2015 Annual Report

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

U.S. Department of Commerce

March 2016

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 in 2007. 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 2015 annual report covers the period from the beginning of March 2015 through February 2016.

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 Culture
- Bioscience
- Information Technology/Cybersecurity
- Retaining a World-Class Workforce
- NIST Partnerships

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 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.

Four new members were appointed during the period covered by this report: Dr. Allen Adler (Boeing), Dr. Waguih Ishak (Corning, Inc.), Dr. Theodore Sizer (Nokia Bell Labs), Dr. David Wilson (Morgan State University)

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. Tony Haymet, Chair
University of California, San Diego
Term: September 1, 2009 - August 31, 2015

Dr. Darlene J.S. Solomon, Vice Chair
Agilent Technologies
Term: January 3, 2010 - January 2, 2016

Dr. Allen Adler
The Boeing Company
Term : January 25, 2016 – January 24, 2018

Dr. Rodney Brooks
Rethink Robotics
Term: June 1, 2014 – May 31, 2017

Dr. Sujeet Chand
Rockwell Automation
Term: April 1, 2010 - March 31, 2016

Dr. Rita R. Colwell
University of Maryland at College Park
Term: January 6, 2014 – January 7, 2017

Mr. Michael Garvey
M-7 Technologies
Term: January 23, 2015 – January 22, 2018

Mr. William M. Holt
Intel Corporation
Term: May 13, 2012 - May 12, 2018

Dr. Waguih Ishak
Corning Incorporated
Term : January 25, 2016 – January 24, 2018

Dr. Karen Kerr
Agile Equities, LLC
Term: June 1, 2011 - May 31, 2017

Dr. Roberto Padovani
Qualcomm Technologies, Inc.
Term: May 1, 2011 - April 30, 2017

Ms. Hemma Prafullchandra
HyTrust, Inc.
Term: October 27, 2014 - October 26, 2017

Dr. Alton D. Romig, Jr.
Lockheed Martin Aeronautics Company
Term: April 15, 2009 - April 14, 2015

Dr. Theodore Sizer
Nokia Bell Labs
Term: August 28, 2015 – August 27, 2018

Dr. John J. Tracy
The Boeing Company
Term: January 7, 2013 – January 6, 2016

Dr. David Wilson
Morgan State University
Term: March 23, 2015 – March 22, 2018

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1. VCAT Focus in 2015

In 2015, the VCAT was charged with reviewing NIST's current portfolio of activities in the areas of biosciences and information technology with a focus on identifying NIST's ability to respond to emerging measurement and standards needs in these areas. In addition, the VCAT reviewed the diversity and depth of NIST partnership arrangements and continued to explore the current and future technical workforce needed to ensure NIST has the ability to attract and retain world-class staff now and into the future. This 2015 Annual report summarizes the VCAT's work, observations and recommendations in these areas.

2. Safety

Safety has been a focus and priority of the VCAT for several years and the VCAT is pleased that NIST has developed a safety culture focused on shared responsibility and continuous improvement. NIST has made substantial progress in developing a positive safety culture, and the VCAT continues to receive regular updates on the trends in safety incidents, programs on safety training for leaders and staff, and overall progress on the safety culture.

In 2014 NIST conducted a safety climate survey to measure employee perceptions as they relate to five aspects of NIST's occupational safety and health policy: Management Commitment, Adequacy of Resources, Employee Engagement, Personal Responsibility for One's Own Safety, and Personal Responsibility for the Safety of Others. Through this survey, NIST identified the following areas for improvement:

- Improve communication of safety rights to employees.
- Provide guidance on addressing unsafe conditions and practices.
- Implement improved incident reporting processes and mechanisms for sharing lessons learned.
- Improve the quality of safety training.
- Incorporate discussions of safety culture issues into management observations.
- Re-emphasize the importance of employees receiving safety performance feedback.

Over the course of 2015, the VCAT was updated on the activities NIST undertook to implement specific initiatives, training programs and communications to address these areas. Specific examples include dedicated NIST Safety Leadership training to educate all supervisors on safety policies, laws regulations, NIST safety management system, staff training opportunities and how to properly manage risk. NIST has put great emphasis on the importance of shared responsibility, the need to report safety problems and safety rights and responsibilities at all levels of the organization.

OBSERVATIONS:

The VCAT continues to focus on safety at NIST and it is regularly briefed on safety statistics, safety related initiatives, and their progress. The committee is very pleased with the continued improvement in cementing a strong safety culture and with the safety performance, specifically:

1. NIST OSHA-recordable and DART cases continue to be low and have consistently compared very favorably with three peer laboratories (Department of Energy) for the past three years.

2. NIST initiatives in the areas of training and improvement to its design and the employee reporting of unsafe conditions are to be lauded and will certainly pay off in strengthening the strong safety culture.

3. NIST has taken actions to address the concerns raised in the safety climate survey and is regularly updating the VCAT on these efforts.

RECOMMENDATIONS:

1. Continue to report to the VCAT on safety metrics and safety initiatives.

3. NIST Bioscience Program

In the area of bioscience, NIST provides the underpinning measurement science, standards and technology needed to increase the accuracy, comparability and efficacy of measurements used in medical diagnostics, advanced therapeutics, synthetic biology, and many other areas. These measurements enable the adoption of new technologies, improvements in efficiency, and reductions in cost across biomanufacturing, healthcare, agriculture, and other important sectors. In 2015, the VCAT was asked to review NIST's bioscience program and assess whether it is positioned to respond to measurement and standards needs of this industry.

In the 10-year period of 2005—2015, NIST focused on leveraging experience in the quantitative physical sciences to provide the measurement infrastructure to underpin innovation in the biosciences. During this period, NIST's biosciences program was targeted in the areas of omics measurements, biomanufacturing, cell and system analysis. As NIST moves into the next 10-year period, it envisions developing a bioscience program with strong core capabilities in target areas of molecular and cellular analysis necessary to impact and support the emerging bioeconomy. Strategic areas of importance moving forward include:

- **Quantitative Tools for Characterization of Complex Biologics**
  Define complex biomolecules/biologics through quantitative measurements to enable prediction of biological function in healthcare applications
- **Microbial Measurements**
  Develop measurement infrastructure for microbial measurements
- **Engineering biology**
  Develop the measurements and models for engineering biology to map out the fundamental principles that drive development of next generation bio-based products
- **Precision Medicine**
  Develop measurement science and standards to ensure confidence in clinical decision-making, and ultimately enable adoption of precision medicine
- **Data and Informatics**
  Provide validated data and informatics tools to support confident decision-making

As part of the review of NIST's bioscience program, the VCAT explored three active research streams within the NIST biosciences portfolio to understand the types of problems NIST is working on, what our deliverables are, and how we interact with the broader biosciences community. The areas examined included:

- **Biomanufacturing and biologic drugs --** Biologic drugs, the fastest growing class of therapeutics, offer new life-saving options for patients in areas such as cancer and inflammatory diseases. Unlike traditional small molecule pharmaceuticals, most biologic drugs are complex mixtures of large protein molecules that undergo modifications and structural changes are not easily identified or characterized. In this area of biomanufacturing, NIST is addressing measurements, standards and data needed to support the development and manufacturing of protein therapeutics. Through this effort, NIST works closely with stakeholders in industry and other federal agencies to identify the key biopharmaceutical measurement challenges that need to be addressed to support the development of protein drugs. NIST research improves the development and manufacturing process of biologic drugs, informs regulatory decisions for products, and improves the safety and efficacy for patients.

- **Engineering biology and systems biology --** Rapid advances in the ability to genetically modify biological organisms have created a new engineering discipline, termed 'synthetic biology.' This approach seeks to harness the power of living matter for a variety of manufacturing applications including advanced therapeutics, sustainable fuels, feedstocks, and advanced materials. Designing organisms for specific functions is currently done through trial-and-error, which is costly and inefficient. A more fundamental understanding of cellular control mechanisms will provide greater predictability of genetic modifications, but will also require precise and relevant data, based on sound measurement strategies. NIST is working with industry and academia to develop the standards and protocols needed to support this growing technology area.
- **Quantitative measurements of complex biological systems --** Many of the innovations in health care are founded upon data derived from living organisms. However, living systems are complex and dynamic and therefore their measurement is often not as straightforward as measurements of physical and chemical systems. Biological systems are complex and often poorly defined, and may be the result of an array of molecular events. These challenges often discourage researchers from approaching experimental design with robust and quantitative data outcomes in mind. However, it is imperative that the development of new therapeutic interventions be based on meaningful and reproducible data. In support of this need, NIST is taking these complex functions and determining how to quantify them to allow for confidence in the measurements and reproducibility in testing methods.

To leverage resources and technical expertise in the bioscience area NIST has strong partnerships with other federal agencies such as the National Institutes of Health (NIH) and Food and Drug Administration (FDA). Several partnerships with academia have led to joint initiatives including the Institute for Bioscience and Biotechnology (IBBR) with the University of Maryland focused on biomanufacturing and more recently the Joint Initiative in Measuring Biology with Stanford University focusing on measurement, standards and informatics for genetics and the emerging synthetic biology area. NIST envisions expanded partnerships as a key factor in developing strong core capabilities and the collaborations necessary to support this industry into the future.

OBSERVATIONS:

1. Over the past decade, NIST has successfully leveraged its traditional strengths in the physical sciences and measurement technologies to make meaningful contributions to bioscience innovation and the biotechnology industry. The VCAT observes that Bioscience is an increasingly well-established set of programs across NIST. The research programs are enabling the measurement of previously unobservable aspects of biological systems, which in turn is opening up new insights into both the mechanisms of diseases, and avenues for treatment of them. NIST's research in these fields appears to be well-ahead of its peer metrology institutes outside the US.

2. Beyond its core contributions to the Material Measurement Laboratory (MML) research portfolio, important collaborative research is now underway in conjunction with each of the other NIST Laboratories, bringing multidisciplinary expertise into the programs and amplifying the expertise NIST is able to contribute in Bioscience.

3. Especially significant is the progression in recent years of the external view of NIST in Bioscience, where it has developed deep ties with NIH, FDA and industry stakeholders – we observe that these groups are now taking the initiative to work with NIST, which is a major milestone and validation of the quality and importance of NIST's capability and contribution in these domains. That these external collaborations with industry, academic and government partners are well-established is especially critical in fields such as bioscience which are highly complex and rapidly changing.

RECOMMENDATIONS:

1. While NIST has made excellent progress in building its commitment and visibility in Bioscience, we recommend NIST continue to place extra emphasis in its recruiting of bioscience research staff. NIST is positioned well for recruiting in areas where it already has high external credibility and visible top talent, as in the physical sciences. In Bioscience, NIST is less well known and extra efforts to increase NIST visibility may be worthwhile in ensuring it is attracting world class talent to its staff, as well as the awareness of policy makers to the success already achieved and anticipated.

2. NIST leadership is commended on how it has re-focused its partnership with IBBR in measurements enabling advanced biotherapeutics—challenging science that is also core to important Pharma and FDA needs. The program applying MS and NMR capability to the development of methods and standard reference materials is very solid. As technologies emerge, NIST might also consider research in support of higher throughput, lower cost screening technologies for complex protein quality assurance and quality control.

3. Partnerships require time and effort to be successful, and sometimes fewer, stronger partners can be more effective and efficient. Accordingly, NIST might consider how they might leverage their already strong relationships with leading academic institutes into additional technological capacity in areas like biochemistry, biotechnology, and computer science.

4. Continued investment in the biosciences will be important. The VCAT will continue to monitor the biosciences portfolio with periodic updates from NIST to ensure the research remains on the forefront of bioscience innovation and is relevant to the biotechnology industry.

4. NIST Information Technology Research

Information Technology (IT) continues to change at a rapid pace, it is pervasive in almost every business and personal applications and is intrinsically complex. As innovations in this area continue to evolve quickly the demand for measurement science supporting these changes is paramount. NIST's programs and projects in the area of information technology are diverse and expansive, ranging from quantum computing to cybersecurity to complex systems and much more. While NIST is working to provide the metrics, tests, tools, and frameworks to support these areas, the vastness and ever-changing advances in this technology space require NIST to ensure the needs of today are considered along with the emerging trends and changing technologies of tomorrow. The VCAT was asked to review NIST's role in the broader information technology space beyond cybersecurity.

NIST has three strategic drivers unpinning the research and standards work in this technology space. They include:

- **Fundamental research in mathematics statistics and IT**
  Develop the essential foundations of computer science, mathematics, statistics, and physical science that contribute to NIST's role in IT and measurement science
- **Applied IT research and development**
  Accelerate IT innovation through the development and application of measurements and related technology and tools
- **Standards development and technology transfer**
  Ensure the research products are available to all to promote U.S. innovation and industrial competitiveness, enhance economic security, and improve our quality of life

Within these strategic drivers are priority growth areas that will cut across all areas to support industry needs in software defined networks, cryptography, big data, privacy, software assurance, and metrology for scientific

computing. Supporting NIST research are a number of partnerships and collaborations to leverage knowledge and resources. These include the National Cybersecurity Center of Excellence, Joint Center for Quantum Information and Computer Science (QuICS), and many standards developing organizations. The external stakeholders interested in NIST's efforts in this space is vast and diverse. From federal agencies like the Department of Defense to companies like Red Hat and Microsoft and a considerable number of academic establishments, all are demanding secure, innovative information technology solutions.

While NIST activities supporting information technology research is wide-ranging, three unique projects were highlighted to demonstrate how NIST is working to support different aspects of industry needs.

- **Metrology for IT --** Measurement science for IT is crucial for uncertainty analysis and the development of computations for predictive capability. With computers increasingly used to complement experiments, prototype engineering systems, and predict the safety and reliability of systems, the need for standard reference computations, uncertainty quantification, and traceability into scientific computations is vital.
- **Data --** New technology continues to evolve to harness the rapid growth of data. There is a broad agreement among commercial, academic and government leaders that effective use of the vast data resources has the potential to spark innovation, fuel commerce and drive progress. In the area of Big Data, NIST has been serving as a convener of the community to bring forth best practices and standards. NIST has led over 700 individuals, with representation from industry, government agencies, and academia, to form committees and subcommittees, facilitate communications, and develop a draft proposal for a reference architecture for the Big Data ecosystem. NIST is also focused on a common access platform to allow for data sharing and broad access.
- **Software quality and assurance --** With the proliferation of computer systems and connected devices in every aspect of society, the importance of quality, trusted software applications is paramount. NIST is working to develop tools, methods, and related models for improving the process of ensuring that software behaves correctly and for identifying software defects, thus helping industry improve the quality of software development and maintenance. NIST established the software assurance reference data set and collected and characterized almost 200,000 programs to allow for the development of software quality and assurance tools and testing products. NIST conducts in-depth studies and provide feedback to the tool makers so they can improve the tools and techniques that are built into the next version of software.

OBSERVATIONS:

1. NIST's programs and projects in the area of information technology are diverse and expansive, ranging from quantum computing to cybersecurity to complex systems and much more. While NIST is working to provide the metrics, tests, tools, and frameworks to support these areas, the vastness and ever-changing advances in this technology space requires NIST to ensure it is considering the needs of today along with the emerging trends and changing technologies of tomorrow.

2. Information Technology spans the globe and there are no real boundaries on the Internet. NIST provides tremendous value by being a globally recognized and trusted source of information, is reliable and has best-in-class expertise, helps accelerate innovation and collaboration, and is seen as a thought leader in this space.

3. NIST has three research portfolio categories in this space:
    a. Fundamental research - develop the foundations of measurement science for IT & develop the foundations of IT for measurement science
    b. Standards development & technology transfer - open, transparent, collaborative, iterative
    c. Applied IT research and development - drive national priorities and advance NIST mission

4. NIST has the following growth priorities: software-defined networks, cryptography, big data, privacy, software assurance, and metrology for scientific computing. The VCAT feels that these areas are on target with respect to industry needs and NIST should continue its efforts in these spaces.

RECOMMENDATIONS:

1. NIST is centered on important problems of national economic importance; external collaboration with industry and academic partners is well-established and especially critical in these fields which are highly complex and rapidly changing. NIST must continue maintaining close partnerships with industry, standards and academic partners, both domestic and international. Partnerships require time and effort to be successful, and sometimes fewer, stronger partners can be more effective and efficient.

2. NIST should explore ways to collaborate and engage with the small to mid-size organizations, beyond regional workshops. These organizations use of IT is drastically different from large organizations, and will be impacted by the pace of their ability to adopt emerging technologies. With broader engagement the National Cybersecurity Center of Excellence (NCCoE) partnership model provides a unique arrangement for industry and NIST to collaborate on neutral ground for a common cause and advancement. NIST needs to consider similar partnerships around IT testing for security, compliance and interoperability.

3. NIST has highly skilled staff on-board that attracts similar talent but needs to develop stronger ties with IT innovation hubs across the country.

4. NIST must 'lead by example', and remain a world-class IT organization. As the demands for the NIST IT environment increase, NIST needs the appropriate budget to internally utilize emerging technologies, meet the demands from other labs and research areas, implement best practices, and attract and train staff at the pace of IT innovation. This will help NIST with independent strength, demonstrable capabilities and maturity, and in-depth experience which will all be required as the measurement science for IT matures.

5. The implications of Cyber-Physical Systems (CPS) and the Internet-of-Things (IoT) will continue to grow with major implications for our way of life. NIST should continue to ensure that it has the technical capacity necessary to address the emergent challenges of this technology area including security, privacy, reliability, and interoperability concerns.

5. Recruiting and Retaining a World-Class Workforce

NIST research is diverse and broad and is focused on extending the limits of today's state-of-the-art measurement and prediction capabilities and to set the stage for the next generation of transformational technologies. While supporting the NIST mission, NIST researchers have received four Nobel Prizes in Physics as well many other prestigious honors, including National Medals of Science and Technology, and a MacArthur Genius Award. NIST's reputation as a world-class research organization is paramount in developing the collaborations and connections needed to address future measurement needs and respond to emerging technological advances. In order to ensure NIST is positioned to remain a world-class research organization, it must continue to attract and retain high-quality scientists and engineers from across all fields of science.

In 2015, the VCAT talked with staff at different levels of the organization to identify the reasons why they choose NIST as a career and what the organization should do to ensure it is able to attract and retain technical staff to address today's measurement challenges while looking forward to the skills and research needed for the future.

OBSERVATIONS:

VCAT recognizes that the attraction and retention of a world-class workforce is paramount to NIST's ongoing success.

- The most recent employee engagement survey demonstrated that NIST slightly exceeds DOC and the federal government in the area of employee engagement.
- NIST has a robust recognition program to acknowledge significant achievements of its staff. Also, NIST's staff is frequently recognized with prestigious, external awards.
- Researchers are attracted to NIST for access to other experts, state-of-the art laboratories and equipment, and a collegial work environment.
- As NIST continues to transform and evolve to serve the Nation's and world's measurement challenges, it must effectively compete with leading companies to attract and retain new skills in Information Technology and Bioscience.

As a leading science agency that is in a very competitive environment for talent NIST requires additional tools and hiring flexibilities necessary to promote and retain a world class workforce. As such the VCAT strongly supports NIST's plans to seek expanded personnel authorities under its Alternative Personnel Management System (APMS). The VCAT has also observed increasing external attention to the presence of foreign national guest researchers at NIST. As representatives of industry and academia, the VCAT recognizes that foreign born researchers are a critical part of the overall U.S. Science and Engineering workforce. The statistics compiled by the National Science Foundation show that among individuals with their highest degree in an S&E field, 34% of master's degree holders and 41% of doctorate holders are foreign born. Reliance on foreign-born scientists and engineers is greatest in the engineering, mathematics, and computer sciences fields. At least half of doctorate holders in these fields are foreign born.[1] In order to meet its mission NIST must maintain the flexibility to work with the best scientists in the world.

RECOMMENDATIONS:

1. The VCAT recommends that NIST explore and seek expanded hiring flexibilities and authorities under the APMS, including more competitive pay-scales like those in place at NIH.

2. As part of these efforts the VCAT recommends that where applicable NIST benchmark its hiring processes with industry best hiring practices

3. To remain competitive the VCAT recommends that NIST seek an expedited direct hire authority for all NIST occupations.

4. VCAT recommends and supports a pilot study to look at work force needs in Bio and Information Technology areas.

5. NIST should develop specifications on the skillsets/competencies/technical specialties needed for the future workforce and identify gaps between current and future projected workforce needs.

6. Identify and implement actions to continue to improve employee engagement at NIST.

[1] NSF Science and Engineering Indicators http://www.nsf.gov/statistics/2016/nsb20161/#/digest/u-s-s-e-workforce-trends-and-composition

6. NIST Partnerships

NIST has a long history of partnerships focused on strengthening core research competencies and responding to emerging technology needs or national priorities. Many partnerships like JILA date back to the early 1960s and have been invaluable in developing competencies in emerging research areas as well as producing innovative, award-winning staff. NIST has had a significant increase in formal partnerships the past 10 years. NIST's partnerships range from formal joint institutes to engagements with specific communities on standards issues in areas such as cybersecurity, forensics, and advanced materials. The expansion in partnerships has increased NIST's access to expertise and allowed entry into technical areas where there is significant growth potential and offers NIST a pipeline for a future skilled workforce. The partnerships provide flexibility to work with academia and industry in different ways and allows NIST to address emerging areas and mission mandates. There are challenges involved in the expanded partnerships, including the time to formalize the arrangements, need for special authorities in some cases, and IP issues. There is continual need for balance between internal programs at NIST, the research laboratories, and NIST's offsite engagements and an understanding of how these relationships will have a long-term impact on what is critical to the NIST mission.

The VCAT was asked to consider how effective these partnerships are for engaging and collaborating with industry and/or academia to address NIST's strategic priorities and complement NIST research capabilities. In reviewing the evolution of NIST partnerships, the VCAT considered the structure and focus of long-standing partnerships such as JILA and the Institute for Bioscience and Biotechnology Research (IBBR) along with newer models like the Centers of Excellence focused on expanding collaborations with leading research institutions in emerging technology areas and enhancing technical innovation through early alignment of measurement science with emerging fields of research.

OBSERVATIONS:

1. Long established partnerships such as JILA and National Synchrotron Light Source (NSLS), that strengthen the core NIST mission of measurement science, have been and still are extremely successful.

2. Most recently, namely in the past five years, the number of partnerships have increased considerably, reflecting the demands placed on NIST to either increase its participation in ongoing activities or to expand in new areas, such as cybersecurity, disaster resilience, and forensic sciences. A number of these new initiatives have also new governance structures, e.g. the Centers of Excellence.

3. Establishing and nurturing successful partnerships requires a substantial investment of resources from all parties involved. It is too early to judge whether the more recent initiatives like the NIST Centers of Excellence program, will develop into successful partnerships and we will continue to monitor progress.

4. The VCAT is concerned that the rapid increase of different partnership models employed by NIST may be stretching NIST's technical research capabilities to a limit. At the center of NIST's success is the fact that it is first and foremost a research laboratory organization with a critical mass of talented scientists and engineers that have the support (both time and resources) necessary to have a broad impact across many technology areas. By forming partnerships with offsite organizations NIST must be careful that its internal research programs are not adversely affected.

5. While NIST appears to be using its existing authorities successfully to conduct research in collaboration with other parties, the addition of Other Transaction Authority would provide NIST with needed additional flexibility in those situations where existing authorities do not fit the collaboration well. Other Transaction Authority would provide NIST the ability to enable research while protecting government interests in specific research projects by providing an additional mechanism when Cooperative Research and Development Agreements (CRADAs), contracts, grants or financial assistance awards are not feasible or appropriate.

RECOMMENDATIONS:

1. The structure for a successful partnership is highly dependent on a variety of factors and each project is unique. Therefore, the VCAT recommends that NIST retains great flexibility on which model to use and its associated governance structure.

2. The Committee recommends that NIST promptly and actively seek from its congressional authorizing committees an amendment of the NIST Organic Act to include Other Transaction Authority. This could be accomplished, for example, by amending existing 15 USC 272(b)(4), authorizing NIST:

   > "to enter into and perform contracts, including cooperative research and development arrangements and grants and cooperative agreements, and other transactions on such terms as it may deem appropriate, in furtherance of the purposes of this chapter;"

3. The VCAT recommends NIST periodically update the committee on the progress and accomplishments of the more recent partnerships based on NIST suggested metrics.

7. NIST Budget and Planning

7a. NIST Three-Year Programmatic Plan 2017-2019

The Committee has read and reviewed the draft NIST three-year programmatic plan as of February 2016 and believes that it accurately portrays the near-term path of activity and development at NIST. The Committee appreciates NIST management's continued focus on developing longer-term strategic plans outlining the agency needs and challenges that are evident in this programmatic plan. The VCAT supports NIST's continued focus on core measurement needs related to precision measurement, complex systems, and data, which will enable NIST to address emerging measurement and technology needs across multiple sectors.

7b. NIST Budget (Dollars in Millions)

	FY 2015 Enacted	FY 2016 Enacted	FY 2017 Request
Scientific and Technical Research and Services (STRS), including Laboratory Programs Corporate Services, Standards Coordination and Special Programs	**$675.5**	**$690.0**	**$730.5**
	$138.1	**$155.0**	**$189**
Industrial Technology Services (ITS)			
Advanced Mfg Tech Consortia	8.1	0.0	0.0
Hollings Mfg Ext Partnership (MEP)	130.0	130.0	142.0
Nat'l Network for Mfg Innovation (NNMI)	0.0	25.0	47.0
Construction of Research Facilities (CRF)	**$50.3**	**$119.0**	**$95**
Building 245, Gaithersburg	0.0	64.0	40.00
Saf, Cap, Maint & Maj Repairs	50.3	55.0	55.0
Total, NIST Discretionary	**863.9**	**964.0**	**1,014.5**

7c. FY 2016 Appropriations and FY 2017 Request

The FY 2016 Omnibus appropriations grew the NIST budget by a total of $100M over FY2015 enacted numbers. The real growth came in the construction budget where NIST received an additional $68.7M for much needed repairs to Building 245 on the Gaithersburg campus. Also included in this budget is an increase in the Industrial Technology Services area to fund a DOC-supported NNMI, a high priority of the current Administration. The VCAT is strongly supportive of this budget growth, especially as it provides much needed funding responding to VCAT recommendations supporting NIST laboratory infrastructure improvements necessary to foster world class research.

The VCAT is pleased with proposed FY 2017 budget for NIST, growing the research programs by $40.5M with a focus on supporting advanced communications, future computing, and biomanufacturing. The Committee is supportive of the continued focus on NIST's manufacturing programs and the on-going support for the NNMI. While the VCAT appreciates the modest growth in the NIST budget over the past few years, the Committee continues to be concerned about the increasing number of unfunded mandates that are being assigned to NIST that drain already limited resources away from the ongoing research efforts. As increasing demands pull NIST staff away from research and development activities they run the risk of significantly eroding their technical reputation that is necessary for long-term success, in exchange for short-term "policy wins".