews expressed admiration for Mr. Stanley's leadership in establishing TIP and the Advisory Board, and he thanked Dr. Wisniewski for arranging this meeting and for continuing to maintain the high standards that have been set for TIP operations.

Dr. Wisniewski summarized TIP's purpose and key features as well as the current status of the program. In 2009, TIP received 138 proposals, of which 20 were funded (8 in civil infrastructure and 12 in manufacturing). Most awardees were small businesses. Civil infrastructure project awards were made in technical areas such as highways and bridges, pavement, water and wastewater, and dams and levees. Manufacturing project awards were in areas such as nanomaterials, composites, alloys, and smart materials. Funded projects are listed in the appendix to this report.

Proposals were due on July 15, 2010, for the third TIP competition for which the topical area was "Manufacturing and Biomanufacturing: Materials Advances and Critical Processes."

Civil infrastructure and manufacturing have already been shown to meet TIP's criteria for critical national needs appropriate for TIP support. At this meeting, two other areas currently under consideration as possible critical national needs were discussed:

- Advanced automation
- Water

TIP has received considerable input from stakeholders in both of these technical areas.

The Board reinforced the importance of TIP continuing to be involved in interagency discussions of technical areas that are candidates for critical national needs. It endorsed the idea of TIP running competitions for other federal agencies.

Advanced Automation

Several speakers addressed advanced automation as a potential critical national need, including Dr. Richard Bartholomew of TIP, Dr. Howard Harary and Ms. Elena Messina of NIST's Manufacturing Engineering Laboratory, and Dr. Sridhar Kota of OSTP (the White House Office of Science and Technology Policy). Dr. Kota noted that the Administration, through OSTP, has a keen interest in manufacturing and advanced automation. The President's Council of Advisors on Science and Technology (PCAST) has a special committee on advanced manufacturing that will soon issue a report. OSTP is examining issues of how to create new industries and how to improve existing ones.

In 2007 Congress formed a Congressional Caucus on Advanced Automation. OSTP has also formed an Advanced Automation Working Group, confirming the current Administration's interest in this topic. A number of groups such as the Robotic Technology Council of the National Center for Manufacturing Sciences have devoted attention to identifying challenges and opportunities. TIP has received twelve white papers on this topic, indicating a high level of interest, and three advanced automation related projects have already been funded as part of the manufacturing critical national need area.

Advanced automation includes technologies such as sensing, signal processing, artificial intelligence, modeling and control systems, all of which are important enablers for the adoption of new products and technologies in markets ranging from manufacturing to care for the elderly. Advanced automation technology can improve safety and effectiveness, and therefore, the commercial viability, of a wide range of new products.

Sensing and actuating are part of the field of advanced automation even when the process is a continuous process rather than one involving discrete parts. Future robots

will need to be able to decide what action is called for and modify their programs depending on what is being sensed. There is a spectrum of needs, ranging from cases where just being able to perform a repetitive task is all that is needed, to other cases where adaptability would be extremely valuable.

Vision systems, image recognition for robots, and artificial intelligence are key generic R&D areas that TIP might support. Humans should be able to shout commands to robots that could react accordingly based on voice recognition.

The U.S. lags behind some other countries in the adoption of advanced automation because it is expensive to install robots and their support systems as a retrofit in old plants. Compared to rapidly developing countries, many U.S. factories are older plants. Current robots may be too expensive and insufficiently flexible for small companies not involved in mass production. There are accounting and return-on-investment problems, too. When the capitalization associated with installing new robots is compared with outsourcing, robots may not win. High volume manufacturing may benefit from robots, but low volume manufacturing may not. More flexible robots that can adapt to small lot production are needed.

Dr. Howard Harary of NIST's Manufacturing Engineering Laboratory told of a Maryland company (Marlin Wire) that converted production to robots. It increased sales and increased its workforce substantially, suggesting that the perception that the adoption of robots inevitably reduces jobs may not be the case. Because this company now uses flexible automation, they can undercut Chinese producers and shorten turn-around time.

Agriculture is a potentially important application for advanced automation. Designing a robot to pick apples, for example, is a difficult challenge—being able to handle fruit without damaging it and being able to distinguish a ripe apple from one that is not ready to be picked requires a sophisticated robot with color vision and decision-making ability.

High precision robots can be essential for manufacturing tiny assemblies where human fingers are too clumsy to handle the small parts.

Water

TIP's Dr. Donald Archer spoke about water as a potential critical national need. Like advanced automation, water is also being explored by TIP to determine whether it reaches the threshold of being a critical national need appropriate for TIP funding. Demand for water grows proportionally with population growth. Already there are water shortages in sections of the United States, and as population grows, such shortages are likely to become more commonplace. Thirty-six states anticipate water shortages in the next ten years. The economic impact of droughts is significant.

Some have suggested an approach whereby not all water to consumers is purified to potable water standards. Much water consumption goes to toilets, taking showers, washing clothes and dishes, watering lawns—applications that do not require potable water. The problem is that the cost of installing a second set of water mains and piping to homes and businesses to supply non-potable water would be prohibitively expensive. People are exploring options for reusing "grey water" for lawn watering, etc. In parts of the country like Southern California, some people are replacing grass with native wildflowers or other approaches that do not require watering.

There are innovative ideas around, and that is why there are opportunities for proposing to TIP—to encourage people to think out of the box. There are biometric approaches to selectively removing particular contaminants. Microorganisms can do cleanup. After Chernobyl, sunflowers were planted because they take up uranium from the soil.

Technical challenges include desalination, removing contaminants, and transporting water long distances at a cost that is economically viable. New desalination technologies such as carbon nanotubes could provide new solutions, but a technical issue is whether carbon nanotubes could be made in the large quantities needed at an affordable price.

Agricultural use accounts for about 65 percent of water consumption. Domestic use is about 20 percent, and

industrial use, about 10 percent. As water is increasingly taken from less desirable sources (e.g., brackish or polluted water), subject to more intensive treatment, and transported over increasingly greater distances, the cost to the consumer increases. That will have an adverse impact on the economy. In California, a state that moves vast quantities of water over great distances, 19 percent of the state's energy generation is used for water supply and treatment—a surprisingly large number.

Inexpensive robust sensors to detect harmful substances in water is another area for exploration, as is affordable technology to remove harmful trace elements. Still another area for exploration is how to reduce the energy required to process water.

Because the providing of water is frequently a government responsibility, the private sector has traditionally not invested much R&D funding in water processing. Federal agencies have some efforts underway, e.g., NOAA and NASA, as well as DOE's efforts on climate modeling and hydrosphere prediction. EPA has worked on assessing water quality. NSF has funded predictive science. The Bureau of Reclamation has funded desalination plants. There has not been much R&D work devoted just to lowering the cost of future water supplies and ensuring their purity.

2. November 2 Meeting

Introduction

TIP Advisory Board Chair, Jeffrey Andrews, welcomed new Board member Dr. Ray Johnson.

TIP Acting Director, Dr. Lorel Wisniewski, noted that TIP's third competition is currently underway, with approximately $25 million available for awards. TIP received 110 proposals as of the July 15 deadline. After subtracting administrative expenses and the $25 million set aside for new awards, the remainder of the $69.9 million in FY 2010 funding will be used to support ongoing projects.

The Small Business Jobs Act of 2010 directs TIP to ". . . enhance the competitiveness of small and medium-sized businesses in the United States in the global marketplace." TIP's existing charter is fully consistent with that directive. TIP encourages small and medium-sized businesses and joint ventures to undertake high risk R&D, which enhances their competitiveness. TIP proposers must demonstrate that the project is in the best interests of the United States. Usually that means that the technology is intended primarily for use in the United States. But even if a U.S. company develops a new technology that predominantly is sold overseas, if it creates wealth here, then that is beneficial to the United States.

TIP puts much effort into ensuring that there is no inappropriate duplication between R&D supported by TIP and that supported by other Federal agencies. TIP surveys their plans and also works with groups such as the Science and Technology Policy Institute. For instance in the case of bio-manufacturing, TIP staff engaged in in-depth discussions with agencies such as FDA and NIH. While both agencies carry out biological research, they typically do not fund R&D on improving industrial bio-manufacturing processes.

Each TIP Advisory Board meeting usually includes a discussion of one or more technical topics—topics that have already been determined to be critical national needs, or topics that are candidates for being designated critical national needs for potential TIP funding. At this meeting, the topic was the "Smart Grid." NIST is playing a key role in standards-related issues associated with the Smart Grid, as explained by Mr. Dean Prochaska, NIST's National Coordinator for Smart Grid Conformance. He was followed by Dr. Jeffrey Mazer, (formerly at the Department of Energy (DOE), now a Physical Scientist at TIP). Dr. Mazer is collecting input from industry and other agencies and exploring whether the Smart Grid might qualify as a critical national need suitable for TIP investment. The Advisory Board considers the Smart Grid to be a good candidate.

Non-constant power sources such as solar and wind, when connected to the Smart Grid, increase the demand for inexpensive and efficient energy storage. Both at this meeting and at the previous meeting, the Advisory Board called attention to the importance of better energy storage technology. In collaboration with DOE, NIST/TIP is an appropriate organization to call attention to this need. Through TIP, battery manufacturers (as well

as companies researching other storage technologies) can learn about needs and opportunities arising from adoption of the Smart Grid, and how breakthroughs in storage technology might impact the larger picture. By fostering this kind of dialogue, and by helping to support high-risk new technologies, TIP can help to create a competitive advantage for U.S. companies. Information technology aspects of the Smart Grid also present opportunities for innovation.

The Smart Grid will be characterized by ubiquitous sophisticated sensors coupled to autonomous computers capable of making real time decisions to optimize bi-directional power flows, enhance reliability of the overall system, and permit the use of more complex billing schemes. With increases in dispersed generation not under the control of the utilities, utility companies will have an increasingly difficult time matching the time-varying grid-connected generating capacity to the changing load.

An important issue is whether U.S. standards for the Smart Grid will be accepted overseas. U.S. standards are already widely accepted overseas. Most standards committees include representatives from other nations, given the extent to which markets have become global. In the current Smart Grid standards framework developed in the U.S. close to 80 percent of the standards are considered international standards. NIST is working closely with other countries to ensure harmonization of Smart Grid standards.

Needs and interests regarding the Smart Grid differ widely from country to country. For example, in China, the focus is on long distance high-voltage transmission from remote power plants. In Denmark and the Netherlands, the emphasis is on incorporating wind turbines into the grid. Australia has said it will look closely to the U.S. with regard to Smart Grid standards. In Japan, the "smart community" concept is receiving attention, in which the focus is on building efficiency, so HVAC and automatic lighting systems are receiving attention.

Discussion of Other Issues

Up to now, TIP has waited until funding has actually been available before announcing a competition. After proposals are received, TIP must allow sufficient time to permit careful review. Congress rarely approves agency budgets prior to the beginning of a new fiscal year. TIP funds are "no-year" money, so in principle, money can be carried over into a subsequent year. However, because so many Federal programs are chronically short of funds, if TIP does not allocate its funds before the end of the fiscal year, there is a high probability that they will be reallocated to some other program. Given this situation, TIP's mode of operation has been to obligate all funds before the year ends. The result of these constraints is that TIP proposers typically have only 90 days to prepare and submit proposals. The Board's conclusion was that it is in the interest of TIP to lengthen the effective "reaction time" for proposers.

Based on the discussion at this meeting, there was a consensus of the Board on the following major points:

- TIP should seek ways to announce potential competitions as far in advance as possible with appropriate caveats about funding uncertainties. Six months notice is a recommended goal.

- Descriptions of critical national need technical areas should be written as broadly as possible to encourage innovation.

- TIP should continue to aggressively market the program to ensure that all those with a potential interest in proposing are aware of it.

- Just because another Federal agency is providing funding in a given area does not mean that all good proposals in that area will be funded. (In the case of the development of the Internet, R&D funding came from several agencies, and this helped to achieve the critical mass needed to make rapid progress.) If a need is truly a critical national need, then TIP should not hesitate to sponsor R&D even if other agencies are funding that area.

- Companies should not have to demonstrate herculean efforts to find other funding before becoming eligible for an award as this can create an "adverse selection" issue where high quality programs choose not to apply.

Appendix 1
TIP Projects Funded to Date

TIP Project Awards, FY 2010 Competitive Funding Opportunity

Critical National Need: Manufacturing

"Manufacturing and Biomanufacturing: Materials Advances and Critical Processes"

Manufacturing of Fully Deleted Helper-Virus Independent Adenoviral Vectors
Isogenis, Inc. (Aurora, Colo.)

Project Duration: 3 years
Projected TIP Contribution: $2.7 M
Total Project Cost (est.): $5.5 M

Volume Production of Nanocomposite Alloy Anode Materials for Lithium-Ion Batteries
ActaCell, Inc. (Austin, Texas)

Project Duration: 3 years
Projected TIP Contribution: $3 M
Total Project Cost (est.): $6.2 M

Atmospheric Spray Freeze-Dried Powder Process Advancement and Scale-Up
Engineered BioPharmaceuticals, Inc. (Manchester, Conn.)

Project Duration: 3 years
Projected TIP Contribution: $3 M
Total Project Cost (est.): $6 M

High-Throughput Manufacturing of Electrospun Core-Sheath Fibers
Arsenal Medical, Inc. (Watertown, Mass.)

Project Duration: 3 years
Projected TIP Contribution: $2.3 M
Total Project Cost (est.): $4.7 M

Process Innovation for High Technology Manufacturing of Flexible Liquid Crystal Displays
Kent Displays, Inc. (Kent, Ohio)

Project Duration: 3 years
Projected TIP Contribution: $3 M
Total Project Cost (est.): $6 M

Reprogram a Mammalian Cell Line to Optimize Production of Biopharmaceuticals
Precision BioSciences, Inc. (Research Triangle Park, N.C.)

Project Duration: 3 years
Projected TIP Contribution: $2.7 M
Total Project Cost (est.): $5.4 M

Volatile Reporters for Monitoring Biomanufacturing of Therapeutic Proteins; Ginkgo BioWorks (Boston, Mass.)

Project Duration: 2 years
Projected TIP Contribution: $1 M
Total Project Cost (est.): $2.3 M

Low-Cost, Scalable Manufacturing of Surface-Engineered Super-Hard Substrates for Next-Generation Electronic and Photonic Devices
Sinmat Inc. (Gainesville, Fla.)

Project Duration: 3 years
Projected TIP Contribution: $2.4 M
Total Project Cost (est.): $4.8 M

Synthesis of High-Efficiency Organic Photovoltaics for Scalable, Cost-Effective Manufacturing
Polyera Corporation (Skokie, Ill.)

Project Duration: 2 years
Projected TIP Contribution: $2 M
Total Project Cost (est.): $5 M

TIP Project Awards, FY 2009 Competitive Funding Opportunity

Critical National Need: Manufacturing

"Accelerating the Incorporation of Materials Advances into Manufacturing Processes"

Production of Low-Cost, High-Quality Metallic and Semiconducting Single-Walled Carbon Nanotube Inks
Brewer Science, Inc. (Rolla, MO), joint venture lead, with SouthWest NanoTechnologies (SWeNT), Norman, OK)

Project Duration: 3 years
Projected TIP Contribution: $6,527,000
Total Project Cost (est.): $13,910,000

Functionalized Nanographene for Next-Generation Nano-Enhanced Products
Angstron Materials, LLC (Dayton, OH)

Project Duration: 3 years
Projected TIP Contribution: $1,494,000
Total Project Cost (est.): $2,988,000

Transformational Casting Technology for Fabrication of Ultra-High-Performance Lightweight Aluminum and Magnesium Nanocomposites
University of Wisconsin-Madison (Madison, WI), joint venture lead; with Eck Industries, Inc. (Manitowoc, WI), Nanostructured & Amorphous Materials, Inc. (Houston, TX), the Oshkosh Corporation (Oshkosh, WI), and Wisconsin Alumni Research Foundation (Madison, WI)

Project Duration: 5 years
Projected TIP Contribution: $4,863,000
Total Project Cost (est.): $10,092,000

High-Speed, Continuous Manufacturing of Nano-Doped Magnesium Diboride Superconductors for Next-Generation MRI Systems
Hyper Tech Research, Inc. (Columbus, OH)

Project Duration: 3 years
Projected TIP Contribution: $3,000,000
Total Project Cost (est.): $6,050,000

PRINT® Nanomanufacturing: Enabling Rationally Designed Nanoparticles for Next-Generation Therapeutics
Liquidia Technologies, Inc. (Durham, NC)

Project Duration: 3 years
Projected TIP Contribution: $2,971,000
Total Project Cost (est.): $5,942,000

Silicon Nanowire Production for Advanced Lithium-Ion Batteries
Amprius, Inc. (Menlo Park, CA)

Project Duration: 2 years
Projected TIP Contribution: $3,000,000
Total Project Cost (est.): $6,000,000

Integrated Multiscale Modeling for Development of Machinable Advanced Alloys and Corresponding Component Machining Processes
Third Wave Systems, Inc. (Minneapolis, MN)

Project Duration: 3 years
Projected TIP Contribution: $1,564,000
Total Project Cost (est.): $3,170,000

High-Volume Production of Nanocomposite Electrode Materials for Lithium-Ion Batteries
A123Systems, Inc. (Ann Arbor, MI)

Project Duration: 3 years
Projected TIP Contribution: $2,864,000
Total Project Cost (est.): $6,000,000

Building U.S. Strategic Metals Competitiveness through Integration of Advanced Sensor Technologies
wTe Corporation (Bedford, MA), joint venture lead, with National Recovery Technologies, Inc. (Staten Island, NY) and Energy Research Co. (Nashville, TN)

Project Duration: 4 years
Projected TIP Contribution: $5,670,000
Total Project Cost (est.): $11,532,000

Homogeneous Three-Dimensional Pultruded Processing of PEEK, PEI, and PPS High-Temperature Thermoplastic Composite Profiles
Ebert Composites Corporation (Chula Vista, CA)

Project Duration: 2 years
Projected TIP Contribution: $1,866,000
Total Project Cost (est.): $4,018,000

High-Risk, Low-Cost Carbon Nanofiber Manufacturing Process Scale-Up;
eSpin Technologies, Inc. (Chattanooga, TN)

Project Duration: 3 years
Total project (est.): $6,006,000
Requested TIP funds: $3,000,000

Development and Scale-Up of Nanocomposites with Sub-10 nanometer Particles
Pixelligent Technologies LLC (College Park, MD), joint venture lead, with Brewer Science, Inc. (Rolla, MO)

Project Duration: 3 years
Projected TIP contribution: $4,089,000
Total project cost (est.): $8,178,000

Critical National Need: Civil Infrastructure

"Advanced Sensing Technologies and Advanced Repair Materials for the Infrastructure: Water Systems, Dams, Levees, Bridges, Roads, and Highways"

Civil Infrastructure Inspection and Monitoring Using Unmanned Air Vehicles
The Droid Works, Inc. (Framingham, MA), with the Georgia Institute of Technology Research Corporation

Project Duration: 3 years
Projected TIP Contribution: $2,453,000
Total Project Cost (est.): $4,996,000

Automated Nondestructive Evaluation and Rehabilitation System (ANDERS) for Bridge Decks
Rutgers, The State University of New Jersey (Piscataway, NJ), joint venture lead, with Drexel University (Philadelphia, PA), PD-LD, Inc. (Pennington, NJ), Mala GeoSciences USA, Inc. (Charleston, SC), and Pennoni Associates, Inc. (Philadelphia, PA).

Project Duration: 5 years
Projected TIP Contribution: $8,810,000
Total Project Cost (est.): $17,923,000

Distributed Fiber-Optic Sensing Technology for Civil Infrastructure Management
Optellios, Inc. (Newtown, PA)

Project Duration: 3 years
Projected TIP Contribution: $1,930,000
Total Project Cost (est.): $3,917,000

Robotic Rehabilitation of Aging Water Pipelines
FibrwrapConstruction, Inc. (Ontario, CA); joint venture lead, with Fyfe Company (San Diego, CA) and the University of California, Irvine

Project Duration: 5 years
Projected TIP Contribution: $8,462,000
Total Project Cost (est.): $17,582,000

A Rapid Underground Pipe Rehabilitation Technology
LMK Enterprises, Inc. (Ottawa, IL)

Project Duration: 2 years
Projected TIP Contribution: $1,701,000
Total Project Cost (est.): $3,411,000

Development of a Multiscale Monitoring and Health Assessment Framework for Effective Management of Levees and Flood-Control Infrastructure Systems
Rensselaer Polytechnic Institute (Troy, NY), joint venture lead, with Geocomp Corporation (Boxborough, MA)

Project Duration: 4 years
Projected TIP Contribution: $3,462,000
Total Project Cost (est.): $6,928,000

Development of High-Toughness, Low-Viscosity Resin for Reinforcing Pothole Patching Materials
University of California, Los Angeles, joint venture lead, with Materia, Inc. (Pasadena, CA)

Project Duration: 3 years
Projected TIP Contribution: $1,499,000
Total project cost (est.): $3,051,000

Advanced Coating Technology for Infrastructure
MesoCoat, Inc. (Euclid, OH), joint venture lead, with The Edison Materials Technology Center (Dayton, OH) and Polythermics, LLC (Kirkland, WA)

Project Duration: 3 years
Projected TIP Contribution: $1,792,000
Total project cost (est.): $3,956,000

TIP Project Awards, FY 2008 Competitive Funding Opportunity

Critical National Need: Civil Infrastructure

"Advanced Sensing Technologies for the Infrastructure: Roads, Highways, Bridges and Water Systems"

Development of SCANSn for Advanced Health Management of Civil Infrastructures
Acellent Technologies, Inc. (Sunnyvale, CA)

Project duration: 3 years
Projected TIP contribution: $2,995,000
Project cost-share contribution: $2,995,000

Fiber Sensing System for Civil Infrastructure Health Monitoring
Distributed Sensor Technologies, Inc. (Santa Clara, Calif., joint venture lead, with Optiphase, Inc., (Van Nuys, CA), Redfern Integrated Optics, Inc., (Santa Clara, CA) and the University of Illinois at Chicago

Project duration: 3 years
Projected TIP contribution: $4,030,000
Project cost-share contribution: $4,518,000

Infrastructure Defect Recognition, Visualization and Failure Prediction System Utilizing Ultrawideband Pulse Radar Profilometry
ELXSI Corporation (Orlando, FL), joint venture lead, with UltraScan, LLC. (Ruston, LA) and Louisiana Tech University (Ruston, LA)

Project duration: 3 years
Projected TIP contribution: $3,119,000
Project cost-share contribution: $3,629,000

Microwave Thermoelectric Imager for Corrosion Detection and Monitoring in Reinforced Concrete
Newport Sensors, Inc. (Irvine, CA)

Project duration: 3 years
Projected TIP contribution: $1,249,000
Project cost-share contribution: $1,249,000

VOTERS: Versatile Onboard Traffic Embedded Roaming Sensors
Northeastern University (Boston, MA), joint venture lead, with the University of Massachusetts at Lowell, the University of Vermont and State Agricultural College (Burlington, VT) and Witten Technologies, Inc., (Somerville, MA)

Project duration: 5 years
Projected TIP contribution: $9,000,000
Project cost-share contribution: $9,802,000

Self-Powered Wireless Sensor Network for Structural Bridge Health Prognosis
Physical Acoustics Corporation (Princeton Junction, NJ), joint venture lead, with Virginia Tech (Blacksburg, VA), the University of South Carolina (Columbia, SC) and the University of Miami (Coral Gables, FL)

Project duration: 5 years
Projected TIP contribution: $6,930,000
Project cost-share contribution: $6,969,000

Next Generation SCADA for Prevention and Mitigation of Water System Infrastructure Disaster
University of California at Irvine (Irvine, CA), joint venture lead, with Earth Mechanics, Inc. (Fountain Valley, CA), the Irvine Ranch Water District (Irvine, CA), the Orange County Sanitation District (Fountain Valley, CA), and the Santa Ana Watershed Project Authority (Riverside, CA)

Project duration: 3 years
Projected TIP contribution: $2,800,000
Project cost-share contribution: $2,885,000

Cyber-Enabled Wireless Monitoring Systems for the Protection of Deteriorating National Infrastructure Systems; University of Michigan (Ann Arbor, MI), joint venture lead, with Weidlinger Associates (New York, NY), SC Solutions (Santa Clara, CA), LFL Associates (Ann Arbor, MI), Monarch Antenna (Ann Arbor, MI), and Prospect Solutions (Albany, NY)

Project duration: 5 years
Projected TIP contribution: $8,998,000
Project cost-share contribution: $10,164,000

Development of Rapid, Reliable, and Economic Methods for Inspection and Monitoring of Highway Bridges; The University of Texas at Austin (Austin, TX), joint venture lead, with National Instruments Corporation (Austin, TX) and Wiss, Janney, Elstner Associates, Inc., (Northbrook, IL)

Project duration: 5 years
Projected TIP contribution: $3,421,000
Project cost-share contribution: $3,421,000

Appendix 2
TIP Engagement with the S&T Community

1. Summary of White Papers Submitted to TIP

On October 29, 2010, TIP renewed its call to solicit white papers from the public[2]. In this call for white papers, TIP is seeking information in all areas of critical national need, including information to assist TIP in further defining several areas of interest for future TIP funding opportunities, and also to identify new areas for consideration. By December 31, 2010, TIP received white papers as follows:

Total number of white papers received:	267
Number of authors and contributors:	567
Organizational affiliation of author/contributor:	346
University	183
Small/medium company	238
Large company	33
Non-profit organization	52
Government/national laboratory	18
Foreign entity	12
Individual/no organizational affiliation	18
Number of states represented:	42[3]

The technologies discussed in the submitted white papers are often cross-disciplinary. A categorization of the technologies by major topic area follows:

Civil Infrastructure	20
Complex Systems and Networks	16
Electronics/Photonics	19
Energy	76
Green technology	16
Healthcare	42
Manufacturing	63
Security	23
Water	10
Other	15[3]

[2] *Federal Register,* 73, no. 242, Tuesday, December 16, 2008, p. 76339.

[3] The District of Columbia was also represented.

[4] "Other" includes aircraft, agriculture, aquaculture, software development, education and social science.

2. Comments Received on TIP White Papers

On November 6, 2009, TIP posted for public comment four of its draft white papers on its website. These draft white papers represented the program's consolidated assessment of critical national needs in these areas as well as associated societal challenges that have a scientific or technical solution. These papers incorporated prior TIP research on these critical national need topics, including input received by the time of publication from the NIST laboratories, other agencies, and members of the scientific and technical communities, along with ideas from the many white papers received by TIP. The following four TIP white papers were posted to the TIP website:

Civil Infrastructure: Advanced Sensing Technologies and Advanced Repair Materials for the Infrastructure: Water Systems, Dams, Levees, Bridges, Roads, and Highways

Energy: Technologies to Enable a Smart Grid

Healthcare: Advanced Technologies for Proteomics, Data Integration and Analysis, and Biomanufacturing for Personalized Medicine

Manufacturing: Accelerating the Incorporation of Materials Advances into Manufacturing Processes

As of October 28, 2010, TIP had received 188 comments on these white papers. The breakdown of comments by topic area was as follows: Civil Infrastructure – 18; Energy – 71; Healthcare – 41; Manufacturing – 58.

On October 29, 2010, TIP posted on its website six new draft white papers for public comment . The six papers are in the following critical national need areas:

Civil Infrastructure: Advanced Sensing Technologies and Advanced Repair Materials for Infrastructure: Water Systems, Dams, Levees, Bridges, Roads, and Highways

Energy: Technologies to Enable a Smart Grid

Healthcare: Advanced Technologies for Proteomics, Data Integration and Analysis and Biomanufacturing for Personalized Medicine

Manufacturing: Advanced Robotics and Intelligent Automation

Manufacturing: Manufacturing and Biomanufacturing: Materials Advances and Critical Processes

Water: New Technologies for Managing and Ensuring Future Water Availability

About the Technology Innovation Program

The Technology Innovation Program (TIP) assists U.S. businesses, institutions of higher education, and other organizations — such as national laboratories and nonprofit research institutes — to support, promote and accelerate innovation in the United States through high-risk, high-reward research in areas of critical national need. TIP aims to speed the development of high-risk, transformative research targeted to key societal challenges that are not being addressed elsewhere. Program funds support research that has scientific and technical merit, as well as strong potential for advancing the state of the art and contributing to the U.S. science and technology knowledge base.

TIP was created on August 9, 2007, through the America COMPETES Act (P.L. 110-69), a comprehensive strategy to keep the United States the most innovative nation in the world by strengthening scientific education and research, improving technological enterprise, attracting the world's best and brightest workers, and providing 21st century job training. TIP is part of the National Institute of Standards and Technology (NIST) in Gaithersburg, Md.

- TIP has a novel purpose. TIP has the agility to make targeted investments that are within NIST's areas of technical competence and are not possible by other mission-oriented agencies or programs.

- TIP supports rich teaming. Projects may be proposed by individual for-profit companies or by joint ventures that may include for-profit companies, institutions of higher education, national laboratories, or nonprofit research institutes, so long as the lead partner is either a small or medium-sized business or an institution of higher education. Large businesses may participate in a TIP-funded project, but they may not receive TIP funding.

- TIP is a public-private partnership. TIP makes cost-shared awards of up to 50 percent of total project costs. TIP may award a total of $3 million in direct costs over 3 years for a single-company project or up to $9 million over 5 years for a joint venture.

- TIP complements—but does not duplicate—existing R&D efforts. TIP funds R&D that is not already being addressed, for which other funding (public or private) is not available, and for which government support is justified.

- TIP awards funding in response to publicly announced competitions. All proposals are subject to peer review.

Contact TIP for further information:

- On the internet: http://www.nist.gov/tip
- By e-mail: tip@nist.gov
- By phone: 1-888-TIP-NIST (1-888-847-6478)
- By writing: Technology Innovation Program, National Institute of Standards and Technology, 100 Bureau Drive, Mail Stop 4701, Gaithersburg, MD 20899-4701

[5] *Federal Register*, 75, no. 209, Friday, October 29, 2009, p. 66737.