

**VISITING COMMITTEE ON ADVANCED TECHNOLOGY (VCAT)
MINUTES OF THE JUNE 13-14, 2017 MEETING
GAITHERSBURG, MD**

ATTENDANCE:

**Visiting Committee
Members Attending**

Adler, Allen
Colwell, Rita
Folena-Wasserman, Gail
Garvey, Michael (Mike)
Holt, William (Bill)
Ishak, Waguih
Sizer, Theodore (Tod)*
Vasko, David

Designated Federal Officer

Shaw, Stephanie

NIST Leadership Board

Boehm, Jason
Brockett, Del
Copello, Brian
Dimeo, Rob
Dohne, Kirk
Fangmeyer, Bob
Fasolka, Mike
Jenkins, George
Kayser, Rich
Kimball, Kevin
Kushmerick, James
Locascio, Laurie
Molnar, Mike
Olthoff, Jim
Porch, Susanne
Rochford, Kent
Romine, Chuck
Royster, Cecilia
Thomas, Carroll
Vaughn, Skip
Wixon, Henry

NIST Staff

Acierto, Linda
Bald, Kevin
Banovic, Stephen
Barbosa, Nicholas
Bergman, Rhea
Castillo, Gilbert
Cherny, Paul
Currens, Chris
Davis, Rick
Drapela, Timothy

NIST Staff

(Continued)

Gayle, Frank
Gillerman, Gordon
Greer, Chris
Gundlach, David
Hickernell, Bob
Hughes, Colleen
Ivy, Nahla
Jillavenkatesa, Ajit
Kauffman, Leah
Liu, Rosa
Makar, Susan
Martinez, Serena
Moylan, Shawn
Miner, Laurel
Newton, Tom
Ouimette, Mylene
Phillips, Margaret
Porter, Gail
Richter, Curt
Rogers, Kelley
Rowland, Carolyn
Rudnitsky, Robert
Satterfield, Mary
Saundry, Claire
Schlatter, Katie
Seiler, David
Semerjian, Hratch
Silcox, Barbara
Spitalniak, Vicky
St. Pierre, Jim
Strouse, Gregory
Szakal, Christopher
Teske, Michael
Thorne, Roger
Wilkinson, Richard
Zielinski, Paul

Others

Ambrose, Mitchell- American
Institute of Physics
Gray, Amber- U.S.
Government
Accountability Office
Harpst, Elias- U.S.
Government
Accountability Office
Kowalewski, Elizabeth- U.S.
Government
Accountability Office
Pinto, Emily- U.S.
Government
Accountability Office
Webber, Naomi - Lewis-
Burke Associates LLC

*Participated Remotely

Tuesday, June 13, 2016

Call to Order - Dr. Rita Colwell, VCAT Chair

Dr. Colwell called the meeting to order at 8:30 a.m., went over logistics for the meeting and gave a summary of the discussions for the three preparatory working groups from the May 8th webinar.

- The Communications Preparatory Working Group, led by Dr. Colwell, worked with NIST's communications director, Gail Porter, to summarize all the ways NIST lets the public know about the outputs and impacts of its work. NIST has a wide variety of communications media – from traditional press releases and web articles, to blog posts and videos. By having this multifaceted approach, NIST can reach a lot of different audiences. NIST also has a robust social media presence, with an impressive number of followers on Twitter, Facebook, LinkedIn, YouTube, and others. Finally, NIST has custom web content highlighting its Nobel Prizes and the new Industry Impact series. The VCAT discussed, among other things, the importance of telling a story, and new ways to get the message of NIST's R&D to a broader audience.
- The Trade Preparatory Working Group, led by Dr. Alder, emphasized how NIST's metrology and standards work has a fundamental role in supporting US trade. The group also provided some suggestions of areas where NIST should maintain or increase its efforts, such as NIST's support for internationally-recognized standards that reduce technical barriers to trade. Lastly, to ensure continued relevance to U.S. exports, the group emphasized that NIST should maintain leadership by anticipating where advancing technologies will provide opportunities for economic growth and will require corresponding advances in measurement science.
- The Innovation Preparatory Working Group, led by Dr. Brooks, provided thoughts on how NIST could better engage the communications and biopharmaceutical industries to promote their work and better understand their needs. NIST working closely with industry can best understand the particular measurement science and standards necessary to support innovation in various sectors.

The three working groups prepared and positioned the VCAT to support and advise NIST. Dr. Colwell emphasized the importance of communicating the value of NIST, the critical nature of the work that's being done, and how to continue to anticipate the future needs of the US economy and build the expertise to support those needs.

SESSION I: NIST UPDATE

NIST Update – Dr. Kent Rochford, Acting Under Secretary of Commerce for Standards and Technology and Acting NIST Director

Dr. Rochford began by thanking the VCAT working groups. He requested the VCAT's assistance in identifying the right strategic priorities to ensure that NIST allocates its resources, particularly if they are decreasing, to continue with the important metrology work for not just next year but for the next 20 years. He also stressed the likelihood that future success would require more interdisciplinary cross-laboratory work.

Dr. Rochford introduced the two newest members, Dr. Gail Folena-Wasserman and Mr. David Vasko.

Dr. Rochford then provided a brief update on safety at NIST. So far in 2017, there has been an increase in DART (Days Away, Restricted or Transferred) cases, such that DART cases are at their highest since 2012. More than half of the cases are from slips, trips and falls, which resulted in an average of 37 days away from work. After a deeper dive, a third of these cases were due to inattention and people hurrying, things that could be controlled.

Dr. Rochford then discussed the following personnel changes, Mr. Del Brockett has replaced Ms. Mary Saunders, who left in February, as the Acting Associate Director for Management Resources. Del is also the Chief Information Officer. On July 3rd, Dr. Laurie Locascio will complete her 6-month rotation as the Acting Associate Director for Laboratory Programs (ADLP), and will return as the Director of the Material Measurement Laboratory (MML). Dr. Locascio will be leaving NIST on October 1, 2017 for a new position at the University of Maryland as Vice President of Research. Mr. Mike Fasolka will step in as the Acting Director of MML. Dr. Jim Olthoff, Director of the Physical Measurement Laboratory (PML) will begin a 6-month rotation as the Acting ADLP on July 3rd and Dr. Carl Williams will step in as the Acting Director for PML. Dr. Jim Kushmerick is now Acting Director of the Center for Nanoscale Science and Technology since Dr. Bob Celotta retired in April.

Taking to heart the VCAT's suggestions into better communicating NIST impact, Dr. Rochford highlighted a new website NIST has created with continually updated stories of NIST's impact on industry. In a similar vein, Dr. Rochford also highlighted a study of the Hollings Manufacturing Extension Partnership Program conducted by the W.E. Upjohn Institute that showed through econometric studies a return of almost 9-to-1 for federal dollars spent.

Dr. Rochford provided updates on NIST's efforts to support redefinition of the SI. NIST's most recent measurements from its watt balance are accurate enough to support redefinition of the kilogram in the fall of 2018.

In the area of quantum science, Dr. Rochford discussed NIST's previous accomplishment of a loophole-free Bell's test showing that quantum mechanics was an active representation of the universe, without using local variables. NIST repeated the test with two beryllium ions, entangled them, separated them, and then manipulated the spin of one ion to show that manipulation influenced the other in a non-local way, another breakthrough in quantum mechanics and the ability to manipulate matter at the most fundamental level.

He also highlighted progress of NIST's National Fire Research Laboratory. This recently recommissioned facility has conducted six burn studies, in coordination with the National Research Council of Canada, using composite laminate timbers to aid industry in developing fire and burn codes for new structures that are 10-stories or taller.

Dr. Rochford next provided the VCAT an update on NIST's first National Manufacturing Institute. The National Institute for Innovation in Manufacturing Biopharmaceuticals (NIIMBL) was launched in March 2017. The goal of this institute is to move the biopharmaceutical production from a batch process to a continuous process and make the processes more flexible for industry. NIST is providing \$70 million over 5 years and the NIIMBL participants \$130 million in cash and an additional \$50 million in-kind. NIIMBL has over 150 supporters from both the private sector and universities.

Moving to NIST's work in Public Safety Communications, Dr. Rochford reminded the VCAT that NIST's public safety program has an account until 2022 that receives mandatory money from funds raised from the auction of broadband spectrum. The goal of this program is to develop technologies that first responders need to build a nationwide broadband network for firefighters, EMS, police, and FirstNet, to do away with big bulky radios, and provide LTE-type technology. As part of this effort NIST has awarded several grants to universities and industry to conduct work in critical areas of first responder communications. NIST has also started a new prize challenge to study virtual reality in measurements, simulating first responder scenarios and repeatable testing of new first responder interfaces and technologies.

Lastly, Dr. Rochford briefed the VCAT on the Presidential Executive Order (EO) on Strengthening the Cybersecurity of Federal Networks and Critical Infrastructure, signed by President Trump in May. For NIST, the EO 1) instructs all government agencies to use the NIST Cybersecurity Framework, 2) in partnership with Department of Homeland Security (DHS), NIST will work on resilience against botnets and automated distributed threats, and 3) workforce development, assessing efforts to educate and train the American cybersecurity workforce.

Discussion:

The group discussed the following topics:

- Outreach programs to adopt the “NIST standard” in cybersecurity for small and medium businesses as well as state and local school districts.
- Development of the Baldrige Cybersecurity Excellence Builder tool to leverage the NIST Cybersecurity Framework to assist organizations in achieving their goals.
- Role of MEP in assisting implementation of the NIST Cybersecurity Framework with educational institutes and state organizations.
- Risk/issue of cybersecurity in supply chains with small firms.
- Implementation of workforce development through NIIMBL grants.

For more information, see Dr. Rochford’s [presentation](#).

NIST Security Update – Dr. Kent Rochford, Acting Under Secretary of Commerce for Standards and Technology and Acting NIST Director and Dr. Richard Kayser, NIST Chief Safety Officer

Dr. Rochford and Dr. Kayser briefed the Committee on NIST’s recent efforts to improve its security posture, with a special focus on the recent “Security Sprint.” Dr. Rochford began by reminding the VCAT of the many activities underway following policing lapses in security. First, based on the results of an independent security assessment, NIST has increased the size of its contract security force, the access controls on both campuses have improved, and a pilot project has been started in Gaithersburg to increase sophistication of access controls. NIST also plans to develop a security program to work in parallel with its safety program to protect its reputation, people, facilities, and equipment, and its open and collaborative research environments. The security program will also protect NIST’s information and technology infrastructure. The goal is to create comprehensive solutions and manage a culture change. Dr. Rochford charged Dr. Kayser with a 30-day sprint to review the existing inputs and prioritize actions while considering NIST’s numerous mission activities.

Dr. Kayser updated the VCAT on findings from the 30-day sprint. NIST focused on two significant issues: systemic security weaknesses, which are deficiencies in its organizational structure, leadership management, culture, systems, processes, and services; and undesirable event risks. The information used to conduct the 30-day sprint included the three external security expert reports; the recent Antiterrorism Risk Assessments conducted every three years by the Department of Commerce Office of Security; the Strategic Risk Management Action Plan: NIST Top Mission Support Risks; Chapter 10, Security developed with the support of NIST’s Enterprise Risk Management Office containing responses to the three external security expert reports and results from the antiterrorism risk assessments; the Organizational Risk Assessment; and interviews of the fourteen NIST managers from both Gaithersburg and Boulder. Two questions were asked of the NIST managers, 1) what are the greatest actual security concerns and 2) what are the concerns about how changes in security could adversely impact the ability to do actual work. The final report was submitted on March 22, 2017 and presented to the NIST Security Advisory Board (SAB) on April 17, 2017. After review of the report, the SAB concurred on an initial set of 12 prioritized actions submitted to Dr. Rochford, which were accepted. The SAB is now developing action plans.

Discussion:

The group discussed the following topics:

- Simple actions to take to improve NIST’s security culture, which will also affect the safety culture.
- Development and implementation of security standards to ensure correct measures are taken to protect what needs protecting.
- Viewpoints on merging safety and security together or keeping them separate.

For more information, see Dr. Rochford and Dr. Kayser's [presentation](#).

Budget Review – Dr. Kent Rochford, Acting Under Secretary of Commerce for Standards and Technology and Acting NIST Director

Dr. Rochford briefed the VCAT on the President's Budget Request for Fiscal Year 2018. The FY18 budget request reflects the Administration's priority to rebuild the military, make critical investments in the nation's security, and keep the nation on a responsible fiscal path. To increase defense spending by \$54 billion while not increasing the deficit, discretionary programs will decrease.

The President's Budget Request aims to maintain core capabilities in measurement science so the Institute can continue to meet its mission to provide measurements and standards that accelerate innovation. The budget proposed 24 percent reduction in the NIST budget across its three major budget lines: \$88.7 million (12.8%) reduction in Scientific and Technical Research Services (STRS), \$133.7 million (86.4%) reduction in Industrial Technology Services (ITS), and \$14.8 million (12.4%) reduction in Construction of Research Facilities (CRF).

The President's budget request eliminates the MEP program resulting in the loss of 61 staff. The budget provides \$6 million for shutdown costs. NIST is exploring potential paths to continue MEP through non-federal funds. The Manufacturing USA program had smaller cuts, allowing money for NIST's coordination role for the 14 centers and to maintain funding NIIMBL, but would eliminate funds to stand up a second institute.

The CRF request provides funds to continue renovations of its Radiation Physics Building. To maintain minimal momentum on the ongoing renovations in Boulder, NIST will have to redirect funds from its Safety Capacity Maintenance and Major repair fund, which will further decrease NIST's ability to keep up with its significant maintenance backlog, now over \$300 million. Funding at this level will lead to more infrastructure failures and increased use of scientific funding for renovations and repairs.

For the STRS budget, the NIST Laboratory Programs are reduced by \$59.3 million. NIST's Corporate Services, which provide IT support for STRS programs, is reduced by \$6 million. The Special Programs Office and the Standards Coordination Office are reduced by \$23.4 million. The proposed reductions would have significant programmatic impacts across NIST with significant reductions in scientific and technical staff, with NIST projected to lose 337 people, including 208 professional scientists and technologists, 21 technical support staff, and 108 administrative and support staff.

Dr. Rochford also mentioned administration efforts to reform and reorganize the federal government, related to the budget process. First was the Executive Order on a Comprehensive Plan for Reorganizing the Executive Branch, signed on March 13, 2017. OMB issued a memorandum to execute that Executive Order, "Comprehensive Plan for Reforming the Federal Government and Reducing the Federal Civilian Workforce". This memorandum instructs the Department of Commerce to take immediate action to achieve workforce reductions and cost savings, develop a plan to maximize employee performance by June 30, 2017, and submit an Agency Reform Plan to OMB. The Reform Plan, due in September 2017, is part of the FY19 Budget and includes long-term workforce reductions.

Finally, Dr. Rochford concluded by asking the VCAT the following key questions:

- What are the important issues and what metrology trends does the Committee see?
- How can NIST be most effective in times of budget changes like this?
- Are the strategic priorities NIST identified the right ones?
- How can NIST be more effective in interdisciplinary technologies, cross-laboratory work, and how can NIST do that work with more flexibility and quickness?

Discussion:

The group discussed the following topics:

- Technical programs that will be reduced and positions of the people in these programs.
- How to maintain staff morale.
- How to preserve NIST's future and maintain its core with the requested reduction.
- The effects the budget will have on updating NIST's facilities to meet standards.

For more information, see Dr. Rochford's [presentation](#).

SESSION II: NIST LABORATORY PROGRAMS STRATEGIC PLANNING

[Associate Director of Laboratory Programs Strategic Planning Overview – Dr. Laurie Locascio, Acting Associate Director of Laboratory Programs](#)

Dr. Locascio updated the VCAT on the NIST Laboratories recent strategic planning efforts. Currently the NIST labs are developing a long-range strategic plan with the goal to identify high-level priorities to best position NIST in 10 years. The goal with a long-range plan is to be proactive instead of reactive in shaping NIST in an ever-changing landscape of both federal funding and technical opportunities.

To lay the groundwork for the strategic plan, a scan of the technical landscape was completed, and numerous interviews with NIST senior leadership, former NIST directors, as well as former VCAT members were conducted. The interviews explored major opportunities, risks, areas for investment/divestment, NIST culture, leadership, indicators of success, and advice for Commerce Secretary Ross. During a 2-day workshop held at the end of May, a five-person thought leader panel provided their perspectives on the future of technology. One theme that was clear is that science increasingly depends on systems thinking and learning, multimodal data, and multimodal measurements. The second key theme was NIST has a place and a part in teaching people about measurement science and ensuring measurements are being conducted to get the best data out. During these early stages of discussion, three possible areas for growth were identified in vertical capabilities, meaning associated with specific disciplines: bioscience, quantum science, and Internet of Things (IoT). In horizontal capabilities, meaning cross-cutting areas, potential areas for growth include data science and artificial intelligence, systems-level thinking and modeling, and democratization of measurement. When discussing the future state of NIST, everyone seemed to agree that trust will be essential. NIST must be known as the place that provides trust in measurement, technology and science.

Dr. Locascio continued by describing how these trends align with those identified in other planning processes, such as NIST 3-Year Programmatic Plans, which laid the groundwork for the current discussions. She also showed how NIST's Laboratory Programs budget initiatives over the past few years have aligned with these areas. NIST has made progress, but there are several areas that have not reached critical mass. In addition, new areas are emerging. As far as organizational opportunities, NIST needs to be more flexible to respond to the new and emerging multidisciplinary and convergent technical fields and become a more collaborative organization.

Discussions will continue throughout the summer to identify NIST's priorities and hopefully have a strategic plan in place by October 1st.

Discussion:

The group discussed the following topics:

- Are the strategic priorities identified the right ones;
- Are there more pressing areas or topics missing;

- How to best make these changes in the current environment;
- What advice does the VCAT have for NIST on establishing the capabilities needed and the approach to take;
- How far out should NIST plan for – what is long term; and
- How much of the budget should be placed into high risk research?

For more information, see Dr. Locascio's [presentation](#).

Update on NIST Bioscience Program – Dr. Kelley Rogers, Technical Program Director for Biosciences, Material Measurement Laboratory

Dr. Rogers provided the Committee with an update on advances in NIST's bioscience program since the VCAT's review in 2015. Within MML there are two bio divisions, Biomolecular Measurements and Chemical Sciences Division and Biosystems and Biomaterials Division. In addition, MML collaborates on bioscience with all operating units across NIST. For example, MML collaborates with CNST and NCNR in measurements for biomolecules and analytics for biomanufacturing processes such as DNA, RNA, proteins, metabolites, omics, and bioprocess analytics; and with ITL, PML, and CNST in quantitative tools for cell characterization and measurements and models for cells in populations such as cell identity, morphology, viability, stability, activity/potency, multimodal population behaviors, community structure, and context effects. NIST serves the biomanufacturers in industry, and to do this NIST needs to develop process analytics.

NIST has many customers. The clinical medicine community relies on NIST to develop standards to trace laboratory tests. The biopharmaceutical industry requires NIST's measurements to help ensure the safety and quality of their products made from biological systems, the DNA forensics community requires NIST's measurements for accuracy. NIST is a world leading expert on mass spectrometry measurements for biological molecules and maintains the database used by the research community. The emerging synthetic biology industry may use NIST as it uses genetically engineered, genetically modified organisms to manufacture products, such as high-value commodity chemicals.

The five biological sciences strategic priorities are complex biotherapeutics, microbial metrology, engineering biology, precision medicine, and reproducibility of biomedical research. NIST's job is to provide the biomedical research community the infrastructure it needs to move toward a more rigorous basis for reporting results and have trust in those results.

Dr. Rogers continued by describing products for biosciences within NIST. Those include reference materials for cancer biomarkers, documentary standards for cell line authentication, reference cell standard for HIV monitoring, MRI phantom imaging standards, genomic DNA reference material, and the mass spectral database.

Customers of many of NIST's products also receive an extensive data analytics package to help them understand the measurements. For example, NIST has world-class expertise in imaging capabilities for biomolecules and biological tissues. NIST is developing algorithms to allow more automated selection of what a good cell looks like. NIST is also expanding the microbial measurements to allow evaluation of what is populating a microbiome or biological environment, as well as pathogen detection. A better method or sequencing a protein is also being explored.

One example of a productive partnership with industry is NIST's biomanufacturing program, funded in 2009. This partnership, which is centered at NIST's Institute for Bioscience and Biotechnology Research, helps define the measurement challenges in the biomanufacturing industry. It has been successful in integrating NIST with industry, finding out what the measurement needs are and meeting those needs.

Dr. Rogers mentioned a few significant accomplishments in biosciences since the 2015 update. NIST released reference materials that provide an effective measurement foundation for the bioscience industry, including the first monoclonal antibody reference material, and the expansion of NIST's human and microbial genomic DNA

reference material. NIST also released a genomic DNA standard for tumor profiling. In addition, since 2015 two new advanced manufacturing institutes in bio-focused technologies have been established. This includes the NIST-funded National Institute for Innovation in Manufacturing Biopharmaceuticals (NIIMBL) and the Department of Defense-funded BioFabUSA. NIIMBL is roughly a \$189 million investment in innovative biomanufacturing, scalable manufacturing processes for emerging classes of biologics, and standards development. BioFabUSA is focused on tissue bio-fabrication, ultimately making organs.

Dr. Rogers addressed the four recommendations the VCAT made in 2015 for the NIST Biosciences programs. The first recommendation was to increase visibility in bio expertise to recruit world-class talent. NIST is addressing this with a three-pronged approach: aggressively recruiting individuals from leading research institutes into the NRC postdoctoral program, investing in Ph.D. staff with the resources to do high-level measurement science and service development, and leveraging existing partnerships as a talent pipeline for recruiting. From the last update to present, NIST has done the following: produced high-impact publications with Massachusetts Institute of Technology (MIT) in Engineering Biology, NIST is leading consortia helping coordinate standards for regenerative medicine, hosted high-profile workshops to bring the research community in and share its expertise, and created a new website to facilitate external access to NIST expertise.

The second recommendation was to leverage existing partnerships to expand technological capacity. NIST's partnership with IBBR and the University of Maryland (UMD) has expanded collaboration in Cryo-EM capabilities. Also, UMD's membership in NIIMBL will help to strengthen the alignment in biomanufacturing focus areas. NIST's Joint Institute for Metrology in Biology (JIMB), a partnership with Stanford, has refined its scope to focus on DNA read (genomics) and write (synthetic biology) capabilities, and is currently establishing a new shared research facility to collaborate in a platform lab and create commercial partnership space.

VCAT's third recommendation was to complement existing protein analytical tools with higher throughput, lower cost screening technologies. NIST's monoclonal antibody standards development enables technology-agnostic development within innovator companies. NIST's basic research offers disruptive potential, such as next-gen protein sequencing, and its NIIMBL partnership will provide industry prioritized needs and partnering opportunities.

The fourth recommendation was to continue investment in the biosciences portfolio. Even though NIST has received less than half of the funding requested for bioscience in its budget requests over the last few years, it has leveraged every source available to fund programs and activities in cell measurements and regenerative medicine, gene-editing standards, and engineering biology. NIST's biomanufacturing process technology, considering it is the highest priority for industry, is not yet at critical mass and has fully leveraged available non-base funding opportunities. NIST hopes to also leverage the partnership within NIIMBL to develop needed standards and measurements.

Finally, Dr. Rogers mentioned future growth areas for biotechnologies that NIST is not yet able to address and is watching for future opportunities. NIST understands and expects biology to be inherently complex, as will be the bio-metrology tool kit needed to measure it and will need to continually increase its sophistication in measuring that complexity.

Discussion:

The group discussed the following topics:

- Possible establishment of a consortium uniting the bioscience societies and the medical societies.
- Benefits of the NIIMBL partnership with Food and Drug Administration.

For more information, see Dr. Rogers' [presentation](#).

Update on NIST Information Technology Research – Dr. Chuck Romine, Director, Information Technology Laboratory

Dr. Romine provided the Committee with an update on advances in NIST's information technology research program since the VCAT review in 2015. He began by describing a recent ITL strategic planning effort undertaken by ITL. One highlight of that effort was development of ITL's purpose: cultivating trust in IT and Metrology through measurements, standards, and testing.

Dr. Romine briefly described how ITL fulfills its purpose with a budget several orders of magnitude smaller than the industry it serves. Some examples include:

- Approximately 30 percent of the US enterprises use the **Cybersecurity Framework**. Usage is expected to grow to 50 percent by 2020.
- **The Digital Library of Mathematical Functions**, the online digital equivalent of the *Handbook of Mathematical Functions* by Abramowitz and Stegun, has enormous value to the entire scientific enterprise.
- In **Health IT**, the development of the online tools to improve electronic health records and the distribution of incentive payments Congress allocated to adopt electronic health records.

NIST's primary challenge in IT research, as with other areas, is to maintain a balance between fundamental research, applied research and development, and standards development and technology transfer. If the balance is not maintained year after year, NIST won't have technology to transfer or be relevant to its stakeholders.

The goal for fundamental research is to develop the essential foundations of computer science, mathematics, statistics, and physical science that contribute to NIST's role in IT and measurement science. This includes two critical areas: measurement science for IT, which is how to measure information technology, and IT for measurement science, which is how to use information technology to improve the measurement science across the rest of NIST and around the world.

The goal for applied research is to accelerate IT innovation through the development and application of measurements and related technology and tools. This is accomplished by accelerating development and adoption of emerging information technologies, addressing national priorities through IT research and technology transfer, and strengthening measurement science through math, statistics, and computing.

The goal for standards development and technology transfer is to ensure the products of NIST research are available to promote US innovation and industrial competitiveness, enhance economic security, and improve quality of life. This is done through active participation with industry in catalyzing the development of IT standards. There are approximately 90 NIST staff involved in standards development organizations who build communities of interest in IT priority areas, such as data science, cloud computing, health IT, and cybersecurity to name a few. NIST has strong and active collaborations with academia, industry, and other agencies in the information technology sector, which allows NIST to effectively communicate its results as well as promote open data access.

Dr. Romine also stated that because of activity in addressing cybersecurity for critical infrastructure sphere, collaborationism with other important sectors of the economy, financial services, transportation, and energy have been developed and are now routinely undertaken.

Next, Dr. Romine briefed the Committee on the status and implications of the recommendations the VCAT made in 2015. One theme from the VCAT's recommendations was to continue, strengthen, and expand partnership with industry, standards and academic partners, both domestically and internationally, and to keep a special focus on small and mid-sized organization. NIST has been assertive in strengthening such collaborations for IT research. Dr. Romine shared some important interagency collaborations ITL has recently

participated in and led, including the National Strategic Computing Initiative and a subcommittee of the National Science and Technology Council subcommittee on artificial intelligence. He also provided a list of NIST's key external stakeholders and its international collaborations and stressed the importance of maintaining these connections.

There were changes made to NIST's priorities after a re-examination, mainly resulting in a cyber sprint assignment, a presidential executive order to establish a commission on enhancing national cybersecurity, and another executive order on strengthening the cybersecurity of federal networks and critical infrastructure. Under the most recent executive order were three new assignments; promoting the use of the NIST framework, which is now mandatory for other federal agencies; addressing the serious challenge of botnets and other risks associated with the infrastructure; and development of the cybersecurity workforce. NIST now has the priority of housing the program office for the National Initiative for Cybersecurity Education.

Next, Dr. Romine highlighted IITL's priorities and their goals for IT research. These priorities had changed since 2015 due to the fast pace of technology, the spotlight in the cybersecurity arena. Current priorities include:

- Cybersecurity, to cultivate trust in the digital economy and provide expert guidance to help protect IT infrastructure;
- Internet of Things (IoT), a multi-laboratory activity to cultivate trust in IoT by accelerating development of measurements, standards, and guidance;
- Reliable Computing, to cultivate trust in computing by developing new IT-based metrology;
- Future Computing Technologies and Applications, a NIST-wide effort that includes large-scale computer simulations and data analytics, quantum computing, biomimetic computing, and all different kinds of new computing paradigms making this a multi-laboratory activity; and
- Artificial Intelligence and Machine Learning, to cultivate trust in AI by building an infrastructure for rigorous AI system-level testing.

There are also several areas that NIST may prioritize in the future. For example, NIST may develop a "horizontal" capability in artificial intelligence by cultivating cadre of experts to support projects across the entire institute. Other areas include improving software reliability through software metrology, and cultivating trust in metrology through uncertainty quantification.

Finally, Dr. Romine proposed the four following questions to the VCAT for their advice and or feedback.

- Do you agree with the horizontal approach to data science?
- How can NIST maintain balance between cybersecurity and other IT priorities?
- What questions should NIST address in IoT?
- Are the future priorities NIST proposed the right ones; and what is missing?

Discussion:

The group discussed the following topics:

- Coupling brain science with AI.
- Defining degrees of trust, statistical or other, and how to trust the results.
- What is the contextualization and quality of data analytics and big data being pushed to the cloud?
- The intersection of discipline between the labs and what NIST is doing to differentiate itself from other agencies.
- Cultivating reasonable distrust in realistic behavior.

For more information, see Dr. Romine's [presentation](#).

Wednesday, June 14, 2017

SESSION III: SAFETY UPDATE

Safety Update – Richard Kayser, Chief Safety Officer

Dr. Kayser provided an update on NIST's safety culture. He began with brief overview of the 2014 NIST safety climate survey and the approach for the next scheduled assessment, August 2017. In this assessment, NIST will identify actionable information to improve its safety culture at the OU, division, and group levels; identify key policies, procedures, and practices used by other organizations with a positive safety culture to share across its organization; and create templates for success. In November, a report will be published and in December recommendations will be presented to the NIST Director.

NIST is continually seeking improvements to its incident reporting and investigation program. NIST has made tremendous progress in its enhanced workplace inspection program. The first phase was deployed last October and the second phase will be implemented and in effect by October 1, 2017. In addition, a streamlined investigation process was developed for the approximately 60 percent of incidents that have obvious root causes. Also, staff can now subscribe to receive notifications of incidents and investigative reports to share lessons learned across NIST.

Finally, Dr. Kayser briefed the Committee on the process used to develop and deploy safety programs at NIST. First, the Safety Office produces a written document, incorporates stakeholder feedback, and then drafts a program for review by the Safety Advisory Committee (SAC). The Safety Office addresses comments by the SAC before the program is sent to the NIST Executive Safety Committee for their review. After Executive Safety Committee concurs with the program, the Chief Safety Officer approves the program.

Discussion:

The group discussed the following topics:

- The integration of historical data collected and the current trending.
- What the possible effects will be to the safety program with the recently released budget.
- The ratio between near-misses and DART cases.
- Types of training and workplace inspections.
- Combining Safety and Security Updates in future meetings.

For more information, see Dr. Kayser's [presentation](#).

SESSION IV: DEVELOPING ORGANIZATIONAL FLEXIBILITY

NIST Laboratory Structure – Dr. Jason Boehm, Director, NIST Program Coordination Office

Building on the presentations by Dr.'s Rochford and Locascio, Dr. Boehm provided the Committee with a perspective on the importance of organizational flexibility. NIST needs to address the measurement needs in complex multivariable areas of biological sciences, internet of things, artificial intelligence, and machine learning. In these emerging issues, NIST needs to be flexible to combine existing expertise of scientists from across laboratories to develop new methods of delivering trust in measurement. Because of this, NIST must to maintain organizational agility and flexibility and deliver on core mission activities.

Dr. Boehm continued by describing NIST's institutional characteristics. First, NIST is primarily a lab-based intramural research organization. This means NIST must have dedicated infrastructure and staff. Second,

NIST's organizational structure is relatively static considering the last major reorganization took place in 2010, twenty-two years after the prior major change. This stability allows for the development of deep technical expertise in key areas while remaining a discipline-based organization, but does engender some stove-piping. Lastly, NIST laboratories have broad autonomy within their respective scopes, but must continue to deliver on its core activities and a large part of that is measurement traceability.

NIST has used several methods to increase its operational flexibility. One method is startup and directed funding. The ADLP's portfolio includes two programs: 1) a Strategic and Emerging Research Initiative (SERI) fund of about \$5.75 million to provide seed funding to start programs towards specific national need, and 2) an Innovations in Measurement Science (IMS) fund of about \$27 million, which is used to develop new measurement capabilities and techniques by supporting three to four projects of \$1 to \$1.5 million over 5 years. These two programs are extremely important to NIST and were protected in the FY18 budget.

Another method is cross-organizational program management which enables bench-level collaboration across the organization. The more organizational lines the program crosses, the more factors, perspectives, or expectations limit the program manager's control. In the FY18 budget, NIST cut some cross-organizational program management capabilities housed in the Special Programs Office, pushing some of the research into the laboratory programs.

Over the past several years, NIST developed organizational flexibility through its expanded use of grant-based partnerships. Since 2012, NIST has created three Centers of Excellence: one in advanced materials, the Center for Hierarchical Materials Design (CHiMaD) headquartered in Chicago; one in resilient infrastructure headquartered at Colorado State University; and one in forensic science headquartered at Iowa State. These centers have several advantages for NIST. They allow NIST to partner closely with some world-class capabilities in areas important for its mission, providing access to expertise, data, and unique facilities not on hand; expand in new fields and minimize risk by not developing formal in-house capabilities; allow visible focus on priority NIST efforts; and build critical mass necessary for impact. If the FY18 budget is enacted, NIST will eliminate funding for the Forensic Science Center of Excellence.

Dr. Boehm also highlighted NIST's longer-term joint institutes with universities. These include the Joint Quantum Institute, JILA, the Hollings Marine Laboratory, the Institute for Bioscience and Biotechnology Research, and the Joint Initiative for Metrology in Biology. These institutes allow NIST scientists to interact with academic colleagues to build long-term capabilities in technical areas without the constraints of the federal system. With the FY18 budget, there will be difficulty in establishing new or even expanding some activities with these institutes. For example, if the budget is enacted, the partnership with HML would be eliminated.

Lastly, Dr. Boehm mentioned leveraging NIST's extramural programs – Manufacturing USA in particular - to raise the visibility of the importance of metrology, build new capabilities, and engage in a broader network of stakeholders. However, it is difficult to develop long-term research partnerships with manufacturing institutes with large national networks.

Discussion:

The group discussed the following topics:

- How NIST can quickly and effectively cross organizational boundaries meet major national needs.
- Equipment and collaborative spaces needed for research.
- Budget constraints and the need to maintain a discretionary fund.

For more information, see Dr. Boehm's [presentation](#).

SESSION V: NEXT STEPS AND ADJOURN

Administrative Business

Dr. Colwell stated the final business to be addressed is submission of the VCAT Annual Report to Congress through the Secretary of Commerce. Usually the annual report is provided within 30 days of issuance of the President's budget. This year, due to change in administration and a variety of other issues, the draft report the VCAT prepared prior to the election requires updating and editing. The Committee agreed these updates would be best done through email to capture all comments and observations prior to submitting the final version to Congress.

Lastly, Dr. Colwell mentioned a reporter from the American Institute of Physics was present at this meeting and was interested in how an agency such as NIST deals with its budget and stated he may reach out to VCAT members for comment. Also, present at this meeting was a representative from the Government Accountability Office (GAO). GAO is conducting a broad study of NIST measurement services and would like to speak with relevant stakeholders, such as members of the VCAT, to obtain their perspectives on what challenges NIST will be facing in the future and how they can help in enhancing the organization.

There were no public comments offered.

In closing, Dr. Rockford thanked the VCAT members for their time and input and extended a general invitation to host any member interested in learning more about NIST between meetings.

Adjournment

The meeting was adjourned at 10:50 AM.

I hereby certify that to the best of my knowledge; the forgoing minutes are accurate and complete.

Stephanie Shaw, Designated Federal Officer, NIST Visiting Committee on Advanced Technology

Dr. Rita Colwell, Chair, NIST Visiting Committee on Advanced Technology