Minutes
Technology Innovation Program (TIP)
Advisory Board Meeting
July 7, 2009

Executive Summary

The first meeting of Technology Innovation Program's (TIP) Advisory Board was called to order at 8:30 a.m. TIP Director Marc Stanley and NIST Deputy Director Patrick Gallagher welcomed the attendees. Jeffrey Andrews received thanks for agreeing to chair the Board.

Marc Stanley reviewed TIP's mission and the Board's charter. TIP seeks to address the wide gap between basic research and private sector commercialization that is often difficult to bridge. TIP funds projects only in areas of critical national needs. 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 U.S. to help ensure future economic growth. The emphasis at this meeting was to seek advice from the Board on program directions and to discuss critical national needs. Areas of critical national needs discussed by the Board included energy, healthcare, manufacturing, software, and green technology.

The board feels that respect for National Institute of Standards and Technology (NIST) within the technical community and NIST's reputation as "an honest broker" will serve the program well. Knowledge of how to run a successful government-industry R&D partnership program gained through NIST's Advanced Technology Program (ATP), as well as program assessment techniques honed within ATP should help TIP succeed. TIP is already involving the NIST laboratories, and that will help to ensure that measurements and standards needed to support new innovations will be developed.

Interdisciplinary technical areas and interfaces between agency programs represent promising areas of opportunity for TIP. To be successful, a program like TIP must demonstrate knowledge of what other agencies are doing and be able to show that the programs are complementary. TIP can leverage programs of other Federal agencies.

Nine million dollars was appropriated for TIP's first year, and approximately $25 million for new awards is available this year. The current budget under consideration by the Congress would result in about $8.3 million for new TIP awards next year. TIP uses cooperative agreements as its financial assistance funding mechanism, although TIP is actually authorized to enter into grants, cooperative agreements, and contracts.

Access to business mentors can be important to TIP small company awardees. TIP should consider the relationship between new business models and technical innovation.

Global warming and related energy concerns (e.g., the nation's strong dependence on imported fossil fuels) were mentioned several times by Board members as critical national needs that TIP might help to address. A related topic is technology and standards for a "smart" national electrical grid that would manage and distribute energy more efficiently and cost-effectively.

The venture capital community is unlikely to fund large-scale energy projects because of high capital costs, reluctance of that industry to accept high technical risk, and the complex nature of this regulated industry.

Renewable energy sources such as wind turbines and photovoltaics, improved vehicle battery technology, and the smart grid could all combine to make possible new approaches to energy usage, distribution and conservation. Alternatives to today's ubiquitous low-voltage DC power supplies in homes and offices could be explored.

Opportunities abound for new technology in the healthcare sector, e.g., shortening supply chains, standardizing and digitizing information, and streamlining information flow among hospitals, doctors, insurance companies, drug companies, and patients.

Manufacturing also has opportunities for technological innovation, such as enabling production machines to communicate with each other and non-destructive evaluation techniques for recycling products.

Action Item: Marc Stanley asked Dr. Cooney to poll his colleagues at MIT about opportunities for improving manufacturing productivity in the companies with which they interact.

Other critical national needs noted by the Board include better tools for software quality control, identity verification and green technology.

One Board member summarized the discussion thusly:

1. The role of TIP in supporting, promoting and accelerating innovation through high-risk, high reward research in areas of critical national need is rather unique and important to the economy.

2. TIP projects should fill such gaps, especially at interdisciplinary boundaries.

3. TIP's convening power means that TIP's modest resources can leverage funding by other agencies.

4. Business models must change to accommodate new technologies. A new technology will not succeed unless a suitable business model accompanies it.

5. In the healthcare area, information technology focused on the patient is where many opportunities lie—making information available where and when it is needed.

6. TIP should focus on technical problems that, if solved, would have major impact. The private sector should lead in identifying technical problems in areas of critical national need.

Mr. Stanley concluded by saying that the discussions were extremely valuable and stimulating. The next TIP meeting has tentatively been scheduled for December 8.

This meeting was adjourned at 2:40 p.m.

MINUTES

BOARD ATTENDEES:

Jeffrey P. Andrews, Atlas Venture
Dr. Vinton G. Cerf, Google, Inc.
Prof. Charles L. Cooney, Deshpande Center for Technological Innovation
Dr. Martin Izzard, Texas Instruments Inc.
Radia Perlman, Sun Microsystems
James E. Reeb, Caterpillar, Inc.
Dr. William Teagan, Independent Consultant

OTHER ATTENDEES

Brad Pantuck, Bright Idea Patents, LLC
Neil MacDonald, FTW
Jim Jaffe, NASVF

NIST ATTENDEES:

Marc Stanley, TIP
Lorel Wisniewski, TIP
Linda Beth Shilling, TIP
Mrunal Chapekar, TIP
Dan Archer, TIP
Rob Sienkiewicz, TIP
Clara Asmail, TIP
Rob Ivester
Dave Swanson, TIP
Tom Lettieri, TIP
Thomas Wiggins, TIP

Welcome and Introduction

Marc Stanley, Director, Technology Innovation Program (TIP), called this first meeting of the Advisory Board to order at 8:30 a.m. and welcomed the attendees. (Bio sketches of the board members can be found on TIP's website and will not be repeated here.) Mr. Stanley commented on the impressive breadth of expertise represented by the members and thanked them for volunteering to serve, noting his anticipation that the Board's findings will benefit both TIP and NIST as a whole. Mr. Stanley thanked Jeffrey Andrews for agreeing to chair the Board.

Patrick Gallagher, Deputy Director of National Institute of Standards and Technology (NIST), spoke next. Mr. Gallagher also thanked the members and added that NIST truly values advice from its several advisory committees and Boards. TIP is such a new program, advice from TIP's Advisory Board at this early stage will help ensure future success.

TIP's Role and Mission

Marc Stanley reviewed TIP's mission and the Board's charter.

TIP funds projects only in areas of critical national need. A critical national need is defined in the TIP Rule (15 C.F.R. 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."

Our nation cannot rely on past technical achievements for future economic growth. A 2007 report titled *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future*, produced by the National Academy of Sciences/National Academy of Engineering/Institute of Medicine, called attention to the connection between innovation and economic growth. The Council on Competitiveness has also addressed this issue and has urged policy makers to pay more attention to stimulating innovation and improving American competitiveness. Local, state and Federal resources all have a role. Public-private partnerships, like those fostered by TIP, can help rejuvenate American innovation.

Identifying technical areas suitable for TIP support involves soliciting the views of industry, academia, and other agencies. Those interested are encouraged to submit "white papers" that outline particular societal challenges within areas of critical national need for potential funding. Civil infrastructure and manufacturing have already been identified as critical national needs.

There is substantial Federal funding for basic research. Once the risk of new technological approaches is sufficiently reduced, private sector investment can, and usually does, lead to commercialization of new technologies. But because of the technical risk factor, there is a wide gap between basic research and private sector commercialization that is often difficult to bridge. That is where TIP's role lies.

TIP seeks projects that are "disruptive" (game-changing) and challenging rather than projects that focus on "low-hanging fruit." TIP can fund small and medium U.S. businesses, universities, national laboratories (with the exception of NIST), non-profit research institutes, and other organizations or joint ventures involving such organizations. Large companies can participate as members of joint ventures but may not directly receive Federal funds.

Mr. Stanley noted that it would be premature to review the progress of the small number of TIP projects funded to date; hence the emphasis at this meeting was to seek advice from the Board on program direction and to discuss critical national needs.

Board Discussion: The Role of NIST and TIP

Several members commented on NIST's sterling reputation in the technical community. Its in-depth expertise and its neutral "honest broker" role often help the technical community develop standards about which consensus might otherwise be difficult to achieve. NIST's measurement expertise often contributes to progress in a variety of technical fields.

A question was raised about how progress towards TIP's goals might be measured. Mr. Stanley noted that NIST's Advanced Technology Program (ATP), which preceded TIP, had developed a rigorous assessment program. A report by the National Academy of Sciences, National Research Council (*The Advanced Technology Program: Assessing Outcomes*, 2001) concluded that this assessment program was world-class because ATP scrutinized both successes and failures, and

used state-of-the-art evaluation tools for assessing the success or lack thereof of *every* project—a thoroughness in results analysis that is rare in Federal R&D agencies. Even ATP applicants who did not receive awards were contacted to compare their success without Federal funding to that of awardees. That assessment know-how has been carried over to TIP. TIP's Impact Analysis Group intends to carry out an equally rigorous assessment program consistent with the TIP legislation and TIP's published Rule. Like ATP, TIP will employ "value-added project management." Unexpected technical challenges are often encountered in high-risk research projects. Because TIP projects are partnerships, TIP project managers serve as knowledgeable technical resources for projects. While a TIP project can be terminated if the project strays from its original intent or if the technical challenges prove too great, every effort is made to help TIP projects succeed.

Anti-trust concerns have often prevented companies in the same field from discussing common technical problems, but TIP can bring them together for workshops in a neutral environment. The National Cooperative Research Act (NCRA—15 U.S.C. 4305) also helps to mitigate anti-trust concerns for joint ventures through specific registration requirements under Section 6 of the NCRA, as required for TIP joint ventures in paragraph 296.7 of the TIP Rule. In addition to industry and NIST expertise, TIP also involves other Federal agencies, non-profit research institutes and the academic community through various outreach approaches. For example, TIP has established solid rapport with the Department of Energy (DOE) in technical discussions of critical national needs in energy, ensuring that TIP and DOE programs will be complementary. There is even less likelihood of inappropriate overlap between TIP and the National Science Foundation (NSF) because NSF funds basic research (discovery science) at universities, whereas TIP focuses on early-stage, high-risk innovation that has the potential to create transformational products in the medium term.

The Board encouraged TIP's managers to think beyond the normal technical disciplines and other constraining artificial boundaries. Interdisciplinary technical areas and interfaces between agency programs represent areas of opportunity. A Board member suggested that TIP not worry unduly about potential duplication among agencies. Familiarity with other agencies' related programs is important, but a certain amount of overlap is not necessarily a bad thing. For example, for a major technical challenge, having multiple agencies working on different approaches to a similar goal increases the chances of a breakthrough. Traditionally, Congress has been concerned about duplication of effort among agencies. To be successful, a program like TIP must demonstrate knowledge of what other agencies are doing and be able to show that the programs are complementary.

Mr. Stanley was asked about funding for TIP. He replied that $9 million was appropriated for the first year of the program and approximately $25 million for new awards is available this year. TIP generally does not fully fund multi-year projects up front, which means that each year there are out-year funding obligations or "mortgages" for the ongoing multi-year projects. Internal administrative costs as well as support for programs like the Small Business Innovation Research (SBIR) must also be subtracted from the total appropriation. The current budget under consideration by the Congress would result in about $8.3 million for new TIP awards next year, but of course that number could change.

The Board asked whether TIP projects were funded by grants or by contracts. TIP is currently using the cooperative agreement as its financial assistance funding mechanism, although TIP is actually authorized to enter into grants, cooperative agreements and contracts.

While TIP's funding is currently small compared to the program budgets of some mission agencies, the Board commented that TIP may be able to achieve high leverage—just as a pebble may deflect the path of a moving larger boulder. A breakthrough in a TIP project or results that reduce technical uncertainty might cause another research agency or other players in the technical community to significantly alter future R&D plans.

The Board felt that there was also a role for government demonstration projects that can show industry the value of a new technology. The Internet is a good example. Developed initially for government use, once the government began allowing industry to use the Internet, its value and its potential quickly became apparent, and industry embraced it.

On the other hand, the Board urged TIP to be accepting of high risk. If too many TIP projects meet all their goals, this might suggest that the program has been insufficiently aggressive in seeking breakthroughs or high leverage opportunities. Private sector R&D in the U.S. in recent years has been even more short-term oriented than it used to be and so TIP needs to push the envelope towards longer-term payoff projects with the potential to be game-changing.

The Board asked Marc Stanley to explain the intellectual property provisions of TIP. (See page 14 of the March 2009 *TIP Proposal Preparation Kit* for details.) Awardees are encouraged to patent innovations developed in TIP projects. While the government reserves the right to a non-exclusive, royalty-free license to use the technology for government purposes, this right is rarely invoked. Similar provisions applied to the Advanced Technology Program and it never became an issue. The Bayh-Dole Act applies to single applicants, with some additional requirements, to ensure that title to inventions vests with a U.S. entity. Universities may own patents. TIP joint venture members can negotiate ownership of inventions among any participant(s) in the joint venture.

The Board noted that in some fields (e.g., information technology) patents are less important than in others. Patent exclusivity for pharmaceutical firms is probably less important than is often thought. Money is wasted because patenting can be expensive, there are cases of patents that should never have been granted, and they create roadblocks for firms seeking to innovate.

The role of business mentors is important to high-tech start-up companies. The Board recommended that TIP foster communication between the companies it funds and venture capitalists. (TIP provides public information about funded projects but not proprietary information.) Mr. Stanley mentioned the ATP "halo effect" whereby projects that received ATP funding were more likely to receive venture capital funding later because the venture capital community knew that ATP-funded projects had survived intense scrutiny. No doubt TIP projects will be viewed similarly by potential funders. ATP also arranged public meetings between the technologists and the funding community to foster mentorship of small companies.

Board Discussion: Energy

Global warming and related energy concerns (e.g., the nation's strong dependence on imported fossil fuels) were mentioned several times by Board members as critical national needs that TIP might help to address. New technology is a must. A related topic is technology and standards for a "smart" national electrical grid that would manage and distribute energy more efficiently and cost-effectively.

Jeffrey Andrews noted that in his experience in the venture capital field, energy projects are often capital intensive and involve complex regulatory and public policy issues and therefore many times are not a good fit for venture capital. Those willing to fund large-scale energy projects typically shun technology risk. Technologies such as the "smart grid" are likely to move slowly given the regulated and complex structure of the industry. NIST is already working on smart grid issues and since standards are so important, NIST and TIP can play a valuable role.

There appears to be a growing consensus that future automobiles will evolve in the direction of plug-in hybrids and/or electric vehicles. The research director for General Motors believes that light-weight cheaper vehicle batteries is a key critical national need. Aspects of battery research, therefore, would be an appropriate topic for TIP.

An Israeli demonstration project called Project Betterplace was cited as a good example of an innovative approach that could prove successful. This project involves plug-in hybrid vehicles with batteries that can be quickly swapped for fully-charged batteries at the analog of a gas station. This is a chicken and egg situation. No one is likely to purchase a vehicle of this type unless there are a sufficient number of "filling stations" at convenient locations where rapid battery swaps can be made. But no one is likely to create the battery "filling stations" unless enough vehicles exist to justify the investment. Even with gasoline prices currently considerably lower than the peaks experienced last summer, plug-in hybrid electric vehicles with swappable batteries appear to be able to compete successfully with regular gasoline engine vehicles in life cycle costs, but the infrastructure problems are daunting. One must reach a certain critical mass before an approach such as Project Betterplace can succeed.

That example and others make it clear that one cannot consider technology apart from business models. Radically new technology often requires new business models. No matter how elegant a new technology may be, if no one can figure out how to make money with it, it will not be adopted. TIP managers must consider whether there are viable business models to accompany the new technology that it funds.

Another thought expressed by the Board was that the combination of a smart grid and new electric vehicle battery technology might help ameliorate a problem that has always plagued electric utility companies—energy storage. Peak load power is much more expensive per kilowatt-hour than base load power. Cheap, efficient energy storage would help, but up to now it has not been available. Renewable energy creates even more need for energy storage—for wind turbines when the wind does not blow, and for photovoltaic when the sun is not shining. If huge numbers of people bought electric vehicles with storage batteries and had them plugged in when they were not driving, and if the grid were designed so that power could flow either to or from

the batteries, then the nation would have a massive dispersed energy storage system and that could have important implications. Obviously there are complex issues of controls, metering and billing to be solved. If homes had energy stored in this manner, and an appropriate control system was in place, peak loads could be reduced. That would reduce the amount of investment required for transmission, distribution and generation infrastructure.

The Board commented that government policies sometimes adversely affect the ability to adopt new technology. When utilities owned their generation, transmission and distribution, it might have been easier to implement new approaches such as the smart grid. The extensive deregulation that has taken place complicates the picture because in any given area there is no longer a single vertically integrated company that can model and control the entire utility system from the generator to the consumer. Utilities in some cases may actually be prohibited by regulation from adopting distributed storage. So this is a public policy issue as well as a technical issue.

Projects to improve energy efficiency are also a critical national need. An example of proliferating energy inefficiency was cited. Today homes and businesses have a huge number of "wall-warts" (adapters that convert 110-VAC to lower voltage DC for things like wireless telephone chargers, answering machines, laptop computer power supplies, cable boxes, and many other electronic gizmos). They consume energy even when the device being powered is disconnected. Collectively, these inefficient devices use considerable electrical energy. Would it make sense to wire homes with low-voltage DC power? The Board commented that it could save considerable energy, but the cost of retrofitting homes would be prohibitive. While it may not be high-tech technology, standardizing chargers and other low voltage DC power supplies could have benefits for consumers. Developing "smart bricks" might be a better technical approach to this problem. Power supplies that could communicate with the devices into which they are plugged would enable them to shut down when power is not needed. A universal power supply that could supply the proper voltage for any low voltage DC-powered device would save resources.

Lower cost photovoltaic is another example of a technology that was suggested where TIP could have an impact. The generic area of converting waste heat to useful energy is yet another. Building technology in general is ripe for these types of improvements.

Board Discussion: Healthcare

The Board agreed that lowering the cost of healthcare is definitely a critical national need. Managing and shortening the supply chain between drug company and patient so that a patient can receive just the right dosage at just the right time without too many intermediaries could reduce costs and also improve treatment outcomes.

Personalized medicine holds great promise. Establishing baseline data for patients and monitoring excursions is important for managing a variety of diseases. An example: equipping a patient with simple unobtrusive sensors that can collect data (e.g., blood pressure) in real time and report the data via cell phone to a physician's database. TIP might fund projects to promote such advances.

Seamless information flow is another area of opportunity noted by the Board. Doctors, hospitals, drug companies, pharmacies, insurance companies, and patients are currently disconnected. The system for paying for medical care is unduly complex and generates too much paper and administrative burden. Information is stored in many different forms by different users. Standardized formats are difficult to implement.

If a patient has been treated at one hospital and later experiences a similar problem in a different city, there should be a way for the two hospitals to share medical information quickly. Technologies that allow such data sharing to occur seamlessly without compromising personal privacy are needed. Secure data-sharing permission strategies, perhaps involving encryption, are elements of a solution. Problems of this sort are complex because their solution may involve interfaces between technical issues and legal issues.

A Board member cited an example of an actual near disaster attributable to insufficient patient information. Microwave ablation to the patient's head was proposed as a treatment option. The doctor managing the treatment was initially unaware that the patient had a cochlear implant (which would rule out microwave ablation).

Failures in drug development are costly. Better information flow during clinical trials (identifying failures sooner) could result in cost savings. The present system of a series of trials is not the most efficient model.

Board Discussion: Manufacturing

TIP has identified manufacturing as a critical national need. The Board agreed that manufacturing challenges and technical barriers can be found in fields as disparate as pharmaceuticals and heavy machinery. Lower labor costs offshore are often cited as the rationale for shifting manufacturing to other countries. But there are other factors that come into play in choosing factory sites. Locating a factory in the country where the sales are taking place is sometimes a prerequisite for doing business. For large earthmoving equipment, labor costs may account for only about five percent of product cost. Proximity to skilled engineering talent is an important factor. When concerns about offshore production first began, the assumption was that the loss of U.S. jobs would be predominately factory-floor workers. Now, with worldwide high speed internet access, even engineering tasks can be contracted to off-shore experts.

The machine tool industry often employs proprietary control systems. Being able to interface design tools with production machines, and getting production machines to communicate with each other, is an area deserving of more research. The semiconductor device industry makes extremely complex devices and has had to develop sophisticated modeling and simulation software to predict device performance. Opportunities for similar simulation tools probably exist in other fields. If human physiology were better understood, the drug industry might be able to better model how a new drug would be likely to affect different patients.

More and more, companies are being expected to take back used products or machines for recycling. This is commonly being done now with printer cartridges, but increasingly other products will be returned to the manufacturer. Non-destructive evaluation technology that allows a manufacturer to quantify the remaining lifetime in used parts or subassemblies is important.

Action Item: Marc Stanley asked Dr. Cooney to poll his colleagues at MIT about opportunities for improving manufacturing productivity in the companies with which they interact.

Board Discussion: Information Technology and Wireless

Software quality control is an area where improvement is needed and where TIP might help. Programmers can generate code rapidly, but finding bugs is much more time consuming and difficult. Today, software modules may be generated anywhere in the world and need to be merged without creating additional problems.

Better ways to interface business processes in supply chains are needed. Exchanging information such as order entry, inventory controls, etc. across different software platforms in a seamless way could reduce paperwork and redundant data entry.

As people increasingly use roaming modes (for their Blackberries and laptops), the problem of authentication becomes more acute. Ensuring that an individual is actually who he or she claims to be is critical. Banks in particular need better authentication technology. NIST's Information Technology Laboratory has considerable expertise in this area. Identity theft is on the increase, and TIP might work on finding better solutions. Traditional password protection schemes are often insufficient to deter fraud. Two-factor authentication and/or more sophisticated biometric approaches are needed. Even cryptography does not help if a criminal installs a keyboard scanner on your device. There would be obvious benefits resulting from a simple, cheap device to ensure that if your laptop or cell phone were stolen, the thief could not use it.

Board Discussion: Other Topics and Summary Thoughts

There has been considerable interest in green technology in recent years—developing more environmentally benign materials and processes. Expensive printer ink cartridges are produced in huge quantities every year and must be replaced frequently. Is there a better way? Being able to *measure* how green a process is could be useful. Replacing incandescent lighting with LED lighting could spark a revolution if costs could be lowered sufficiently. Replacing oil-based feedstocks with biomass-based feedstocks is yet another promising area for TIP.

A Board member suggested that if, at future meetings, TIP presented the Board with a list of options under consideration for areas to pursue, it might help the Board come to closure more quickly on the most appropriate technical area priorities.

Another member summarized his closing thoughts as follows:

1. The role of TIP in supporting, promoting, and accelerating innovation through high-risk, high-reward research in areas of critical national need is rather unique, and important to the economy.

2. TIP projects should fill such gaps, especially at interdisciplinary boundaries.

3. TIP's convening power means that TIP's modest resources can leverage funding by other agencies.

4. Business models must change to accommodate new technologies. A new technology will not succeed unless a suitable business model accompanies it.

5. In the healthcare area, information technology focused on the patient is where many opportunities lie—making information available where and when it is needed.

6. TIP should focus on technical problems that, if solved, would have major impact. The private sector should lead in identifying technical problems in areas of critical national need.

By coordinating with the NIST labs and the standards community, TIP can also help to ensure that necessary standards to support new technologies are developed in a timely fashion, and this can help bring new technologies to the marketplace sooner.

An audience member (not from NIST) commented that his experience in working with Marc Stanley has been uniformly positive. He opined that the Board would find Mr. Stanley open to suggestions, and that he (Mr. Stanley) runs a government program the way that a business executive would want it to be run.

Concluding Remarks from the TIP Director

Mr. Stanley reminded the members that the Board's annual report to the Secretary of Commerce and the Congress can be an important vehicle not only for making recommendations about TIP, but could affect technology policy more widely. The Administration is committed to fostering technological innovation. There is no longer an Office of Technology Assessment within the Congress, or a Department of Commerce Technology Administration to explore issues of technology for the nation. The Technological Innovation Progam is seen as an important program for identifying opportunities for innovation, and hence may have influence on public policy disproportionate to its modest funding level. Mr. Stanley recommended that at each meeting, Board members flag important points that should be included in the annual report.

TIP must focus on high-tech, high-risk solutions, and not all of the suggestions made at this meeting fall into that category; however, many do, and the program will certainly consider them.

Mr. Stanley concluded by saying that he felt the discussions were extremely valuable and stimulating.

The next TIP meeting has tentatively been scheduled for December 8.

This meeting was adjourned at 2:40 p.m.