VISITING COMMITTEE ON ADVANCED TECHNOLOGY
National Institute of Standards and Technology

2009 Annual Report

Visiting Committee on Advanced Technology (VCAT) of the National Institute of Standards and Technology

U.S. Department of Commerce

March 3, 2010

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Executive Summary of Recommendations

The National Institute of Standards and Technology (NIST) is vital to the economic and infrastructural well-being of the Nation. The United States continues to excel in translating basic research into new technologies due to its world leading commercial and industrial infrastructure. Efficiently deploying these new technologies in commercial products creates new prospects for economic growth and maintains U.S. competitiveness. It is often underappreciated that new technologies require the development of standards which can facilitate interoperability, as well as provide performance, safety, efficiency and economic benefit metrics, and benchmarks. For the past 100 years, NIST has vigorously acted on requests from U.S. industry and fellow government agencies to provide both first responder and sustained efforts in support of U.S. economic growth. NIST provides a superb staff and excellent facilities for developing measurement standards, supplying standard reference materials, and supporting progress in measurement science in both established and emerging areas of U.S. commerce.

In his first year in office, President Obama launched several major initiatives designed to encourage the introduction of new technology to address several areas of critical national need and to enhance the competitive position of U.S. industry. These initiatives demand a leadership role by NIST to develop programs to provide a framework to assist the government and U.S. industry to achieve the President's goals. These initiatives include:

- Reducing medical costs and improving quality of health care by developing and deploying a universal standardized electronic medical records capability;
- Improving U.S. energy efficiency and accelerating the adoption of renewable energy resources by establishing a 'smart' electrical grid utility;
- Protecting the U.S. cyber network from disruption due to accidents and deliberate attacks; and
- Accelerating the translation of biomedical research into effective diagnostic and therapeutic tools by improving and streamlining the drug development process.

During the course of its work during 2009, the NIST Visiting Committee on Advanced Technology (VCAT) reviewed key elements of the NIST program and developed a set of recommendations for consideration by NIST management. These are set out below and amplified in the body of the text of this report.

The NIST VCAT of 2009 makes the following recommendations:

SAFETY RECOMMENDATIONS:

- ***Eliminate common safety concerns.*** *The VCAT continues to observe safety practices that are not consistent with a world-class safety-focused laboratory. The inconsistencies among individual laboratories suggest that safety is not yet part of a pervasive leadership-driven culture.*

- ***Proactively seek advice from external experts.*** *First, conduct a series of visits to research laboratories known to have excellent safety records and a strong safety culture. The NIST leadership has already initiated these visits and several best practices have been identified for implementation. Second, the Director should establish an independent, external review committee to assist the organization in monitoring the implementation of world-class safety practices in the laboratories.*

NIST OVERALL ROLE IN STANDARDS RECOMMENDATIONS:

- ***Serve as the principal inter-agency convener for documentary standards*** *affecting national, international,and/or inter-agency interests by obtaining executive branch authority. The Department of Commerce (DOC) should sanction such a role for NIST where NIST would serve*

  to coordinate the development of action plans and assure that overall architectural integrity of the standard is preserved. NIST would coordinate the application of expertise across relevant agencies.

- ***Promote and facilitate the development and use of international standards*** *by insuring coordination with the State Department, the Office of the United States Trade Representative (USTR), and other agencies that share similar interests.*

NIST ROLE IN SMART GRID INTEROPERABILITY STANDARDS RECOMMENDATION:

- ***Engage with the Consumer Product Safety Commission*** *to assure that the Information Technology (IT) standards for Smart Grid provide for the kinds of consumer appliance safety testing undertaken by Underwriters Laboratories.*

NIST ROLE IN HEALTHCARE IT STANDARDS RECOMMENDATIONS:

- ***Acquire expertise in the Healthcare IT sector*** *by a combination of direct employment, delegating responsibility to and borrowing staff from agencies with the requisite expertise.*

- ***Adopt the role of convener and facilitator of Healthcare IT documentary standards efforts,*** *engaging sources from within the U.S. government and the private sector as appropriate to the task similar to NIST's responsibility in the Smart Grid program.*

NIST ROLE IN CYBERSECURITY STANDARDS RECOMMENDATIONS:

- ***Expand collaborations with the Department of Energy (DOE), the National Security Agency (NSA), the National Science Foundation (NSF), and the Department of Homeland Security (DHS)*** *(among others) to assure coordination among multi-agency security research, development, and standardization programs.*

- ***Continue and potentially expand efforts in testing and evaluation of cryptographic standards*** *including interoperation of distinct implementations.*

- ***Consider assisting in evaluating the security of widely used open source software.***

STRATEGIC PLANNING RECOMMENDATIONS:

- ***Continue a multi-year strategic planning process*** *with annual updates to articulate the programmatic directions to the NIST technical personnel. Incorporate input from NIST stakeholders and customers into the process that is necessary to establish priorities and execute NIST's mission.*

- ***Use the Bioscience Planning document and the associated workshop initiative as a model*** *for other application (industrial) segments.*

- ***Develop an annual Implementation Plan as part of the strategic planning process.***

THREE-YEAR PROGRAMMATIC PLAN RECOMMENDATIONS:

- ***Continue efforts toward making multi-year planning an institutional culture.***

- ***Assure external and intra-government partnerships are clearly defined*** *and are an integral part of planning and implementation.*
- ***Balance the reporting of new initiatives in future multi-year planning documents*** *with discussion of ongoing research activities and of programs that will be discontinued. This discussion should include a clear description of the plan that meets the resource requirements, both people and facilities, for the future portfolio.*

MANAGEMENT, LEADERSHIP, STAFFING, AND ORGANIZATIIONAL STRUCTURE RECOMMENDATIONS:

- ***Complete the evaluation of organizational structures*** *that can most effectively support the achievement of the goals and priorities described in its three-year programmatic plan. The NIST Director and his key management already have this process well underway. It does and should include input from stakeholders including VCAT, Congressional staff, industry, and the NIST researchers.*

- ***Obtain approval for and begin implementation of this organizational structure*** *no later than the beginning of the second half of 2010. The VCAT supports the NIST leadership in designing and evaluating organizational alternatives and arriving at an optimized organizational recommendation.*

BUDGET AND RECOVERY ACT RECOMMENDATIONS:

- ***Complete expeditiously the improvement of scientific and measurement capabilities****, including neutron facilities, necessary for NIST and the U.S. industrial users of the facilities to remain in a competitive position in relation to European and Japanese facilities and to enable the United States to develop future generations of physical scientists and engineers.*

- ***Complete NIST construction projects at the Boulder facility.***

Report Overview

In this report of the VCAT, we review new initiatives and ongoing programs at NIST which we are confident will provide critical resources to assist U.S. industry and government agencies in meeting the critical national needs identified by the President.

The VCAT was established in its present form by the Omnibus Trade and Competitiveness Act of 1988 and updated by the America COMPETES Act. The VCAT 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 2009 annual report covers the March 2009 through the February 2010 meetings.

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 to the U.S. science and technology base and to the economy. Over the past year, the Committee has been active in assessing NIST's progress in the following areas:

- Documentary standards:
  - Smart Grid
  - Healthcare IT
  - Cybersecurity
- Strategic planning and performance
- Safety
- Organizational Structure

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

The charter of the Committee calls for the Director of NIST to appoint the members of the Committee. Members shall be selected on a clear, standardized basis in accordance with applicable Department of Commerce guidance. Members shall be selected solely on the basis of established records of distinguished service; shall provide representation of a cross-section of traditional and emerging United States industries; and shall be 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 shall serve as a member of the Committee. Members are appointed for staggered three-year terms.

Three new members were appointed during the period covered by this report: Dr. Tony Haymet (Scripps Institution of Oceanography, UC San Diego), Dr. Alton D. Romig (Sandia National Laboratories) operated by Lockheed Martin Corporation, and Dr. Darlene J.S. Solomon (Agilent Technologies).

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.

VCAT Members During the Period Covered by this Report

Dr. James W. Serum, Chair Scitek Ventures	Dr. Vinton G. Cerf, Vice Chair Google
Dr. Thomas M. Baer Stanford University	Dr. Ruzena Bajcsy University of California, Berkeley
Dr. Paul A. Fleury Yale University	Dr. Peter Green University of Michigan
Dr. Tony Haymet Scripps Institution of Oceanography, UCSD	Dr. Pradeep Khosla Carnegie Mellon University
Dr. Elsa Reichmanis Georgia Institute of Technology	Dr. Alton D. Romig, Jr. Sandia National Laboratories
Dr. Darlene J.S. Solomon Agilent Technologies	Dr. Alan I. Taub General Motors Corp.

VCAT Focus in 2009

The NIST core research areas remain very strong and should continue to have significant, long-term support. This effort, combined with new investments in nanoscience/nanotechnology and biosciences enable NIST to perform its mission in the areas of S*mart Grid, Healthcare IT, and Cybersecurity.*

In 2008, the VCAT was asked by the Director to explore in depth the role that the NIST laboratory and extramural programs play in stimulating innovation and competitiveness, and these findings are summarized in the 2008 Annual Report. In 2009, the VCAT continued the practice of focusing on a specific area of NIST's mission, this time examining in depth the important role that NIST and its laboratory programs play in the development and implementation of documentary standards. As in 2008, the Director charged the VCAT with specific questions to consider:

- What aspects of the Federal coordination role leverage the technical capabilities of the labs?
- How could NIST enhance its support of Federal agencies?
- The NIST role in coordinating federal standards has become a priority (e.g. Cybersecurity, Smart Grid, Healthcare IT). How should this change shape planning and priority setting efforts for the NIST Laboratories?

To address these questions, the VCAT explored the role that NIST plays in documentary standards in three areas of critical importance to the government: Smart Grid Interoperability; Healthcare IT; and Cybersecurity. In each of these areas, the VCAT explored the role of NIST in coordinating federal standards activities working with the private sector. The NIST Laboratories provide a framework for the coordinated development, effective adoption, and utilization of documentary standards by coordinating input from both NIST staff as well as interested parties from the private sector and other federal agencies. The technology laboratories of NIST also provide unique resources when, for example, new measurement methods are needed for the development and assessment of documentary standards.

Although the VCAT did not specifically review the areas of Bioscience and Nanotechnology in 2009, the Committee continues to support the recommendations from last year regarding these research areas as a high priority and accordingly, they should receive significant support and attention.

This 2009 VCAT Annual Report addresses our observations, findings, and recommendations for these topics as well as some comments about the NIST budget; management, staffing, and organizational structure; safety at NIST; and NIST's approach to strategic planning.

Overall, the VCAT strongly endorses NIST's efforts to recruit and retain among the best and brightest technologists and researchers. The record of major awards, including three Nobel Prizes, is a strong indication of the strength of the research capacity of the organization and its commitment to measurement science as a core expertise in many different disciplines.

Safety at NIST

Since the Safety Incident at the NIST Boulder Laboratories in June of 2008, NIST has taken a number of concrete steps to strengthen and improve its safety practices and is making progress as it works to develop a comprehensive and well integrated safety program and culture that is central to everyday NIST operations.

To strengthen overall safety at NIST, NIST and DOC arranged for independent assessments of safety management performance at NIST. In addition to the initial report of the Ionizing Radiation Safety Committee, these included a special review of safety at the NIST Boulder Laboratories by the DOE Office of Independent Oversight and an assessment of management and safety at NIST by a Blue Ribbon Commission. NIST has also had numerous discussions with high-performing safety organizations and outside safety experts and internal discussions of safety priorities. As a result of these reviews and assessments, NIST has taken a number of actions.

Specific Actions Taken to Strengthen Safety at Boulder:

- Updated the inventory of chemicals at the NIST Boulder Laboratories and properly disposed of unused, excess, and legacy chemicals.
- Developed an emergency notification checklist for reporting events to the City of Boulder and to other jurisdictions and agencies that regulate NIST Boulder's handling and disposal of hazardous materials.
- Developed and implemented a worksite training program for the NIST Boulder staff in the prevention and reporting of accidental hazardous material releases to the environment. All employees and associates have taken the training and all future employees and associates will be required to take the training as part of their beginning work at NIST.
- Established a broad agreement with the City of Boulder on the desirability of formalizing future reporting and coordination functions between the City and NIST Boulder through a new Memorandum of Understanding.
- Moved a senior-level research-director position, previously located in Gaithersburg, to Boulder to strengthen local line-management responsible for the safety of all laboratory activities in Boulder.
- Established a senior safety management position to oversee the safety organization in Boulder and filled that position with a highly qualified safety manager.
- Established and hired a new executive-level site-manager position in Boulder to coordinate safety, emergency preparedness, and security for the entire DOC Boulder campus, including NIST, the National Oceanic and Atmospheric Administration, and the National Telecommunications and Information Administration (NTIA).

Actions Taken to Strengthen Safety at All NIST Sites:

- NIST has established and filled a senior-level safety executive position to oversee the safety support organizations in both Gaithersburg and Boulder and is strengthening both of those organizations through additional staff and resources.
- NIST is working to develop and implement a formal written safety program that clearly defines roles, responsibilities, and authorities.
- NIST has developed key metrics and improved safety information sharing across the laboratory.
- NIST has taken steps to ensure leadership awareness of their responsibilities by providing managers and supervisors with training on their responsibility to provide staff with a safe and healthful working environment. As part of this effort, Dr. Gallagher has personally briefed the management and staff in every Operating Unit (OU) about their responsibilities.
- NIST has established hazard management and management observation programs at the OU level.
- NIST has made structural changes in its organization to enhance lines of authority and accountability regarding safety and has worked to embed policy development and implementation capabilities in the responsible organizations.
- NIST has improved its Emergency Preparedness Program.
- NIST is working towards creating a **"Safety Culture"** at NIST**,** demonstrating commitment by senior management, starting with the NIST Director, which is intended to flow down through management through a robust communications plan, capturing proper metrics including leading indicators and a sound lessons learned program. Behavioral based safety and/or Human Performance Improvement Programs should be considered as a possible enabler.
- NIST takes its responsibility to protect the health and safety of its staff and the surrounding community very seriously and is working to strengthen its capabilities in this area, but realizes that it will be a multi-year effort, one that they are just beginning.

RECOMMENDATIONS:

- ***Eliminate common safety concerns.*** *The VCAT continues to observe safety practices that are not consistent with a world-class, safety-focused laboratory. The inconsistencies among individual laboratories suggest that safety is not yet part of a pervasive leadership-driven culture.*

- ***Proactively seek advice from external experts****. First, conduct a series of visits to research laboratories known to have excellent safety records and a strong safety culture. The NIST leadership has already initiated these visits and several best practices have been identified for implementation. Second, the Director should establish an independent, external review committee to assist the organization in monitoring the implementation of world-class safety practices in the laboratories.*

NIST Role in Documentary Standards

Documentary standards are of critical and strategic importance to a number of our nation's top priorities. From Smart Grid to healthcare IT and cybersecurity, standards and technology have a prominent role to play in meeting the goals of the U.S. Government. The Committee examined NIST activities in the coordinated development of documentary standards, as well as closely examining activities associated with the priorities above.

Overall NIST Role in DocumentaryStandards

NIST has a unique role in documentary standards activities with the federal government. The National Technology Transfer and Advancement Act (NTTAA) charges NIST with the role of coordinating "Federal, State, and local technical standards activities and conformity assessment activities, with private sector technical standards activities and conformity assessment activities, with the goal of eliminating unnecessary duplication and complexity in the development and promulgation of conformity assessment requirements and measures." Furthermore, in support of this Act, the Office of Management and Budget (OMB) Circular A-119 on "Federal Participation in the Development and Use of Voluntary Consensus Standards and in Conformity Assessment Activities" assigns NIST the responsibility of chairing the Interagency Committee on Standards Policy (ICSP), an inter-agency group of Standards Executives from Federal Agencies and Commissions. Thus, statute and supporting policy charge NIST with significant responsibility for coordination of standards interests among federal agencies and the private sector.

In fiscal year (FY) 2008, more than 450 technical experts from NIST participated in almost 1,100 standards related activities, in more than 100 standards developing organizations. In FY 2009, under the Energy Independence and Security Act of 2007, NIST was assigned "*primary responsibility to coordinate development of a framework that includes protocols and model standards for information management to achieve interoperability of smart grid devices and systems."*

NIST is playing a significant role in supporting the Department of Health and Human Services (HHS) in development and deployment of standards and conformance systems in Healthcare IT, a major Administration priority. The Federal Information Systems Management Act (FISMA) charges NIST with the responsibility for developing standards and guidelines for all federal, non-national security, information systems. Other examples of NIST leadership and coordination of federal government agencies in standards and conformity assessment include assisting the Election Assistance Commission with the development of voluntary voting system guidelines under the Help America Vote Act of 2002 (HAVA). Based on NIST's investigations of the collapse of the World Trade Center structures on September 11, 2001, NIST has proposed various changes to model building codes, some of which have been adopted in recent revisions to the building codes, and other are still being discussed.

It is clear from these examples, among numerous others, that NIST's technical expertise, its reputation as an unbiased and neutral party, and its extensive participation in standards and conformity assessment activities, strongly positions NIST to address the standards related challenges of the 21st century, and helping the U.S. maintain a competitive edge. However, NIST needs to address a number of issues in how it engages and leads in standardization activities. NIST is working to implement a number of steps to strengthen its role in standards including:

- Working with the White House to re-open OMB Circular A-119 to clarify and strengthen NISTs effective role in coordination;
- In areas where there is a well defined national need for standards (e.g. Smart Grid) to establish a formal interagency process to develop the framework for standards development in those areas

and to define the roles and responsibilities of the various stakeholders, all the while taking advantage of the use of private sector standards and standards developing oganizations (SDOs);
- Ensure that technical programs needed to support implementation and use of standards are developed concurrently with the coordination and development process; and
- Work closely with USTR to ensure that international standards development activities are consonant with a common U.S. position. The goal is to insure that international standards are supportive of U.S. competitiveness.

RECOMMENDATIONS:

- ***Serve as the principal inter-agency convener for documentary standards*** *affecting national, international, and/or inter-agency interests by obtaining executive branch authority. The Department of Commerce should sanction such a role for NIST where NIST would serve to coordinate the development of action plans and assure that overall architectural integrity of the standard is preserved. NIST would coordinate the application of expertise across relevant agencies.*

- ***Promote and facilitate the development and use of international standards*** *by insuring coordination with the State Department, USTR, and other agencies that share similar interests.*

NIST Role in Smart Grid Interoperability Standards

Smart Grid interoperability is a major priority for the Administration and one where standards development is critical. It illustrates the important leadership and active coordination role that NIST can play in standards development. The development and deployment of a Smart Grid presents a major interoperability challenge as the nation must work within an electrical grid that consists of more than 3,100 power utilities using 9,200 power generation plants that are connected to more than 300,000 miles of transmission lines supplying electricity to residential and business consumers all over the country to say nothing of the millions of business, industry, and residential devices that have to interwork with each other and power generation and distribution systems. The introduction of distributed renewable energy sources such as solar panels, wind turbines, and fuel cells bring additional challenges in integrating these systems seamlessly into the grid, through the use of smart meters. It is also important to comprehend the impact of plug-in vehicles on the grid. Clearly defined interoperability requirements and standards to support such implementations will be critical not only in the creation of a Smart Grid, but also in engendering innovation and competition amongst the suppliers, supplying components to the systems thereby reducing costs of implementation, and providing a greater choice to consumers.

NIST has taken a number of steps to fulfill its role as defined under the Energy Independence and Security Act (EISA) of 2007, which gives NIST the "primary responsibility to coordinate development of a framework that includes protocols and model standards for information management to achieve interoperability of Smart Grid devices and systems…." NIST has made significant progress according to the three-phase plan outlined by Dr. Gallagher and the Smart Grid team at NIST:

> **Phase 1** (March to September 2009) – NIST focused on identifying an initial set of existing consensus standards and developing priority action plans to fill any critical gaps. This phase was completed when NIST released the draft report, *NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 1.0,* during the GridWeek conference on September 24, 2009.
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> **Phase 2** (September to December 2009) – NIST established a public/private Smart Grid Interoperability Panel (SGIP) to identify, prioritize, and address new and emerging requirements

for Smart Grid interoperability and security. To help administer the SGIP, NIST awarded an $8.5 million dollar contract to EnerNex Corporation. NIST hosted the first meeting of the SGIP held at the Grid-Interop 2009 Conference. With a current membership of more than 500 organizations sending 1,500 representatives spread among 22 stakeholder categories, the SGIP has three primary functions:

- Provide technical guidance to facilitate development of standards for a secure, interoperable Smart Grid;
- Specify testing and certification requirements necessary to assess the interoperability Smart Grid-related equipment, software, and services; and
- Oversee the performance of activities intended to expedite the development of interoperability and cyber security specifications by standards development organizations.

Phase 3 (January to December 2010) – In 2010, NIST will develop a testing and certification framework to help ensure the interoperability of Smart Grid systems and devices.

NIST brought to the Smart Grid interoperability challenge an unusual approach to organizing the work. Using a combination of bottom-up and top-down methods, NIST facilitated the creation of dozens of Priority Action Plans addressing specific interoperability issues. In addition, it facilitated the creation of the SGIP Governing Board and the formation of a non-profit, non-governmental organization housing the governing board and the interoperability panel. This construct is explicitly not a Federal Advisory Committee under the Federal Advisory Committee Act (FACA). The framework achieved provides for a wide range of participating stakeholders and substantial flexibility in the conduct of the work.

NIST staff also undertook to assure the creation of a reference model of the Smart Grid system that will serve as the basis for standards architecture development and articulation. The importance of this initiative would be hard to overestimate. The absence of a comprehensive reference model would disable the development of a coherent architecture for the Smart Grid system. The reference model itself emerges out of the broad spectrum of use cases contributed by the participants in the SGIP.

The successful efforts thus far reflect well on NIST and its National Coordinator for Smart Grid Interoperability Office through which the SGIP activity is managed. The importance of this work is underscored by the planned use of the SGIP technical guidelines in the Smart Grid funds-granting plans of DOE.

The VCAT observes that the broad spectrum of smart appliances expected to enter the consumer market in consequence of the Smart Grid program will inevitably highlight consumer demand for easy to install and use equipment taking advantage of “plug and play” features that can only arise in the presence of a strong interoperability standards framework. This same avalanche of new consumer equipment will also awaken interest in and concern for consumer safety, leading to the need for the Consumer Product Safety Commission to engage in standards development and conformance testing capabilities.

The VCAT believes that the aggressive coordination role taken on by NIST in the area of Smart Grid should be used as a model and applied to other areas of national priority where standards development is required. The VCAT would like to emphasize that NIST’s Smart Grid Program encompasses more than coordinating the interoperability standards framework for Smart Grid devices and systems. The capabilities of the NIST Laboratories in measurement science, modeling, and conformance assessment provide unique resources that contribute to Smart Grid standards development. The technical outputs of the NIST Laboratories can help accelerate the implementation and improve the effectiveness and security of the Smart Grid especially in the key areas of power system monitoring, power meters and sensors,

electromagnetic interference, conformity assessment programs, and cybersecurity. Continued increased support for NIST's research programs in measurement characterization of electrical systems, data networking, cybersecurity, building energy management, and industrial control systems will be critical for future success. The VCAT strongly urges Congress and the Administration to support increased funding for these activities.

The VCAT believes that NIST can also play a significant role in other energy related areas such as "verification." NIST has organized a conference in 2010 to identify and validate other areas of energy focus.

RECOMMENDATION:

- ***Engage with the Consumer Product Safety Commission*** *to assure that the IT standards for Smart Grid provide for the kinds of consumer appliance safety testing undertaken by Underwriters Laboratories.*

NIST Role in Healthcare Information Technology Standards

Like Smart Grid, the Administration has made improving the healthcare information infrastructure a national priority and is committed to the adoption of Electronic Health Records (EHRs). Unlike NIST's role in Smart Grid, NIST is not the primary coordinator for standards development in the area of Healthcare IT, that role falling to HHS and the Office of the National Coordinator for Healthcare Information Technology. Rather NIST's current efforts are focused on providing the infrastructure to ensure that the expansion of the health information network that is correct, complete, secure, and testable. NIST's programs support the accelerated development and harmonization of standards for healthcare IT technologies, expand the healthcare IT testing infrastructure, increase the usability of healthcare, and address healthcare delivery beyond traditional physical locations. As part of this work, the VCAT feels strongly that NIST should emphasize the development of standards and tools to safeguard the privacy of patient data.

The VCAT observes that the present state of healthcare IT standards has led to complexity and dependence on proprietary offerings that can result in anti-competitive, complex, and non-interoperable offerings. A strong effort, led by NIST, to develop definitive reference models and from these a rational protocol architecture is clearly needed.

While the VCAT believes that a stronger NIST leadership role would benefit the HIT community, the Committee is concerned that NIST does not currently have personnel with the background and standing in both the medical and standards development communities necessary to effectively lead in this area.

RECOMMENDATIONS:

- ***Acquire expertise in the Healthcare IT sector*** *by a combination of direct employment, delegating responsibility to and borrowing staff from agencies with the requisite expertise.*

- ***Adopt the role of convener and facilitator of Healthcare IT documentary standards efforts****, engaging sources from within the U.S. government and the private sector as appropriate to the task, similar to NIST's responsibility in the Smart Grid program.*

NIST Role in Cybersecurity Standards

Cybersecurity is vital to the economic and national security interests of the United States. The Administration has declared the cyber infrastructure a strategic asset. In addition to more than $200 billion of e-commerce transactions in the United States alone for 2008, interconnected networks of computers are essential for life-critical functions such as air traffic control, factory operation, and electric power distribution and NIST plays a critical role in the development of standards and testing and validation capabilities that are necessary to strengthen the Nation's cybersecurity posture. As with its role in Smart Grid, NIST benefits from a clear definition of its role in cybersecurity. NIST is obligated by statute to develop standards and to coordinate with other agencies:

- Homeland Security Presidential Directive (HSPD)-12, 2004: DOC required to develop a "Federal standard for secure and reliable forms of identification"
- FISMA, 2002: NIST responsible "for developing standards and guidelines" for cybersecurity
- OMB Circular A-130, 2002: "The Department of Commerce through NIST is assigned the responsibility to develop and issue security standards and guidelines…"
- Computer Security Act, 1987: NIST responsible for developing standards and guidelines for Federal computer systems.

NIST is engaged in a number of research efforts that impact cybersecurity including: Authorization, Biometrics, Cryptography, Forensics, Identification & Authentication, Key Management, Network Security, Product Assurance, and Security Metrics. In each of these areas, NIST has made significant progress with limited resources. Much of NIST's work is translated into standards through the development of Federal Information Processing Standards (FIPS) that provide the Federal government with a common set of standards and testing protocols to provide security for federal information systems, and provides the private sector with a platform of validated standards and tests upon which they can base their security protocols.

An important example that illustrates the importance of the NIST laboratory research programs in supporting the development of standards is NIST's work related to cryptography. NIST FIPS 46, the Date Encryption Standard (DES), was the first unclassified publicly disclosed algorithm for the protection of U.S. government sensitive but unclassified data. The DES was subsequently adopted by the American National Standards Institute (ANSI) and the International Organization for Standardization (ISO) and became the world's leading encryption algorithm for 25 years. This standard spawned additional NIST research in cryptanalysis, key management, and other areas leading to the development of the Advanced Encryption Standard (AES), which to this day underpins multiple security systems. Today NIST research is working toward the development of a replacement for AES with efforts such as the Secure Hash Algorithim-3, which leverages the talents of the entire cryptographic community to test multiple hash algorithms through NIST-designed competitions. The VCAT endorses the utilization of competitions such as this or other activities such as NIST-sponsored "connectathons" to test interoperability that take advantage of the capabilities of the wider community and leverage the use of NIST resources.

NIST is also engaged in long-term research that will apply quantum methods to security, exploiting the potential benefits of a quantum computer, and developing cryptographic methods not subject to analysis using quantum computing methods. Key distribution by means of quantum entanglement is also of interest and importance and should continue to be part of the quantum research portfolio. The VCAT strongly supports such long-term research and sees NIST as a leader in the field. Closer coordination with the DOE labs in quantum computing should be encouraged. However, the VCAT believes that NIST should balance the resources committed to this work, as the larger cybersecurity threat comes from the use of classical computing and non-quantum attack methods.

Research conducted by NIST in these areas is first-rate. The benefits derived from research in quantum computing to NIST programs in the area of measurement science and standards are important. Furthermore, it is necessary for NIST to perform research in the area of quantum computing because of all the potential security implications. This area is at the frontier of the field of Physics and quite consistent with research that has led to three Nobel Prizes to NIST researchers over the years.

RECOMMENDATIONS:

- ***Expand collaborations with DOE, NSA, NSF, and DHS*** *(among others) to assure coordination among multi-agency security research, development, and standardization programs.*
- ***Continue and potentially expand efforts in testing and evaluation of cryptographic standards*** *including interoperation of distinct implementations.*
- **Consider assisting in evaluating the security of widely used open source software.**

NIST Strategic Planning and Performance

NIST has made progress since last year when it laid the framework by identifying a series of strategic priorities and investment priority areas (IPAs) against which future planning would be conducted. The two major advances in NIST planning efforts come in the establishment of a multi-year programmatic planning process and the establishment of an external needs assessment workshop series.

Multi-year strategic planning is exactly the right path that NIST must follow. That said, NIST should realize that the planning process is on-going and that its plans will need to be updated annually. The world is rarely so static that events will not cause NIST to modify its plans. It will also be important for NIST to develop a Communications Plan so that the strategy is driven down into the organization.

Although the VCAT applauds the progress in planning in the past year, we continue to emphasize that this planning process is still missing some key elements of a full Strategic Plan. We have previously provided input related to our expectations for a comprehensive Strategic Plan so we shall not repeat it here. The focus on national priorities, recognized technology limitations, and feedback from industry and stakeholders is a move in the right direction (See Table I below from NIST's three-year programmatic plan). The Bioscience Planning document was also a step toward Industrial Segment or Application Strategic Planning and we recommend that this approach be considered for other application areas.

The VCAT also recognizes that strategic planning for an organization that addresses so many industrial segments ranging from construction to biotechnology is very complex and difficult. We support the Director's effort to continue to improve both their strategic multi-year thinking and planning processes.

As the NIST strategic planning process matures, there will be a need to create an Implementation Plan that will articulate the resources NIST needs to realize the plan. Funding and derivatively staffing, equipment, and facility needs must be clearly identified and communicated.

RECOMMENDATIONS:

- ***Continue a multi-year strategic planning process*** *with annual updates to articulate the programmatic directions to the NIST technical personnel. Incorporate input from NIST stakeholders and customers into the process that is necessary to establish priorities and execute NIST's mission.*

- ***Use the Bioscience Planning document*** *and the associated workshop initiative as a model for other application (industrial) segments.*

- ***Develop an annual Implementation Plan*** *as part of the strategic planning process.*

NIST Three-Year Programmatic Plan

The Committee has read and reviewed the submitted NIST three-year programmatic plan ("Plan") as of February 2, 2010 and commends NIST management for its preparation.

The programmatic planning process is intended to move the agency away from single year initiative-based planning and instead create the culture and infrastructure that enables the development and maintenance of multi-year program plans with discrete goals, objectives, and performance measures. Current program planning efforts are directed against a series of IPAs: Buildings and Physical Infrastructure, Energy, Environment, Healthcare, Information Technology, and Manufacturing. These IPAs were selected by senior NIST management and technical staff, along with inputs from other stakeholders (including VCAT), based on the following criteria:

- Clearly matches NIST's mission and goals;
- Addresses urgent national needs and priorities, including Administration and Congressional priorities;
- Demonstrates a compelling innovation or competitiveness issue; and
- Represents previously identified NIST priorities that remain important.

NIST is still making progress in this area and we expect the process to evolve. However, we see this as a step in the right direction towards the development of a more robust strategic planning capability at NIST.

Table 1 shows the NIST Programs relationship to the IPAs. Clearly identified ownership and responsibility are vital for the success of these new areas of research. The mappings are not intended to be comprehensive, but rather to indicate the strongest connections between programs and IPAs.

The second major change in NIST planning efforts is the establishment of a formal external needs assessment program. Program planning is a continuous process. To be prepared for tomorrow's needs, NIST needs to understand the future priorities and challenges in each of the IPAs, as well as to identify additional IPAs that may emerge. As the cycle to commercialize innovative products accelerates, so does the need for NIST to deliver increasingly, timely and complex measurement solutions to enable innovation and competitiveness. To address these needs and gain earlier input involvement of customers and other stakeholders, NIST is initiating an external needs assessment workshop series to provide an opportunity for stakeholders to lay out external drivers and/or opportunities for specific technology focus areas. NIST is planning to hold these workshops to inform NIST's strategic decision making and program planning activities. In some cases, NIST will conduct follow-on workshops to address identified key technical barriers in more depth. The workshop series will be a vehicle for accelerating the most critical measurement solutions to support innovation and technology. The initial workshops in the series will address two key areas: Advanced Solar Energy Technologies and Climate Change.

The Plan includes a description of NIST's planning priorities, which include:

- Strengthen and focus NIST Laboratories and facilities to ensure U.S. leadership in measurement science and standards.
- Focus new NIST activities to address critical national priorities.

- Expand collaboration to leverage NIST capabilities and advance innovation at regional and national levels.

TABLE 1: NIST Programs by Investment Priority Area
(✪ Primary, ✓ Secondary)

NIST Programs	NIST Investment Priority Areas					
	Buildings and Physical Infrastructure	Energy	Environment	Healthcare	Information Technology	Manufacturing
Advanced Alternative Energies		✪	✓			✓
Net-Zero Energy Buildings		✪	✓			✓
Greenhouse Gas Measurements and Climate Change			✪			✓
Sustainable Manufacturing		✓	✓			✪
Biomedical Measurements to Support Disease Diagnosis and Treatment				✪		
Nanomaterial Environmental Health and Safety			✪	✓		✓
Scalable Cybersecurity for Emerging Technologies and Threats					✪	
Infrastructure Development and Remediation	✪					
Standards for National Priority Critical Infrastructures:						
– Smart Grid Interoperability		✪	✓		✓	✓
– Health Information Technology				✪	✓	✓

We support these planning priorities and believe that the Plan appropriately describes NIST's proposed activities to address these priorities. In particular, we applaud their increased emphasis to partner with other Federal Agencies related to standards, including documentary standards described earlier in this report. In addressing the nation's priorities in areas like energy and healthcare, we believe that NIST is in a unique position to take a leadership role across government because of their expertise for developing state-of-art measurements and defining relevant standards.

We consider this year's three-year programmatic plan to be clearly written and it does an excellent job in describing the organization's priorities and plans to address these priorities. However, it does not discuss their plans for ongoing programs, resources required, nor their plans for what they will stop doing in order to launch new activities. This will flow directly from the Implementation Plan recommended by the VCAT as described in the previous section of the report.

RECOMMENDATIONS:

- ***Continue efforts toward making multi-year planning an institutional culture.***
- ***Assure external and intra-government partnerships are clearly defined*** *and are an integral part of planning and implementation.*
- ***Balance the reporting of new initiatives in future multi-year planning documents*** *with discussion of ongoing research activities and of programs that will be discontinued. This discussion should include a clear description of the plan that meets the resource requirements, both people and facilities, for the future portfolio.*

NIST Management, Leadership, Staffing, and Organizational Structure

The Committee applauds the nomination and confirmation of Dr. Patrick Gallagher as the Director of NIST. Dr. Gallagher's selection will provide NIST with much needed leadership and stability so necessary to the management, long-term planning, and implementation of important programs. We have already begun to see the positive impact of his appointment as evidenced by a much more proactive engagement with his staff and the VCAT regarding organizational improvements.

NIST is a broad-based organization with activities ranging from deep technical work executed within their own laboratories and with external collaborators to supporting the creation of national standards to managing external funding and recognition programs. These activities have evolved over the years, but the underlying NIST organizational structure that supports them has not seen major change for at least a decade.

In an effort to respond to the various chartered NIST activities, Dr. Gallagher has put forward for approval a top-level reorganization of NIST's management structure. This reorganization would replace the current structure, which has each OU reporting directly to the NIST Director, with a streamlined executive management team consisting of three Associate Directorships. The newly created positions would include the Associate Director for Laboratory Programs responsible for all of the laboratory programs; an Associate Director for Innovation and Industry responsible for all of NIST's extramural programs, and an Associate Director of Management Resources responsible for all of NIST service-providing organizations (safety, facilities, finance, IT, human resources, etc). This new management structure will streamline the management and planning within the agency and put in place the decision-making structure necessary for more effective operations.

Beyond this top-line reorganization of management capabilities, NIST is currently evaluating its broader organizational structure to determine how to maximize the impact of its programs and best serve its stakeholders. In particular, the Director has engaged his leadership team to explore a more efficient way to organize the research laboratories and technical program management. The VCAT had an opportunity to review the principles by which the team is evaluating organizational alternatives and we found the approach to be very sound. The NIST leadership team clearly appreciates the tradeoffs among disciplinary, sector, and mission-based organizational constructs. There appears to be a good understanding of how to balance the needs of program management with internal people development

and external constituencies. As such, the evaluation process is being designed to take into account the views of various stakeholders inside and outside of NIST including, of course, the researchers.

We had a chance to hear from many of the NIST Laboratory directors and it is very apparent that the broad leadership team is fully engaged in the reorganization discussions and sees opportunities for a realignment of laboratories that can improve the efficiency of executing their technical agendas. The VCAT strongly endorses the proposed top-level restructuring as well as a rigorous analysis and implementation of a research laboratory organizational structure which can most effectively achieve NIST's priorities and goals.

RECOMMENDATIONS:

- ***Complete the evaluation of organizational structures*** *that can most effectively support the achievement of the goals and priorities described in its three-year programmatic plan. The NIST Director and his key management already have this process well underway. It does and should include input from stakeholders including VCAT, Congressional staff, industry, and the NIST researchers.*

- ***Obtain approval for and begin implementation of this organizational structure*** *no later than the beginning of the second half of 2010. The VCAT supports the NIST leadership in designing and evaluating organizational alternatives and arriving at an optimized organizational recommendation.*

NIST Budget and Recovery Act

NIST management faced a difficult challenge in FY 2009 with the late passage of the FY 2009 Omnibus and the near simultaneous passage of the American Reinvestment and Recovery Act (ARRA), which stressed the NIST business and financial systems to their limits. While the VCAT appreciates the additional funding that NIST received through ARRA (see Table 2), the majority of this funding will go outside of NIST and will not address NIST's long-term budgetary shortfalls.

TABLE 2: NIST Budget (Dollars in Millions)

	FY 2008 Enacted	FY 2009 Enacted	ARRA*	FY 2010 Enacted
Scientific and Technical Research and Services (STRS)	**$440.5**	**$472.0**	**$220.0**	**$515.0**
National Measurement and Standards Labs	415.2	442.6	211.0	478.1
Baldrige National Quality Program	7.9	9.4	0.0	9.6
Corporate Services	16.5	16.5	9.0	16.8
Congressionally Designated Projects	0.9	3.5	0.0	10.5
Industrial Technology Services (ITS)	**154.8**	**175.0**	**0.0**	**194.6**
Technology Innovation Program	65.2	65.0	0.0	69.9
Hollings Manufacturing Extension Partnership	89.6	110.0	0.0	124.7
Construction of Research Facilities (CRF)	**160.5**	**172.0**	**360.0**	**147.0**
NIST Construction and Major Renovations	79.2	98.0	180.0	80.0
Competitive Construction Grant Program	30.0	30.0	180.0	20.0
Congressionally Designated Projects	51.3	44.0	0.0	47.0
Total NIST	**755.8**	**819.0**	**580.0**	**856.6**

***** Excludes $10 million from DOE for Smart Grid and $20 million from HHS for healthcare IT.

NIST Recovery Act Spending

With the passage of the Recovery Act, NIST received $580 million in direct appropriations, as well as another $30 million in transfers from other agencies ($20 million from HHS for healthcare IT and $10 million from DOE for Smart Grid).

In determining how to allocate these funds, NIST took the position that increased investment in measurement science would strengthen the platform upon which long-term economic recovery would be built, namely through future innovations in areas like green technology, alternative energies, advanced computing, and information technologies. Examples of how NIST is focusing its Recovery Act spending on strengthening the nation's measurement science capabilities include the following activities:

- $108 million to purchase advanced scientific and measurement equipment available from U.S. manufacturers that are needed to strengthen NIST's capabilities targeting the development of alternative energy technologies, the environmental monitoring and mitigation tools, the development and fabrication of advanced nanotechnology, and many other technical areas. Examples include: advanced laser systems that are necessary for precise and accurate

greenhouse gas monitoring tools or one of a kind high-speed, high resolution neutron imaging system that will allow the advanced design and testing of alternative energy sources and devices.

- $35 million in grants to support R&D in U.S. universities, companies, and other research organizations in order to advance the state of the art in measurement science and engineering that is needed to sustain long-term economic growth through innovation in critical national priority areas: energy; environment; manufacturing; bioscience and healthcare; infrastructure; and information technology.
- $42 million to support the next generation of measurement scientists and expand NIST's interaction and collaborations with industry and academia. Of these funds, $22 million will expand the NIST postdoctoral research program providing recent PhDs in science and engineering with the opportunity to work at NIST and gain valuable experience and training in the area of measurement science. Twenty million dollars of these funds will be competitively awarded to support the creation of a collaborative fellowship program that will bring top students and scientists to NIST from industry and universities for limited terms (up to two years) to work with NIST technical staff performing research in key national priority areas.
- $180 million to invest in construction projects that will improve or provide new research facilities for NIST.
- $180 million in competitively awarded construction grants to U.S. universities. These funds are an important contribution to strengthening the nation's S&T infrastructure, which is a key component to future innovation. The competitive grant program has been important in enabling universities access to high quality facilities.

NIST FY 2010 Appropriations

The FY 2010 Appropriations provided NIST with a total of $856.6 million in funds. Of this amount, NIST laboratory programs received $515 million out of a requested $534.6 million. This provides a total of $34.2 million to support new initiatives in healthcare IT, Smart Grid, clinical diagnostics and medical imaging, greenhouse gas emissions measurements, Net-Zero Energy Buildings, cybersecurity, quantum-based measurements, and the NIST Center for Neutron Research (NCNR) Reactor Operations. NIST received $194.6 million to support both the Technology Innovation Program (TIP) and the Hollings Manufacturing Extension Partnership (MEP), with an increase of $4.9 million for TIP and $14.7 million for MEP. In construction funds, NIST received $147 million. Of this amount, $47 million is for congressionally directed projects; $58 million will go to the Safety, Capacity, Maintenance, and Major Repair fund; $12 million will be applied to renovations of Building 1 in Boulder; $2 million will fund a Gaithersburg space study;, and $8 million will finish the expansion of the NCNR. This is important as the expansion will have major positive impact on U.S. neutron science, which has been lagging internationally in recent years. The improvement in U.S. position resulting from the Spallation Neutron Source (SNS) at Oak Ridge National Laboratory will take years to fully materialize, and is not a substitute for an improved NCNR. Finally, $20 million will again be available for a competitive construction grant program for U.S. universities.

RECOMMENDATIONS:

- ***Complete expeditiously the improvement of scientific and measurement capabilities**, including neutron facilities, necessary for NIST and the U.S. industrial users of the facilities to remain in a competitive position in relation to European and Japanese facilities and to enable the U.S. to develop future generations of physical scientists and engineers.*

- ***Complete NIST construction projects at the Boulder facility.***