

VISITING COMMITTEE ON ADVANCED TECHNOLOGY
National Institute of Standards and Technology

2012 Annual Report

Visiting Committee on Advanced
Technology
of the
National Institute of Standards and
Technology

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VISITING COMMITTEE ON ADVANCED TECHNOLOGY
National Institute of Standards and Technology

Preface

The Visiting Committee on Advanced Technology (VCAT) of the National Institute of Standards and Technology (NIST) was established in its present form by the Omnibus Trade and Competitiveness Act of 1988 and updated by the America COMPETES Act. The VCAT is a Federal Advisory Committee Act (FACA) committee and its charter includes reviewing and making recommendations regarding general policy for NIST, its organization, budget, and programs within the framework of applicable national policies as set forth by the president and the Congress. In addition, the America COMPETES Act calls for the VCAT to comment on NIST's three-year programmatic plan in its annual report to Congress. This 2012 annual report covers the period from the beginning of March 2012 through February 2013.

The Committee reviews the Institute's strategic direction, performance and policies, and provides the Secretary of Commerce, Congress, and other stakeholders with information on the value and relevance of NIST's programs to the U.S. science and technology base and to the economy. At the first meeting of each year, the Director of NIST proposes areas of focus to the Committee and agreement is reached on a program for the year. Over the past year, the Committee has been active in assessing NIST's contributions to and progress in the following areas:

- NIST Safety Systems and Safety Culture
- NIST Role in Advanced Manufacturing
- NIST Role in the Public Safety Network
- NIST Centers of Excellence
- R&D Planning
- NIST Budget

The Committee reviews a significant portion of NIST programs through direct discussion with NIST leaders, scientists, and engineers. Reactions and observations of the Committee members are presented candidly to the NIST senior management and other attendees at each meeting. This feedback encourages scrutiny of and continuous improvement in key areas in the overall operation. The Committee also visits various NIST laboratories and satellite facilities to discuss research projects directly with the technical staff. These laboratory tours help the Committee to assess the impact of NIST research, progress towards achieving research goals, the quality of the staff, institutional culture, and the efficacy of the facility infrastructure.

Under the Committee charter, the Director of NIST appoints the VCAT members. Members are selected on a clear, standardized basis, in accordance with applicable Department of Commerce guidance. Members are selected solely on the basis of established records of distinguished service; provide representation of a cross-section of traditional and emerging U.S. industries; and are eminent in fields such as business, research, new product development, engineering, labor, education, management consulting, environment, and international relations. No employee of the Federal Government can serve as a member of the Committee. Members are appointed for staggered three-year terms.

Two new members were appointed during the period covered by this report: William Holt (Intel Corporation) and John Tracy (Boeing Company). During the time of his service, vice-chair Alan Taub transitioned from General Motors to the University of Michigan and Pradeep Khosla moved from Carnegie Mellon to become Chancellor of University of California, San Diego.

This report highlights the Committee's observations, findings and recommendations. Detailed meeting minutes and presentation materials are available on the NIST web site at www.nist.gov/director/vcat.

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VCAT Members During the Period Covered by this Report

<p>Dr. Vinton G. Cerf, Chair Google Term: February 1, 2007 - March 31, 2013</p>	<p>Dr. Alan I. Taub, Vice Chair University of Michigan Term: May 9, 2008 - May 8, 2014</p>
<p>Dr. Sujeet Chand Rockwell Automation Term: April 1, 2010 - March 31, 2016</p>	<p>Dr. Uma Chowdhry DuPont (Emeritus) Term: October 1, 2010 - September 30, 2013</p>
<p>Dr. Tony Haymet Scripps Institution of Oceanography, UCSD Term: September 1, 2009 - August 31, 2015</p>	<p>William M. Holt Intel Corporation Term: May 13, 2012 - May 12, 2015</p>
<p>Dr. Karen Kerr University of Southern California Term: June 1, 2011 - May 31, 2014</p>	<p>Dr. Shaygan Kheradpir Barclays Bank Term: April 1, 2010 - March 31, 2013</p>
<p>Dr. Pradeep Khosla University of California, San Diego Term: June 2, 2008 - June 1, 2014</p>	<p>Dr. Roberto Padovani Qualcomm Technologies, Inc. Term: May 1, 2011 - April 30, 2014</p>
<p>Dr. Alton D. Romig, Jr. Lockheed Martin Aeronautics Company Term: April 15, 2009 - April 14, 2015</p>	<p>Dr. Darlene J.S. Solomon Agilent Technologies Term: January 3, 2010 - January 2, 2016</p>
<p>Dr. John J. Tracy The Boeing Company Term: January 7, 2013 – January 6, 2016</p>	

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1. VCAT Focus in 2012

In 2012, the VCAT focused its primary attention on four major NIST issues:

- Safety Systems and Safety Culture at NIST - The VCAT was charged with providing feedback on progress enacting the 2010 recommendation of the Blue Ribbon Commission on Management and Safety II. For additional information, see the scope and charge for the VCAT Subcommittee on Safety (below).
- Advanced Manufacturing - The VCAT was charged with providing feedback on the design of the National Network for Manufacturing Innovation (NNMI). The Committee used recommendations for the Advanced Manufacturing Technology Consortia (AMTech) as a launching pad plus input from the Request for Information (RFI) and regional workshops. The NNMI is a collaboration between NIST, the Department of Defense (DOD), the Department of Energy (DOE), and the National Science Foundation (NSF), and other government agencies to establish up to 15 Institutes for Manufacturing Innovation.
- Public Safety Networks - The VCAT was charged with using its recent report on the Nationwide Public Safety Communications System to address how NIST can best support the Public Safety Broadband Network in the context of the “First Responder Network Authority” (FirstNet) legislation. NIST will coordinate the development of interoperability standards, technologies, and applications to advanced public safety communications, drawing especially on its Public Safety Communications Research program housed at NIST in Boulder, CO.
- NIST Centers of Excellence - The VCAT was charged with sharing its unique experiences in public-private collaborations to help ensure that the mission and goals of the proposed NIST Centers of Excellence are met. The President’s FY 2013 budget request included \$20 million for up to four Centers of Excellence in measurement science areas defined by NIST for collaborations with academia and industry. This initiative builds on NIST’s long-standing and successful partnerships with academic organizations, such as JILA at the University of Colorado, Boulder, and the Institute for Bioscience and Biotechnology Research (IBBR) at the University of Maryland.

This 2012 Annual Report summarizes the VCAT’s work and the recommendations adopted and issued by the VCAT in each of the above areas. The report also includes our recommendations on R&D planning at NIST and the NIST budget to the extent possible given the current state of budget discussions in the U.S. government.

In addition, we note with pleasure that during calendar year 2012 the Smart Grid Interoperability Panel (SGIP) was successfully transitioned from an entirely government-funded model to a sustainable model in which the private sector and government share in the funding. Just a few months after beginning operation as a not-for-profit 501(c)3 corporation, nearly 100 companies and organizations have joined as dues paying members of the new SGIP, contributing \$800,000 annually in membership dues.

The VCAT was also impressed with the achievements of the Baldrige Performance Excellence Program (BPEP) over the last year, transitioning from a federally-funded program to a fee and Foundation-funded program. The VCAT believes the BPEP is an important contributor to the NIST portfolio and to performance improvement in the United States and should be sustained. In addition to its impact on business, the very high adoption rate in health care can make a significant contribution to health care quality and cost reduction. The VCAT encourages the Department of Commerce to provide support for the Baldrige business model, including its fee-based activities and support from the Baldrige Foundation. Given the public benefit of the program, some level of government support through appropriation and other agencies with compatible missions should not be ruled out.

2. NIST Safety Systems and Safety Culture

In 2012, the VCAT, in consultation with the NIST Director, established a Subcommittee on Safety within NIST to assess and recommend potential improvements. The charge to the subcommittee is shown below:

VCAT Subcommittee on Safety -- Tony Haymet, Chair

NIST is working diligently to address the recommendations of the NIST Blue Ribbon Commission on Management and Safety – II (BRC II), which were released in November 2010. In response to these recommendations, NIST has begun to (i) implement a safety, health, and environmental management system; (ii) develop a comprehensive NIST assessment program; and (iii) establish a suite of meaningful safety metrics. The charge to the VCAT Subcommittee on Safety was to:

- *Assess NIST's progress in meeting senior leadership's commitment to making safety an integral core value and vital part of the NIST culture*
- *Identify strengths and opportunities for improvement in both approach and direction.*

In the 2010 VCAT report, we recommended that NIST fully implement the recommendations of the NIST BRCII report. The 2011 VCAT report reviewed progress in the four primary recommendations, including (a) the appointment of an Associate Director of Laboratory Programs; (b) demonstration of the commitment to safety from senior NIST management; (c) establishment of an audit mechanism; and (d) a set of safety metrics.

The Subcommittee on Safety met in October 2012 and February 2013 to assess progress toward full implementation of the BRC II recommendations. The subcommittee met with a cross-section of NIST staff, including laboratory directors, division chiefs, organizational unit (OU)/division safety personnel (including division safety representatives (DSRs), and group leaders in Boulder and Gaithersburg. In addition, the subcommittee toured older facilities (Building 2 in Boulder and Building 245 in Gaithersburg) as well as newer facilities (the clean room facility in the Precision Measurement Laboratory in Boulder) in order to observe operating conditions.

During the year covered by this report, the committee also examined NIST's progress toward safety metrics. NIST has established and is currently tracking metrics in (a) establishment of the NIST Occupational Safety and Health Management System (OSHMS); (b) incident reporting and investigation; (c) radiation-safety program implementation; and (d) management of hazardous chemical waste.

2a. Establishment of the NIST Office of Safety and Health Management System

NIST's OSHMS is foundational to Occupational Safety and Health (OSH) management at NIST in that it establishes NIST's OSH requirements, delineates OSH roles and responsibilities, and provides the infrastructure to facilitate safety program implementation and management across the Institute. NIST began tracking progress in this area at the beginning of FY 2012 using (a) the number of draft OSH policies, orders, and suborders approved by the Chief Safety Officer per quarter; and (b) the number of draft OSH policies, orders, and suborders vetted through the NIST Executive Safety Committee (ESC) per quarter. Beginning in FY 2013, NIST will begin tracking the number of OSH program deployment plans vetted through the ESC per quarter, and the number of OSH programs deployed.

2b. Incident Reporting and Investigation

On August 30, 2010, NIST launched its Incident Reporting and Investigation Program and supporting Information Technology application, IRIS, both of which apply to all NIST workplaces. Using the web-based forms provided by

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IRIS, NIST OUs can submit incident reports, the results of incident investigations, and “lessons identified” to the Office of Safety, Health, and Environment (OSHE) for posting on the NIST safety website. IRIS also allows NIST staff members to subscribe to receive postings.

In this area, NIST is tracking the following initial set of metrics:

- Number of injuries per month;
- Number of illnesses per month;
- Number of spills/releases per month;
- Number of incidents resulting in property damage per month;
- Number of near misses per month; and
- Number of incidents other than the above per month.

In response to salient features in the data, NIST is now offering courses on machine-shop safety, promoting ergonomics training, and conducting informational campaigns on hand safety and the avoidance of slips, trips, and falls.

On April 1, 2012, and in the spirit of continual improvement, NIST deployed version 2 of the Incident Reporting and Investigation Program, including IRIS, and began tracking the following additional metrics, “making measurements” at the end of every month:

For initial incident reports posted to the NIST safety website during any given month:

- Total number of such reports;
- Number of such reports submitted within two business days of the incident;
- Number of associated incident investigation reports submitted within 20 business days of the incident; and
- Number of associated incident investigation reports not submitted within 20 business days of the incident as of the last day of the last month measured.

For initial incident reports posted at any time prior to the end of any given month:

- Number of associated incident investigation reports at month's end not submitted within 20 business days of the incident.

In addition, NIST is tracking the following two Occupational Safety and Health Administration (OSHA)-defined injury and illness incidence rates:

- Total Recordable Case (TRC) Rate – Number of recordable injuries and illnesses per 200,000 employee work hours (100 employees each working a 2000-hour work year); and
- Days Away, Restricted, or Transferred (DART) Rate – Number of injuries and illnesses of Types 3, 4, and 5 per 200,000 employee work hours.

2c. Radiation-Safety Program Implementation

NIST’s radioactive materials license in Gaithersburg requires quarterly audits of radioactive material facilities for compliance with U.S. Nuclear Regulatory Commission regulations and license requirements. Moreover, recent annual external audits have indicated that NIST needs to strengthen its quarterly audit program. As a result, NIST has formalized this program to a great extent and in the third quarter of FY 2012 began to track and communicate audit results to involved NIST management and staff. In addition to audit findings, NIST is also tracking and communicating recommendations and noteworthy work practices. Over time, NIST expects this effort to result in

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an increased understanding of regulatory requirements, uniformly good work practices, and a significant decrease in the number of findings.

2d. Management of Hazardous Chemical Waste

NIST has developed a formal inspection program for its satellite accumulation areas in Gaithersburg and in the third quarter of FY 2012 began to track and communicate audit results to involved NIST management and staff. Over time, NIST expects this effort to result in an increased understanding of regulatory requirements, uniformly good work practices, and a significant decrease in the number of findings.

OBSERVATIONS:

A culture change toward safety is well underway at NIST. It is moving from the “design-build” phase to one of continual improvement. While NIST has made substantial progress in developing a positive safety culture, the NIST recordable incident data do not yet demonstrate a clear downward trend. The underlying driver of the incidents appears to be high frequency, lower consequence events (rather than low frequency, higher consequence events). This observation may point to a need for an approach to prevention and education activities within the safety system that emphasizes the prevention of more routine incidents such as slips, trips, and falls; body parts struck by or against objects; and ergonomics, including various types of overexertion.

RECOMMENDATIONS:

- NIST’s safety goal should be zero accidents. The VCAT encourages continued recognition of and reward for safety improvement.
- The VCAT recommends continued “grand rounds” audits of individual laboratory rooms led by senior, trained NIST executives.
- The VCAT recommends that NIST set a firm target for improvement in each OSHA recordable statistic.
- The VCAT urges the NIST Director to distribute and discuss IRIS statistics each reporting period. Based upon these reports, NIST leadership should identify top priority IRIS issues and action plans to reduce occurrence. Progress will be reviewed as a standing agenda item at the beginning of each VCAT meeting.
- The VCAT recommends that NIST concentrate its investigation time and reports on OSHA recordable incidents.
- The VCAT strongly urges increased “transparency” on all safety metrics, including easily accessible identification of the exact stage at which any non-closed IRIS cases are at any time.

3. NIST Role in Advanced Manufacturing

In 2012, the VCAT continued its focus on Advanced Manufacturing at NIST, but broadened its lens to survey the entire NIST advanced manufacturing portfolio, from conducting basic research to supporting manufacturers with commercial products. Across these programs, NIST is using a number of partnering mechanisms to support engagement with industry (including small and medium sized enterprises), academia, and other government laboratories. The VCAT was specifically asked to consider the following questions:

- Looking across the various programmatic efforts, are there any gaps in the approach to support the NIST mission of promoting U.S. innovation and industrial competitiveness?
- Our current laboratory programs support emerging technologies and systems interoperability issues. From a program growth and focus perspective, are these appropriate areas in which NIST should focus?
- What is required for NIST’s portfolio to be adequately positioned to meet challenges associated with near-term and long-term national advanced manufacturing needs?

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- Considering congressional support for AMTech at a level of \$14.5 million, what steps should NIST take to ensure maximum benefit from this program?

3a. NIST's Portfolio of Programs in Advanced Manufacturing

Enhancing U.S. manufacturing competitiveness through the delivery of measurement science, standards and technology is at the heart of what NIST does, and is called out in the founding documents that established the National Bureau of Standards in 1901. Long-term economic competitiveness is strengthened by the development and deployment of NIST's advanced manufacturing technology capabilities. NIST aligns its research and services with pressing industry needs through partnerships with manufacturers, academic and government laboratories, and through staff participation in more than 1,000 international standards activities.

- **The NIST Laboratories** address increasingly complex measurement challenges, ranging from the very small (nanoscale devices) to the very large (vehicles and buildings), and from the physical (renewable energy sources) to the virtual (cybersecurity and cloud computing). Research at NIST is underway to develop and deliver the measurement science tools that will support advanced manufacturing technologies, including materials modeling and simulation, nanomanufacturing, biomanufacturing, smart manufacturing, robotics, and other enabling technologies.
 - **Measurement science and standards services** developed at NIST provide the basic and applied research underpinnings to support advances in manufacturing. Physical measurement standards are providing traceability to a common, international standards system – through calibration services, lab accreditation, and other means. NIST efforts are vital to pushing the state-of-the-art in materials characterization and providing critically evaluated materials property data, methods, and standard reference materials to industry.
 - NIST provides the enabling **interoperability standards and tools** to allow manufacturers and researchers to lower costs and accelerate innovation. Standards and other guidance tools open up access to information about shop floor equipment, assist in supply chain management, and support the development of a secure cyber infrastructure. NIST is providing industry with support for open, consensus-based standards and specifications that define technical and performance requirements, with associated test methods for conformity. Some NIST standards also have the benefit of enabling interoperability among disparate systems or competitively produced products, enabling consumer choice and multiple sources of supply.
 - **Unique, cutting edge user facilities** support innovation in materials science, nanotechnology discovery and fabrication, and other emerging technology areas through the NIST Center for Neutron Research, which provides world class neutron measurement capabilities to the U.S. research community, and the NIST Center for Nanoscale Science and Technology, which supports nanotechnology development from discovery to production.
 - **Technology and knowledge transfer** from NIST to promote U.S. competitiveness is enabled through various agreements and intellectual property tools such as NIST inventions, patents, and licenses. Visiting scientists and postdoctoral researchers develop technical expertise through research experiences at NIST.
- **Hollings Manufacturing Extension Partnership (MEP)** is supporting technologies and practices that increase the competitiveness and resilience of our nation's small and medium manufacturing base. A federal-state-local partnership, MEP is enabling future growth with a long-term focus on encouraging cultures of continuous improvement, accelerating the adoption of new technology to build business growth, responding to evolving supply chains, implementing environmentally sustainable processes, and supporting a strong workforce.
 - MEP, in partnership with other organizations, is developing the National Innovation Marketplace (NIM) to facilitate connections between original equipment manufacturers (OEMs) and potential

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suppliers. Through the NIM, sellers, buyers, investors, and distributors across industries are connected through an approach incorporating training, business opportunity forecasting, and access to manufacturers.

- ExporTech is deployed nationally as a collaboration between MEP, U.S. Export Assistance Centers, and other partners including the Small Business Administration. Helping companies enter or expand in global markets, ExporTech leads companies through a facilitated process.
- **Baldrige Performance Excellence Program** – The Baldrige Program promotes excellence in organizational performance; recognizes the quality achievements of U.S. manufacturers, small businesses, and other types of organizations; and publicizes successful performance management strategies. The program also manages a national award that has become a global standard, and one measure of its importance is the growing number of similar programs throughout the world. *(Note: this program has been eliminated from the NIST budget, having transitioned to a foundation-supported model.)*

PROPOSED Programs in the NIST Portfolio:

- **National Network of Manufacturing Innovation (NNMI)** – A proposed \$1 billion program in FY 2013, the NNMI is envisioned as a nationwide network¹ of up to 15 Institutes for Manufacturing Innovation (IMIs) to provide the R&D infrastructure needed to support a robust advanced manufacturing sector by filling a critical gap in the U.S. innovation pipeline. The NNMI will help ensure that manufacturers have access to critical expertise and facilities needed to meet America’s advanced manufacturing needs. The Advanced Manufacturing National Program Office (AMNPO) is coordinating the stakeholder outreach for the design of the NNMI, and is positioned to launch the program (upon funding).
 - **Status:** Stakeholder outreach for input to the design of NNMI is ongoing. Legislation is required to establish this program.
 - **“Pilot”** - In August, DOD announced the new National Additive Manufacturing Innovation Institute (NAMII) that was awarded to a consortium based in the northeastern OH – western PA – WV “Tech Belt.” At least \$30 million in government funding (from DOD, DOE, NASA, NIST, and NSF) will be matched by \$39 million from the proposer team (\$20 million from industry). Though not officially part of the NNMI program, many lessons learned in designing and building NAMII are strengthening Federal coordination and the design for the NNMI.
- **AMTech** – This proposed NIST program (\$21 million in FY 2013) will provide funding to establish industry-led consortia to create technology roadmaps to identify and tackle long-term R&D challenges shared by industry. AMTech consortia will enable university research capabilities to be focused on industry-driven R&D, lower the risk to investment in new technologies, and accelerate technology transfer.
 - **Status:** The AMTech program is supported in both the House (at \$21 million) and Senate (at \$14.5 million) marks for the FY 2013 budget, but as a new program it is not included in the Continuing Resolution for FY 2013 (which extends FY 2012 activities).

¹ The term “network” is used in its most general sense here, but it is highly likely that the institutes will also be interconnected through high speed communication services (e.g. Internet) to facilitate and mutually reinforce their collective work.

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NEW Organizational Resource in the NIST Portfolio:

- **Advanced Manufacturing National Program Office (AMNPO)** – Created in December 2011 by the Secretary of Commerce, the AMNPO is an interagency office hosted by NIST, which serves as the central point of contact for federal programs in advanced manufacturing. The purpose of the AMNPO is to create and implement a whole-of-government advanced manufacturing strategy. The AMNPO is also responsible for planning and executing the NNMI.

NIST FY 2013 Requested Funding in Advanced Manufacturing Programs		
<i>NIST Program</i>	<i>FY 2013 Requested Budget</i>	<i>Additional Comments</i>
Laboratories	\$135 million	This includes new initiatives funded starting in FY 2012: smart manufacturing; biomanufacturing; advanced materials modeling and simulation; and nanomanufacturing.
AMTech	\$21 million	VCAT provided support for this program in the 2011 Annual Report; the report noted that the funding level needs to be sufficient for the program to be successful.
MEP	\$128 million	Federal funding leveraged over 60 MEP centers; each center provides 2:1 cost share of the program.
NNMI	\$1 billion	Mandatory spending – requires legislation.
Baldrige	\$0	This program has transitioned to the private sector.

In addition to hearing from NIST on these programs, the VCAT was also briefed by Dr. Kanti Jain who chaired a National Research Council committee that was charged with assessing the NIST manufacturing portfolio. Principal findings in the report included a positive overall assessment of the technical merit and scientific caliber of research. Research teams were found by the panel to be highly qualified and among the best in the world. The panel did, however, find room for improvement in project selection, organization, and metrics. Further, the panel found that interactions with industry should be expanded, including more visits to companies and greater awareness of industry practices. The VCAT agrees with these findings, and sees both the proposed AMTech Program and the NNMI program as efforts that will help strengthen NIST’s ties to industry.

OBSERVATIONS:

While manufacturing and standards have been a part of the NIST (and the former National Bureau of Standards) portfolio from its origins, this new program is particularly vital to the future of the American economy. Efficient manufacturing of complex goods lies at the heart of successful export economies and the re-invention of manufacturing and manufacturing jobs in America has to be considered fundamental to future economic growth.

The VCAT fully supports the ongoing and planned work at NIST, and feels strongly that NIST’s measurement science mission, its unique and longstanding relationship with industry, and its broad portfolio of programs make it a critical element of the Administration’s efforts to strengthen manufacturing in America.

RECOMMENDATIONS:

- The VCAT strongly urges Congress and the Executive branch to fund NIST’s Advanced Manufacturing programs at the maximum level feasible. Just as the Agricultural Extension program was the backbone of the American farming economy in the 20th century, the Advanced Manufacturing programs will provide a similar role in the 21st century.

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- The VCAT recommends that NIST establish additional definitions and metrics beyond job creation and competitiveness for successful outcomes from the Advanced Manufacturing programs. Metrics might include environmental impacts, lifecycle costs, re-use of materials and subsystems, carbon footprint measurement standards, portable on-line measurement systems, and modularity.
- The VCAT is interested in understanding more fully the interaction between the IMIs and other manufacturing initiatives undertaken by NIST. The potential for mutual reinforcement seems very high and should be a strategic goal of the programs.
- NIST should consider linking Cyber-Physical Systems and Advanced Manufacturing efforts to develop devices and appliances that measure themselves, report status and other usage statistics, security status, etc. The Smart Grid program might be a fruitful area in which to pursue this idea.

4. NIST Role in the Public Safety Network

Following up on last year's work looking at the NIST role in the Wireless Innovation Initiative (http://www.nist.gov/director/vcat/upload/Desirable_Properties_of_a_National_PSN.pdf), the Committee heard updates from both the National Telecommunications and Information Agency (NTIA) and NIST regarding developments surrounding the creation of FirstNet and operations of the NIST Public Safety Communications Research (PSCR) Program. Title VI of the Middle Class Tax Relief and Job Creation Action of 2012, Public Law 112-96, included provisions for the public safety communications and electromagnetic spectrum auctions. This legislation creates the path toward a nationwide public safety broadband network (PSBN). FirstNet was established by the Act as an independent authority within NTIA and is headed by a 15-member Board that takes all actions necessary to ensure the design, construction, deployment, and maintenance operations of the nationwide PSBN in consultation with others, including the NIST Director. The Board is not an advisory committee; however, it will establish a public safety advisory committee.

Congress granted NTIA borrowing authority not to exceed \$2 billion to implement the governance of the public safety spectrum and \$135 million for the State and Local implementation grants. NTIA will borrow the initial funds from the general fund of the Treasury prior to the deposit of auction proceeds into the Public Safety Trust Fund (PSTF). Once the auctions take place, funds deposited in the PSTF are available on a cascading order of priority as mandated by statute, beginning with the repayment of the amounts borrowed by NTIA. If the auction raises \$7.235 billion, then \$100 million will be available to NIST to manage for public safety research and development. Further down on the priority list is \$200 million for additional public safety research provided the auction raises these funds. The research funds may be available in a few years.

The PSCR Program is a successful joint partnership between NIST's Law Enforcement Standards Office (OLES) and NTIA's Institute for Telecommunications Sciences housed in Boulder, CO. This program includes staff from both organizations that have been operating as a team for about 15 years. Some PSCR activities directly overlap FirstNet's responsibilities within the parameters of the legislation. These responsibilities cover requirements, standards, testing, and research and development (R&D). PSCR has been working in the area of public safety requirements for the safety, security, and resiliency of the network for years, especially in the broadband arena by chairing, leading, and/or participating in working groups and other activities. With regard to standards, PSCR has been working to drive public safety needs into international standards bodies when developing standards for voice, data, and video communications. For example, PSCR has introduced a work item into the 3rd Generation Partnership Project to address Direct Mode communications, an effort that aligns directly with the recent VCAT report on public safety. In the area of testing, PSCR is working to identify the commercial test processes that FirstNet can leverage. Turning to R&D, the PSCR is responsible for the only operational multi-vendor broadband Demonstration Network in the United States, which is now deploying four separate operational cellular networks from different manufacturers. Over 60 manufacturers are involved with the Network through Cooperative

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Research and Development Agreements (CRADAs) and about \$60 to \$70 million of equipment have been donated through CRADAs. Other R&D efforts include audio quality testing, video quality testing, 700 megahertz modeling and simulation, and Land Mobile Radio to Long Term Evolution (LTE) interface.

In addition to the discussions on the PSCR Program, the VCAT was also briefed on the intention of NIST to create a Center for Advanced Communications at its Boulder laboratories that would take advantage of the unique mix of research and testing and evaluation capabilities resident there. The Center would help enhance mission effectiveness by better coordinating the measurement science, testing, and standards functions of NIST and NTIA in the area of advanced communication addressing challenges in a number of areas including, Radio Frequency Technology, digital information processing, and spectrum sharing. Furthermore, the Center would create a single focal point for engaging both industry and other government agencies to meet their testing, validation, and conformity assessment needs. The VCAT is excited by the possibilities of the Center and looks forward to working with NIST over the coming year to help support its development.

OBSERVATIONS:

The VCAT report on public safety communications referenced above drew attention to the hazards of relying heavily on existing infrastructure, such as the mobile communication service industry's Long Term Evolution (LTE) design and its associated network of towers and base stations. The report emphasized the need for peer-to-peer (or "talk around") capability, backward interoperability with P25-based devices and, perhaps most important, the ability to form ad hoc networks using packet switching, delay and disruption tolerant methods and application of the Internet protocols to support carriage of voice, video and data to and from first responders and information facilities available from online public safety resources in government at all levels and the private sector.

RECOMMENDATION:

- NIST should track closely the progress of the NIST efforts in FirstNet to achieve coverage and interoperability at all levels of public safety operation. Interoperability is needed not only among the civilian first response community but also with the military when they are called into service to respond to major disasters.

5. NIST Centers of Excellence

The Centers of Excellence, proposed at \$20 million in the President's FY 2013 budget, are an opportunity to leverage NIST base resources through partnerships with academia and industry. NIST has a proven track record of partnerships, including JILA (with the University of Colorado), the Institute for Bioscience and Biotechnology Research (IBBR – with the University of Maryland Biotechnology Institute), the Joint Quantum Institute (JQI – with the University of Maryland and the National Security Agency), and the Hollings Marine Laboratory (with the National Oceanic and Atmospheric Administration, the South Carolina Department of Natural Resources, the College of Charleston, and the Medical University of South Carolina). The goal of the FY 2013 proposed program is to create multidisciplinary centers that complement and extend U.S. measurement science capabilities in critical areas of emerging technologies.

The structure and scope of the centers is currently being developed. NIST is considering a variety of engagement and governance models, ranging from a user facility model (similar to the Center for Nanoscale Science and Technology), to a problem-focused, multi-stakeholder model (similar to the National Cybersecurity Center of Excellence), to long-term collaborations (similar to JILA). Form may follow function, as the governance model may

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be tailored to suit the nature of the technology and measurement science needs, and therefore, may be different from one center to the next.

NIST is currently gathering input from multiple sources to identify potential investment areas for the centers. Each laboratory has provided a list of candidate research topics, along with proposed governance models and specific measurement science issues. Additionally, the Science and Technology Policy Institute (STPI), part of the Institute for Defense Analysis (IDA) was awarded a contract to independently develop research ideas for centers of excellence. STPI scanned the available literature and interviewed key subject matter experts in order to identify emerging areas of science with significant potential for impact, clear measurement science needs, and alignment with NIST mission and strategic direction. These inputs, along with other factors, will help jump-start the selection process for centers of excellence, which may have to move quickly, depending upon when the funding becomes available.

OBSERVATIONS:

Measurement and analysis lies at the heart of successful forensic work and, increasingly, NIST measurement science can and is playing a key role in the steady improvement in forensic analysis. A Center of Excellence in forensic science could be a potential tool to strengthen this community.

In relation to the topic, the VCAT also received several updates on the National Cybersecurity Center of Excellence (NCCoE). Significant progress has been made in standing up the NCCoE to date, and the VCAT is strongly encouraged to learn that NIST is investigating the possibility of establishing a Federally Funded Research and Development Center (FFRDC) as the managing entity for the NCCoE. The VCAT believes that such a mechanism could greatly enhance the ability of the NCCoE to accelerate the delivery of cybersecurity solutions to industry. The VCAT looks forward to supporting NIST in this area over the coming year.

RECOMMENDATIONS:

- A gap analysis for emerging areas of national need should inform the choice of focus for new centers of excellence.
- The VCAT recommends that NIST should expand its footprint in forensic science.
- In addition to its existing partners that have established JILA, the Institute for Bioscience and Biotechnology Research (IBBR), the Joint Quantum Institute (JQI), and the Hollings Marine Laboratory (HML), NIST should consider formally adding NSF as a partner, especially in relation to cybersecurity and cyber-physical systems.
- While a National Cybersecurity Center of Excellence has been created, the VCAT recommends that its scope be expanded to include “cyber-safety” which includes attention to user behaviors, civilian private sector cyber-practices, and coordination with other agencies including the Department of Homeland Security, Department of Justice, and the National Security Agency. The VCAT endorses the FFRDC framework for the management and operation of the NCCoE.
- Reference architectures and metrics of security and safety deserve attention, as does the development of tools for measuring these properties. Compliance with recommendations needs to be leavened with a risk-based approach to conformity assessment practices.

6. R&D Planning

Dr. Willie May, Associate Director for Laboratory Programs (ADLP), reported to VCAT on R&D planning at NIST. As science and technology priorities come from Congress, the Administration, industry, and other federal agencies,

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NIST planning is a fusion of top-down and bottoms-up planning processes. Planning challenges include the breadth of the NIST mission and the dynamic environment of innovation and technology development. These challenges are managed through several different components of the organization.

The ADLP is primarily responsible for strategic planning over a three to four year horizon for the Strategic Focus Areas, with support from the Program Coordination Office, as well as the laboratory directors. Strategic planning includes both program and budget development. In addition, the ADLP is responsible for overseeing measurement services programs and representing the laboratory programs to industry, academia, and other government agencies.

The laboratory directors are primarily responsible for planning within the mission space of their respective laboratories, with a five to ten year horizon. In addition, the laboratory directors have responsibility for the effective implementation of the programs and projects and delivery of measurement services.

OBSERVATIONS:

The VCAT continues to look for more clarity and depth in strategic planning, recognizing that NIST operates in a dynamic environment in which demands arise from a variety of sources that can and do affect its ability to adapt. The newly instituted planning framework offers the opportunity to align the organizational long term plans around the three key perspectives of National Priorities, Science and Technology Trends, and Internal Processes. This approach can then lead to clearly defined and actionable plans around Programs, Technical Capacity, and Process Improvements.

RECOMMENDATION:

- The VCAT strongly encourages NIST to drive this new strategic planning process as quickly as possible and we look forward to reviewing the progress during the upcoming year.

6a. Next Generation Measurement Services

Measurement services are a core function at NIST. The next generation delivery of measurement services is an example of one of the strategic issues that NIST is examining in order to ensure that its programs and services are well aligned with future needs.

Measurement and calibration services assure the accuracy of millions of measurements made daily in medical clinics, manufacturing plants, industrial facilities, and crime labs throughout the United States. NIST performs over 18,000 calibrations on over 1,800 objects annually. However, traditional measurement service may require significant down time for customer equipment or devices, consume significant NIST staff time, require periodic recalibration, and may be less flexible when customer needs change.

NIST is developing a next-generation plan for advancing measurement services, called NIST on a Chip. NIST on a Chip is an integrated program to develop and deploy NIST-traceable measurements and physical standards that are deployed in the customer's lab, factory floor, device, or system; are easily used and integrated; are rugged, yet small in size and weight; and have low power consumption. As the reference standard is integrated into the device or process, many of the difficulties of the traditional measurement service model can be overcome, including minimal down time and recalibration, as well as improved flexibility for innovation. Measurement technologies include force, fluid flow, pressure, length, voltage, current, magnetic field, time and frequency, optical power, displacement, and electric field.

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OBSERVATIONS:

The VCAT was strongly impressed by the potential of the proposed work and looks forward to seeing progress in this area. In particular, device self-measurement and potentially reporting via network raises the possibility of the creation of significant databases of information that could be used to analyze and improve efficiency of electrical power usage and other resource utilization. The Smart Grid program is prototypical of this notion. These ideas are clearly applicable to the advanced manufacturing initiatives in which production plant automation, inventory and raw materials management, product production selection, among other things, are key to efficient and timely production of goods and services.

6b. Three Year Programmatic Plan

The Programmatic Plan is not yet available as it is influenced by the FY 2013 appropriations and FY 2014 proposals from the President. The Committee will review and comment on this plan when it is available and report separately on its findings and recommendations.

7. NIST Budget

NIST Budget (Dollars in Millions)					
	FY 2012	FY 2013	FY 2013	FY 2013	FY 2014
	Enacted	Request	House Marks	Senate Marks	Request**
STRS	\$ 567.0	\$ 648.0	\$ 621.2	\$ 623.0	**
Laboratory Programs	518.0	572.7			**
Corporate Services	18.5	18.5			**
Stds Coord. and Spec. Prgs.	30.5	56.8			**
ITS	\$ 128.4	\$ 149.0	\$ 149.0	\$ 143.0	**
Advanced Manu. Tech. Consort.	0.0	21.0	21.0	14.5	**
Hollings Manuf. Ext. Prg.	128.4	128.0	128.0	128.5	**
Technology Innovation Program	0.0	0.0	0.0	0.0	**
Baldrige Perf. Excel. Prog.	0.0	0.0	0.0	0.0	**
CRF	\$ 55.4	\$ 60.0	\$ 60.0	\$ 60.0	**
Const. & Major Renovations	13.9	11.8			**
Saf. Cap., Maint., Maj. Repairs	41.5	48.2			**
Total Discretionary	\$750.8	\$857.0	\$830.2	\$826.0	**
NNMI (Mandatory)	\$0.0	\$ 1,000.0	\$ -	\$ -	**
WIN (Mandatory) *	\$0.0	\$0.0	\$0.0	\$0.0	**
Total NIST	\$ 750.8	\$ 1,857.0	\$ 830.2	\$ 826.0	**

* The Middle Class Tax Relief and Job Creation Act of 2012 authorized \$300 million in funds, of which NIST is anticipating a Congressional Budget Office score of \$100 million in FY 2017. The first \$100 million is provided to NIST after successful spectrum auction of \$7.2 billion or more, and an additional \$200 million will be allocated if spectrum auctions net more than \$27.6 billion (could take up to 7 years).

** The FY 2014 Request is unavailable at the time of writing this report.

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7a. FY 2013 Appropriations

As stated in the VCAT's 2011 Report, the VCAT is strongly supportive of the President's request for NIST in FY 2013, and looks forward to an appropriation that will continue to support the priorities articulated, especially in the area of manufacturing and advanced communications. The VCAT agrees strongly with the focus on manufacturing and is supportive of the requested increases to the NIST laboratory programs, and believe that they will both increase capabilities at NIST, and create improved partnership opportunities with industry and academia, enabling NIST to interact more effectively across the innovation ecosystem.

A major element of the FY 2013 request was the \$1 billion to stand up the National Network for Manufacturing Innovation (NNMI). Over the past year, NIST, through the Advanced Manufacturing National Program Office has engaged in significant national outreach to scope the program. The network is envisioned to bridge an existing gap in the U.S. innovation ecosystem that exists between basic research and deployment of commercial products and technologies. The entire network will strengthen efforts in a number of critical focus areas determined by the selection of IMIs that complement one another and build on regional strengths. As a partnership-driven endeavor requiring co-investment (i.e. by institute partners from industry, economic development organizations, associations and educational institutions), an IMI may have a focus on such topics as a manufacturing process, an advanced material, an enabling technology, or an industry sector. Each IMI will initiate major activities, which could include:

- Applied research and demonstration projects (for example, for reducing cost/risk on commercializing new technologies, or solving pre-competitive industry research challenges);
- Technology integration through development of innovative methodologies and practices for supply chain integration;
- Engagement with small and medium-sized manufacturing enterprises; and
- Education, technical skills, and workforce development at all levels.

The VCAT believes that this program will fill an important void in the U.S. infrastructure that is supporting manufacturing, and hopes to see continued support for this effort.

The VCAT is supportive of the proposed \$128 million for the Manufacturing Extension Partnership (MEP) and the requested \$21 million for AMTech. While \$21 million will be sufficient to launch the program, as previously stated, the VCAT strongly recommends that the AMTech program be funded at a level that would enable it to have maximal impact.

Over this past year, the VCAT also had the opportunity to visit the NIST facilities in Boulder, and can reaffirm the importance of maintaining funding for the ongoing renovation projects, as any major stoppages or delays will leave research projects in less than optimal temporary facilities, and would likely lead to significant cost increases to the project as a whole. The VCAT remains concerned that the \$48.2 million proposed for NIST's routine maintenance and repair budget is not sufficient to effectively maintain NIST's laboratory facilities, especially given the aging nature of the General Purpose Laboratories and the significant increases in new facilities through the American Recovery and Reinvestment Act (ARRA) construction. The inability for NIST to effectively address major repair needs could negatively impact the safe and efficient operations of NIST.

OBSERVATIONS:

Because of the uncertainty in the budget process for FY 2013 and FY 2014, the continuing resolution, and the potential for sequestration, the VCAT has not reviewed further the budget for FY 2013 and proposals for FY 2014. Once clarity is available regarding the current year budget and the President's proposal for FY 2014, the VCAT will review and make observations and recommendations as appropriate and report these results in an addendum to this annual report.