VISITING COMMITTEE ON ADVANCED TECHNOLOGY (VCAT or Committee)
MINUTES OF THE OCTOBER 20th, 2020
WEBINAR MEETING

ATTENDANCE:

Visiting Committee Members Attending
Adler, Allen
Alexander, Jay
Fischer, George
Garvey, Michael (Mike)
Ishak, Waguih
Jackson, Keoki
Kaler, Eric
Khan, Mehmood
Ku, Katharine
Sizer, Theodore (Tod)
Vasko, David (Dave)
Wasserman, Gail

Designated Federal Officer
Shaw, Stephanie

NIST Leadership Board

Bahar, Mojdeh
Boehm, Jason
Brockett, Del
Brown, Essex
Copan, Walt
Dimeo, Rob
Dowell, Marla
Fangmeyer, Robert
Harary, Howard
Jenkins, George E.
Kushmerick, James
Lin, Eric
Mackey, Liz
Molnar, Mike
Olthoff, Jim
Romine, Charles (Chuck)
Sastry, Chandan
Thomas, Carroll
Vaughn, Robert (Skip)
Wixon, Henry

NIST Staff
Acierto, Linda
Alderman, David
Alderoty, Neil
Antonishek, Brian
Boisvert, Ronald
Bryner, Nelson
Carnahan, Lisa
Choquette, Steven
Claussen, Monica
Deblasi, Ann
Dohne, Kirk
Evans, Heather
Fasolka, Mike
Fedchak, James
Gayle, Frank
Gillerman, Gordon
Glenn, Rachel
Goldstein, Barbara
Greene, Kristen
Hanna, Nancy
Hardis, Jonathan
Healy, Bill
Hoffman, Elizabeth
Hooker, Stephanie
Huergo, Jennifer
Ivester, Rob
Ivy, Nahla
Jahanmir, Said
Jones, Ronald
Jungbluth, George
Kimball, Kevin
Keys, Mirta
Kim, Yekyung (Yennie)
Lawson, Jeremy
Lin-Gibson, Sheng
Materese, Robin
McLinden, Mark
Meritis, Dimitrios
Nist, Jennifer
Perkins, John
Porch, Susanne
Poster, Dianne
Reidy, Kari
Rimmer, Kate
Rudnitsky, Robert
Saundry, Claire
Sberegaeva, Anna
Schiller, Susannah
Schlatter, Katie
Schroeder, Melissa
Seiler, David
Sharpless, Kathy
Shyam-Sunder, Sivaraj
Silverthorn, Courtney
Slifka, Andrew
St. Pierre, Jim
Stine, Kevin
Sullivan, Suzanne
Szakal, Christopher
Szuchyt, April
Tabassi, Elham
Tarlov, Michael
Teske, Michael
Ufford, Donald
Valdez, Zachary
Vanek, Anita
VanLandingham, Mark
Varadi, Laslo
Wang, Tom
Wilkinson, Richard
Williams, Carl
Wollman, David
Yuter, Stephen
Zangmeister, Rebecca
Zimmerman, Neil

Others
Atkinson, Rob – Information Technology & Innovation Foundation
Capella, Gregory – National Technical Information Service
Cassady, Amber – Lewis-Burke Associates, LLC
Hill, Jade – Toyota Motor North America
Jillavenkatesa, Ajit – Apple
Lenihan, Brian – International Trade Administration
McDaniel, Paul – NAVFAC EXWC, Regulatory Support Desk
Updyke, Craig – ASTM International

Tuesday, October 20, 2020

Call to Order - *Dr. Alan Adler, VCAT Chair*

Dr. Adler called the meeting to order at 10:00 a.m., reviewed the meeting logistics and took roll call. Dr. Adler turned the meeting over to Dr. Copan.

SESSION I: NIST UPDATE

NIST Update and Agenda Review – *Dr. Walter Copan, Under Secretary of Commerce for Standards and Technology and NIST Director*

Dr. Copan thanked VCAT members Hemma Prafullchandra and Mike Garvey for their engagement with VCAT and contributions to NIST as their term concludes on the advisory committee.

Dr. Copan also shared the latest NIST leadership changes:

- Ms. Carroll Thomas, Director of Hollings Manufacturing Extension Partnership (MEP) is retiring and Dr. Rob Ivester will become the Acting Director until a replacement is announced;
- Ms. Gail Porter, Director of Public Affairs has retired after 30 years and Ms. Jennifer Huergo will be the Acting Director until a replacement is announced; and
- Mr. Stephen J. Yuter, has been announced as the Director of the Office of Acquisition and Agreements Management (OAAM) and Bureau Procurement Official (BPO).

NIST Budget. Currently, NIST is operating under a Continuing Resolution for Fiscal Year (FY) 2021, planning a budget for FY2022, and in the early stages of developing a budget for FY2023. Dr. Copan said the Office of Management and Budget (OMB) request for FY2021 is matched by NIST's current request for FY2022, a total budget proposal for NIST of $737.5 million. Additional appropriations under the CARES (The Coronavirus Aid, Relief, and Economic Security) Act for the work of Manufacturing USA and Hollings MEP came through at $66 million. There is, however, a $1 billion deficit of maintenance expenses on buildings and infrastructure at NIST.

NIST Inclusivity Update. A major effort of inclusivity is ongoing at NIST, and Dr. Copan outlined some recent events:

- Film screening of *Picture a Scientist* and discussion sessions hosted by WiSTEM (Women's Inclusion in Science, Technology, Engineering & Mathematics) and the NIST Ombuds;
- Upcoming focus Groups in an ongoing COACh study of inequity in promotion;
- Professor Stefanie Johnson at the University of Colorado-Boulder gave insights on ABCs of breaking bias in her recent book *Inclusify*;
- Dr. Ellen Ochoa gave a talk as part of National Hispanic Heritage Month;
- Two upcoming events, Inclusivity in Standards NIST workshop and Inclusivity Showcase; and
- Posting of new position, the Director of Diversity and Inclusion.

NIST Privacy Framework Update. NIST issued its Privacy Framework earlier in the year. International Association of Privacy Professionals hosted a workshop *Growing a Workforce for Managing Privacy Risk* to discuss how to achieve the Privacy Framework's outcomes and activities. Enter privacy Consulting Group performed a Crosswalk of GDPR (General Data Protection Regulation) to the NIST Privacy Framework, utilizing Microsoft's mapping of GDPR to ISO 27701 and ISO 27701 to the NIST Privacy Framework.

Cybersecurity: NIST Work in Encryption Update. Dr. Copan stated there's been tremendous progress made on encryption work. NIST has announced the completion of round three down-selection of the post-quantum cryptographic algorithms. Work is ongoing on lightweight cryptography, including a workshop to gain feedback for a selection of finalist algorithms for lightweight cryptographic standards.

Substantial progress in cybersecurity and privacy has been made. The NIST Special Publication 800-53, a catalog on security and privacy controls, has been gratefully received by the community of practice, to include the Department of Defense. NIST has issued a series of resources on cybersecurity and telework and is in the

midst of the validation of cryptographic modules to FIPS (Federal Information Processing Standard) 140-3 to provide Federal agencies with a security metric to use in procuring equipment There has been a lot of interest and excitement about the development and issuance of the Special Publication 800-207 *Zero Trust Architectures* which discusses cybersecurity paradigms that move defenses from static, network-based perimeters to focus on users, assets, and resources.

Positioning, Navigation, and Timing (PNT): Responsible Use. PNT services is an essential part of NIST portfolio. An Executive Order was issued earlier in the year to recognize NIST's specific role and leadership within the Department of Commerce to make a global navigation satellite system (GNSS)-independent source of Coordinated Universal Time to enhance the resilience of and support the needs of critical infrastructure. A draft came out at the end of August on the development of a cybersecurity profile for responsible PNT use. A PNT workshop to develop the profile was held in September, and a draft profile for public comment is expected in the coming weeks. The aim is to have a system that's a thousand times more accurate than the internet time service. Dr. Copan stated this is of national security importance to have a ground-based backup to GNSS-based time distribution.

Artificial Intelligence (AI) Standards Coordination. NIST is developing the vocabulary and measurements needed for technical requirements of Trustworthy AI. A Bias in AI workshop was held on August 18th, and two draft documents, *Four Principles of Explainable AI* and *Secure AI: Terminology and Taxonomy*, are expected in the fall of 2020. Novel computational paradigms have been established for the needed metrics and benchmarks for AI hardware. There is interest across the federal sector for collaborations to advance these issues, such as hardware-based systems that can be utilized in algorithmic computation. NIST has been working on the testing of synaptic weighting functions using these hardware systems.

AI is being applied broadly across NIST's research and standardization efforts. NIST ran an internal funding competition to identify new use-inspired research topics to accelerate deployment of AI to advance programs. Three projects have been selected for an investment of $3.6 million in the coming year:

- A trusted AI framework for a new class of standard reference materials and data led by Materials Management Laboratory (MML);
- Low-field magnetic resonance imagine being led by Physical Measurement Laboratory (PML); and
- Deep generative modeling for communication system testing and data sharing led by Communications Technology Lab (CTL).

In collaboration with the National Science and Technology Council (NSTC), NIST has Ms. Elham Tabassi as the AI standards coordinator. NIST is working with the broader community to connect all federal efforts relating to AI standards development and use, with the goal of the community leveraging and learning from each other’s successes.

NIST Phish Scale. NIST developed a new tool to support cybersecurity awareness training, the Phish Scale, which provides a methodology for assessing the degree of danger and risk associated with cyberattacks.

NIST Facial Recognition. Dr. Copan said NIST continues its work on facial recognition technology and issued a report on the accuracy of algorithms for facial recognition when face masks are in use. The next report will document accuracy values for more recent algorithms.

Quantum: Interagency Coordination Update. The Quantum Economic Development Consortium (QED-C) has been a tremendous success at NIST, bringing together nearly 200 potential members. Formal participation agreements are in process. The goal is to have a close tie between NIST, public, and private sectors to identify and address needs for enabling technology, standards and a workforce to support the emerging quantum-based industry. The consortium will provide a coordinated voice for industry to inform and guide federal R&D investment priorities, standards and regulation, as well as workforce education and development. NIST will be looking to franchise this model with global partners in the future. A series of R&D (research and development) process have been initiated as part of the National Quantum Initiative. New activities included building the supply chain for quantum 2.0 industry, initiating a project to demonstrate compact scalable quantum repeater, led by NIST's own Nobel Prize winner Dr. David Wineland out of University of Oregon, and an effort to demonstrate an optical clock that could provide a backup to GPS.

Quantum: Material Measurements. Dr. Copan said NIST has been working on a new microscope that can carry out three kinds of atom-scale measurements simultaneously. It is an atomic force image known as the Swiss Army Knife method instrumentation, which can uncover new knowledge about a wide range of special materials that are crucial for developing the next generation of quantum computers, communications and a host of other applications.

NIST-on-a-Chip Update. The Defense Advanced Research Projects Agency (DARPA) has announced two new programs based on NIST-on-a-Chip and quantum sensing systems. A series of patents have been issued. The nanophotonic combs are now available in a chip-scale device.

Standards: 5G and Advanced Communication. As part of the NIST work on 5G and advanced communication, the Synthetic Aperture Measurements of Uncertainty in Angle of Incidence (SAMURAI) system provides traceable measurements to fundamental constants to support accurate 5G measurements for antenna optimization and use of AI in support of frequency sharing.

Advanced Communication: Public Safety. On advanced communications, Dr. Copan stated the public safety program is in high gear, funded through spectrum auction funds. The funding is intended to go through FY 2022.

NIST Community Resilience Update. NIST work has resulted in the development of community resilience guides, codes, and standards for fire mitigation, safety and building materials. The National Academies via NRC (National Research Council) panels gave glowing reports on the NIST programs in these areas.

Interagency Council for Advancing Meteorological Services (ICAMS). NIST has been working with the OSTP (Office of Science and Technology Policy) in structuring a new interagency council. NIST will provide expertise in metrology, cybersecurity, and resilience and will co-chair the Committee on Facilities, Cyber, and Infrastructure to carry out this function.

MEP CARES Act. Manufacturing USA CARES Act non-competitive grants have been awarded to NIIMBL (National Institute for Innovation and Manufacturing Biopharmaceuticals), America Makes, Lift, ARM (Advanced Robotics for Manufacturing), and BiofabUSA. NIIMBL is at the heart of the fight against COVID with a series of pandemic response programs.

MEP Update. MEP continues to be a consistent source of guidance and expertise on cybersecurity for manufacturers, with a specific focus on the defense supply chain, and a MATTR (MEP-Assisted Technology and Technical Resource) program. Dr. Copan said the Strategic Competition Program is having a great impact on network development.

Manufacturing: 3D Printing of Soft Materials. NIST research continues to focus on new methods and standards for 3D printing of soft materials, such as gels. New approach using shorter wavelengths and electrons can produce gels with finer detail. Since hydrogels are compatible with living cells, these materials could be developed for medical applications, such as drug delivery systems or flexible electrodes that can be inserted into the human body.

Smart Manufacturing Guidelines. A series of guidelines have been issued in various dimensions of smart manufacturing, including industrial wireless deployment and the management of manufacturing data.

Rapid Microbial Testing Method Consortium. In September, NIST kicked off a Microbial Testing Method Consortium. Consortium will address shared needs such as measurements for microbial testing in regenerative medicine products and will design in inter-laboratory studies to support development of best practices and new standards.

COVID-19 Measurements Update. Dr. Copan said NIST's work on COVID-19 has focused on standard reference materials. NIST has shipped over 125 units of SARS-CoV-2 synthetic RNA fragments of Reference Grade Test Material (RGTM) to customers in U.S. and abroad. This is an international effort bringing together the National Metrology Institutes around the world, the International Bureau of Weights and Measures, and the CCQM (Care Coordination Quality Measure) working group on nucleic acid analysis. Studies on immune

response to COVID-19 are ongoing, and NIST is a trusted partner to the National Institutes of Health (NIH), the Centers for Disease Control and Prevention (CDC), and the Food and Drug Administration (FDA) in a wide range of efforts in measurements and standards, data integrity, and security in this regard.

ROI Progress: Stevenson-Wydler & Bayh-Dole. The Stevenson-Wydler legislation has gone through a series of cycles and is anticipated that this package on the ROI initiative will go to congressional committees for sponsorship this year. Part of the green paper and this role for technology transfer and innovation is the update to the Bayh-Dole Act. It is anticipated that a Notice of Proposed Rulemaking will be issued in November.

ROI Progress: Other Areas. Dr. Copan shared progress made with laboratory collaboratives. The rebuild of the Interagency Edison system is on schedule, expected to launch in FY2022. The Tech Transfer Metrics definitions have been updated and published for Federal Agencies.

Recent International Engagements.
NIST is engaging with international metrology partners discussing the impact of the pandemic and provided its first online "hands on" lab training to over 30 SIM partners on Radiation thermometry. The BIRD Board of Governors met on October 13 to discuss the future of the foundation to ensure it continues to be a vibrant mechanism for U.S.-Israel cooperation on innovation. NIST is working with UK Research and Innovation (UKRI) to finalize an MOU focused on Innovation and Commercialization Practices and other areas of mutual interest. The US-Australia JCM was held in August, potential future exchanges and collaborations around QIS and AI were discussed.

Recent Awards. Dr. Copan mentioned recent awards of NIST staff. Ms. Donna Dodson received a Service to America medal award, and Dr. Winnie Wong-Ng, who started at NIST as a postdoc and has continued her career, was inducted into the Louisiana State University (LSU) Hall of Distinction for her work in science and technology. The NIST team for the *Rethinking Manufacturing* video was recognized with a regional Emmy award.

For more information, see Dr. Copan's presentation.

Discussion

The group discussed the following topics:
- Hiring of the Director of Diversity and Inclusion;
- Challenges and solutions for an inclusive environment at NIST;
- Tools available to employees to speak up in an environment of diversity and inclusion;
- Discussion sessions on how gender bias is manifested throughout scientific community;
- Challenges associated with training AI facial recognition algorithms; and
- How NIST can maintain synergistic connections between researchers working virtually.

NIST Safety Update – Keeping NIST Staff Safe During COVID - *Dr. Elizabeth Mackey, Chief Safety Officer and Director of Office of Safety, Health, and Environment*

Dr. Mackey provided an update on what has transpired since the last VCAT meeting when a memorandum was issued by OPM and OMB to instruct agencies on how to engage in a phased reopening.
- NIST met OPM/OMB criteria, entered Phase 1 on July 6, 2020
- Ongoing implementation of OPM/OMB and DOC guidance at NIST, monitoring external and internal conditions
- COVID-19 health and safety requirements formalized in NIST Directives
- Training "NIST Safe Return to Campus for Phase 1" Version 1 issued in June; currently on version 4
- Refined procedures established for reporting and responding to possible COVID-19 cases
- Communication with staff: town hall meetings, FAQs, website, guidance

NIST had brand-new directives put in place to minimize the potential for COVID on campus:
- NIST Notice 2200.00 Phased Re-opening During Pandemic Conditions

- NIST Notice 2200.01 Requirements to Mitigate Spread of COVID-19 On Campus
- NIST Notice 2200.02 Use of Cloth Face Coverings During Pandemic Conditions
- NIST Notice 2200.03 Visitor and Contractor Protocols for Mitigating COVID on Campus

The Office of Human Resource Management issued the *Supervisors' Guide: Talking to Staff about Returning to Onsite Work* which covers telework, leave possibilities implementation, and a safety component for high-risk staff. Dr. Mackey said 20 individual guides to help implement the safety requirements have also been issued.

Dr. Mackey reviewed NIST's strategies to prevent COVID transmission at NIST: eliminating the hazard, exposure screening, minimizing the potential of spread, and cleaning of surfaces.

The NIST Daily COVID-19 Screening form is updated on a weekly basis. There is a requirement to stay off campus and self-monitor when having any of the following, based on the CDC website:

- Symptoms
- COVID test status
- Recovering from COVID
- Exposure to others
- Travel to high-risk areas

Dr. Mackey stated it is mandatory for all employees to take the training to return on campus. "NIST Safe Return to Campus Training for Phase 1 - Version 4" has been completed by 3,558 staff.

DOC requires daily updating on teleworking, employees who are symptomatic or no longer symptomatic, self-monitoring, COVID-19 positive and COVID-19 recovered incidents. Staff who spend 15 minutes within 6 feet of a symptomatic person are notified for potential exposure of COVID-19 and instructed to quarantine for 14 days or until notified that the symptomatic person tested negative.

Dr. Mackey emphasized the focus on communication. The safety website is an excellent resource and has links to directives, guides, training, signs, and FAQs. There are 20 different guides on health and safety requirements. There is a comprehensive guide for supervisors on HR policies, practices, and guidance on high-risk staff. There is also signage all over campus to provide reminders on disinfecting workspaces and washing hands.

Much effort has been put into the internal criteria for a phased reopening. The janitorial service contracts have been modified to make sure there is at least a 30-day buffer for supplies of disinfectant and hand sanitizer. Ventilation is another requirement that is evaluated, ensuring all systems are working. Supplemental ventilation units such as portable air filtration systems have been disseminated to increase amount of filtration in the air. There have been 80 spaces evaluated in Boulder campus and 70 in Gaithersburg. Supplemental units are advised in a handful of those places, and that work is ongoing.

There has been a gradual increase in number of people coming on campus, allowing staff to adapt to the new protocols—10 to 12 percent on Gaithersburg campus and up to 20 percent on the Boulder campus. Phase 1 allows up to 25 percent. Monitoring COVID responses on campus is also ongoing. As of Phase 1 (July 6, 2020), there were 17 possible cases in which a person was on campus within less than 48 h of having COVID-like symptoms. Space was disinfected for 10 cases. Close contacts were notified for three cases. None of the 17 tested positive. The total of 13 COVID-19 cases were recorded during Phase 1, and none were on campus while infected.

For more information, see Dr. Mackey's presentation.

Discussion

The group discussed the following topics:

- The program for COVID prevention is proving to be successful;
- Exceptions to return to work may be for reasons other than COVID-related;
- Robots with UV lights used to sanitize laboratories have proven to be effective;
- Laboratory spaces with sensitive equipment will remain dormant to ensure virus is dead;

- Limiting staff returning to work because of space availability;
- Additional protective protocols are in place for reactor operators and fire department;
- Measuring live virus on surfaces; and
- Employees being advised to eliminate clutter because of office areas being sprayed with disinfectants.

SESSION II: SETTING THE STAGE – THE ROLE OF NIST IN AMERICA'S EVOLVING INNOVATION ECOSYSTEM

Keynote – The State of U.S. Advanced Tech Industry Competitiveness and What to Do – *Dr. Robert Atkinson, President of the Information Technology and Innovation Foundation*

Dr. Atkinson's began by stating his career started at NIST and currently works at the Information Technology and Innovation Foundation (ITIF). He gave a brief background on what ITIF does.

Dr. Atkinson began with an update on the economy in terms of employment and productivity growth from 1990 to 2018, and stated it began to stagnate after the Great Recession. Productivity is growing more slowly because the economy needs more workers, and the only way to compete globally is by superior productivity growth, faster than adversaries and competitors. The Gross domestic product (GDP) grew 18 to 19 percent over the past decade, but manufacturing has not kept up – 6 percent less than overall GDP. The data from 1998 to 2018 from the Department of Commerce, Bureau of Economic Analysis sends a distortive message about the overall health of U.S. manufacturing growth. The U.S. should be growing manufacturing by 30, 40, 50 percent, particularly when China is growing its manufacturing. Even with some beneficial steps in the last few years, the U.S. trade balance is just going down and worsening.

Many countries are putting in place a set of policies around the next generation of manufacturing. The Europeans call it "Industry 4.0," and Americans call it "smart manufacturing." They are developing indices, benchmarking tools, pilot fabs to help small companies and demonstrate smart manufacturing technologies. Many countries are providing financial support through grants or tax credits to help manufacturers adopt these new technologies, whether it is Internet of Things (IoT), AI, or other advanced production equipment. Dr. Atkinson believes the U.S. could to do more of that to keep up with what our competitors are doing. Most manufacturers are in the early stages of the manufacturing digitalization journey. American companies need improvement in this area.

The U.S. received little greenfield manufacturing when it comes to foreign direct investment (FDI). Most foreign companies are buying American companies, which is different than a foreign company coming here to open a new facility. Dr. Atkinson says this may be due to the U.S. being less attractive when it comes to business climate issues compared to some other countries.

Dr. Atkinson stated that the U.S. lags on robot adoption and is ranked seventh, about 200 robots per 10,000 manufacturing workers, behind Japan and Germany. Korea is far ahead of everybody else. This is in part because wages in U.S. are 30 to 40 percent higher than Korea and way higher than China and the U.S. is not investing as much in technology or equipment as it should. Data from the National Science Foundation (NSF) shows some sectors have increased their R&D to sales ratio in the U.S., most have not. Dr. Atkinson shared that more R&D-intensive sectors should be investing more in R&D in the U.S. Another troubling statistic is that other nations invest more in university research than the U.S. as a share of GDP, and he shared that Congress should put more focus on the mission of dedicated innovation agencies. Other nations have more generous R&D tax credits. In 2018, Congress passed a tax bill that will take away R&D deductibility in 2022, which takes away incentives for U.S. companies to invest more in R&D.

Dr. Atkinson compared President Trump and President-Elect Biden's take on manufacturing investment. President Trump's approach has tended to be a combination of pressing our global competitors to play more by the rules but in general has not been that supportive of a manufacturing policy. He believes Mr. Biden's approach is more favorable to investment on manufacturing, quadrupling the size of the MEP program, with big

increases in R&D. To fix the data/analysis problem in the U.S., Dr. Atkinson believes there should be more analyzing of the data in a systematic way. NIST does provide this analysis, but more needs to be done in this space. He is hopeful that the next Congress will task NIST with funding and resources to allow this to happen. China has a new initiative called China Standards 2035. It is their attempt to be the global hegemon in standards. To avoid a huge disaster if they are successful, NIST must step up to the plate and respond with the best standards and technologies. Bringing back the NIST Advanced Technology Program, TBED (technology-based economic development) programs, and expanding Manufacturing USA institutes to be more industry-led with greater diversity of sizes and models are ways to advance this effort. A national industrial strategy needs to be developed, which will help push back against China.

For more information, see Dr. Atkinson's presentation.

Discussion

The group discussed the following topics:

- Evidence needs to replace misinformation around innovation and industrial productivity;
- EU projects success through funding and consensus building between industry and academia, and U.S.'s inability to advance due to antitrust laws;
- Collaborative tax credit would help to fund more R&D;
- Rebranding of NIST Advanced Technology Program creating a national innovation network;
- Independent program versus a NIST program for advocacy; and
- Bringing back critical microelectronics manufacturing maybe through the National Defense Authorization Act.

Strategic Landscape and Emerging Challenges – Implications for NIST - *Dr. Jason Boehm, Director NIST Program Coordination Office*

Dr. Boehm stated over the past several years, the Program Coordination Office has been doing an environmental scan looking at the following factors:

- Societal changes
- Geopolitical landscape
- Political and policy landscape
- Technology and science landscape

On societal changes, Dr. Boehm highlighted a few of the issues around social inequality, multigenerational workforce, social unrest, and growing distrust.

COVID-19 has produced ramifications for NIST. Dr. Mackey and others are making strides to ensure NIST can operate safely. The pandemic has had a huge economic impact, and there is stress on federal, state, and local budgets. There are more virtual meetings and more telework. Some of the ramifications for NIST revolve around pressure on solvency, infrastructure degradation, lapse in mission delivery, and procurement of supplies. Some of the biggest changes revolve around workforce with respect to telework.

Dr. Boehm said China is changing their S&T landscape with increased funding for research and development. Though the U.S. is still a large funder of R&D in absolute terms, Southeast Asia is providing more R&D funding on a percentage basis, most of which comes from China, putting pressure on the United States. There is a dramatic increase in the number of patents, publications, and demand for STEM-capable workers, in China. The United States must continue to be a leader moving forward.

Industry provides the majority of R&D funding in the United States, but in terms of basic research, Federal Government is still the biggest funder. However, the level of federal investment has been flat and declining. NIST has been in a consistent 4 percent growth range for funding, though the federal R&D budget has not really been growing steadily.

On technology and science drivers, there has been a huge demand for cybersecurity capabilities and issues related to food security. The pandemic has magnified the quality and supply chain security writ large. These are

the areas where NIST research may have capabilities to apply. Sustainable innovation is a big trend, as well as climate change challenges with water and energy usage. There are huge data needs in this area. With regard to advanced manufacturing, NIST will continue to look at robotics and automation. NIST should be well positioned to have an impact in all of these areas.

Dr. Boehm detailed key implications and future considerations for NIST in the areas of workforce and operational environment and mission delivery. The changing international dynamics will have a huge impact on the NIST workforce as it pertains to foreign national guest researchers. One key area is to maintain openness while protecting security. Trust is going to be important for the workforce moving forward. There is a need to increase communication with stakeholders to build understanding. Maintaining credibility with industry on basic research will play a role in emerging tech areas and standardization and there will be increased calls for leadership from NIST and government engagement.

For more information, see Dr. Boehm's presentation.

Discussion

The group discussed the following topics:

- Benefits of teleworking and flexible environments;
- Reaching college graduates now to increase diversity and inclusion in future workforce pipeline;
- China's aggressive stance on changing standards to their benefit;
- Establishing a way to deliver mission remotely or robotically on neutron scattering mission delivery;
- Possibility of letting staff come on-site to do experiments in Phase 2 while protecting health and safety;
- Allowing parents with school-age kids to work on different schedules; and
- Lack of innovation in remote working.

SESSION III: STEPS TAKEN AND FUTURE OPPORTUNITIES

Update on NIST Strategic Plan - *Dr. Jason Boehm, Director NIST Program Coordination Office*

Dr. Boehm gave an update on the Strategic Plan. There has been a lot of outreach and engagement. Eight actions are under way for implementation. Currently, NIST is at the 6-month progress review and selection of next actions for a second round of implementation. There are four strategic goals are:

- Goal 1, Position NIST to advance U.S. science and innovation
- Goal 2, maximize NIST's stakeholder impact through high-value service delivery
- Goal 3, create the infrastructure for a 21st century research institution
- Goal 4, build a One NIST culture

The leadership team and stakeholders from across NIST developed eight actions to tackle the issues within the four goals. The eight actions fall into three categories: workforce, infrastructure, and operations and procedures. The actions under workforce include improve collaboration and agility across NIST programs, establish a new funding mechanism to foster cross-collaboration, appoint a NIST diversity coordinator, and strengthen NIST's leadership corps by developing and implementing a NIST leadership competency model. Under infrastructure, the two action areas are: developing a prioritized implementation plan of the NIST Campus Master Plan and optimizing ongoing repair activities through utilization of a predictive facilities maintenance tool. In terms of operations and procedures the actions are: 1) increase the successful transfer of NIST developed technologies by applying best practices to enhance customers and stakeholder engagements; and 2) s improve stakeholder awareness of NIST via strategic communications and initiating an effort to rebrand NIST.

Upcoming steps include a 6-month review in mid-October with the Associate Directors and NIST Director. In late November, early December, there will be an open house with NIST staff to showcase progress and collect input on actions staff would like to see progress on, and these will be launched as Round 2 actions in early 2021.

Dr. Boehm mentioned noteworthy accomplishments: plans to create an innovation ambassador detail in the Office of Technology Partnerships, as well as hiring a diversity and inclusion leader. He also stated performance plan modifications to foster a One NIST culture is underway to provide more cross-collaboration across NIST and a contract was awarded to work on the branding study.

For more information, see Dr. Boehm's presentation.

Discussion

The group discussed the following topics:

- More granular KPIs (key performance indicators);
- Returning to campus and looking at underutilized facilities;
- How to effect change in workforce in the virtual world;
- EUL (enhanced-use lease) authority for industry partners to be on-site for collaborative work;
- Inclusion more difficult to attain than diversity, especially for middle and upper management;
- Importance of trust, transparency, and communication with employees working at home; and
- The need for diverse interview panels for better inclusivity.

Strengthening Technology Transfer – Update on ROI and Plans for NIST - *Ms. Mojdeh Bahar, Associate Director for Innovation and Industry Services*

Ms. Bahar stated through public-private partnerships, NIST builds communities around technological innovations, manufacturing, and performance excellence. The overarching goals of IIS (Innovation and Industry Services) is to seek internal synergies, expand the reach, seek external partners, and disseminate the NIST story. She reminded VCAT that IIS consists of four organizational units:

- Baldrige Performance Excellence program
- Manufacturing USA program
- Meeting Extension Partnership
- Technology Partnership Office

In FY2020 and FY2021, IIS continues to collaborate projects among the four pillars. Each member of the team collaborates projects that will strengthen the One NIST vision. It is imperative to deliver services and communicate the delivery of services in a way that is welcomed by partners and stakeholders, as this will help to form the public-private partnerships. There is an overarching communication plan for each of the external partners, and IIS identified the collaboration opportunities within the NIST laboratories and sought to find out which programs were successful and why.

Ms. Bahar said during this age of COVID where everybody has been teleworking, IIS has made breakthroughs in COVID-related projects such as COVID-19 ELISA (enzyme-linked immunosorbent assays) platform and COVID-19 spike protein detection for therapeutic antibodies and diagnostics. Through CARES Act grants, MEP has given away $50 million in grants to 51 centers in 90 days. Manufacturing USA has awarded $12.4 million competitively to five Manufacturing USA institutes, and this has sponsored 13 high-impact pandemic response projects.

Highlights of the FY2021 plan for Manufacturing USA, subject to re-appropriation, are a new Manufacturing USA Institutes competition, development of policy and procedures for recognizing existing entities for participation in Manufacturing USA. Ms. Bahar said NIST gained authority to renew an institute based on a comprehensive performance review, as NIIMBL will be in its final year of the 5-year cooperative agreement. A performance review in 2021 will leverage best practices from across the Federal Government, including from MEP and the National Science Foundation.

Notable accomplishments for Manufacturing Extension Partnership were a series of virtual manufacturer roundtable that highlighted experiences of manufacturing leaders from across the country. During the 11 roundtables, there were 50 manufacturers representing 27 states and diverse industries. Discussions centered on what keeps them up at night, how they are operating during the pandemic, what they see in the future, and what NIST and MEP can do to help U.S. manufacturers. The roundtable format provided an excellent forum for generating these important conversations and resulted in a great deal of insight into the current challenges and

opportunities for manufacturers. NIST MEP will analyze these sessions and produce a report with common themes and actionable findings for NIST and MEP leadership.

FloridaMakes**,** the MEP Center in Florida, will deliver a project to develop and implement a new, manufacturing-specific, Baldrige-derived assessment tool incorporating *Industry 4.0* principles within the Baldrige framework. Through these assessments, used as standalones or through regional, state, and/or national award processes, companies will be able to benchmark themselves against the criteria, and/or against each other, and understand pathways to improve their competitiveness and technological performance.

Developed in response to Executive Orders 13801 Enhancing Apprenticeships and 13845 creating the National Council for the American Worker, cross agency collaboration between DOC, DOL, and WH recognizes companies that demonstrate excellence in workplace education, training, and retraining policies and investments, in order to galvanize industries to identify and adopt best practices, innovate their workplace policies, and invest in their workforces. Award criteria and evaluation process borrow from the Baldrige Award process. Nine recipient organizations were recognized at the White House in an awards ceremony with Pledge to America's Workers Presidential Award (PAWPA).

Integration Baldrige principles in NIST Laboratories is being implemented through Baldrige Fellows Program. One NIST leader per year will go through Baldrige as a fellow to better integrate Baldrige principles.

The assessment of the NIST-on-a-Chip commercialization pilot made the following recommendations to the NIST-wide technology transfer efforts:

1. Eliminate operational silos and communications roadblocks.
2. Create Excitement about tech transfer within the NIST labs.
3. Think and act strategically about IP.
4. Develop technology discovery and marketing strategies.
5. Increase awareness of NIST technologies available for use.
6. Reward and incentivize commercialization activities.
7. Leverage best practices to ensure NIST is world-class in tech transfer.
8. Establish the role of Technology Liaison.
9. Define NIST's roles in the commercialization and patenting process.
10. Communicate the importance of tech transfer broadly.

Ms. Bahar provided a detailed summary of progress made to date to align NIST laboratories with Technology Partnerships Office (TPO). A point of contact will be established for each lab, which will help with better communication going forward. Rewriting position descriptions and redefining roles of some staff members will afford better opportunities to work together and learn from each other. Innovation ambassador program will engage postdoctoral and early career scientists in technology transfer. And umbrella agreements will be put in place to help processes move with the speed of industry.

For more information, see Ms. Bahar's presentation.

Discussion

The group discussed the following topics:

- Difficulties in accepting new technologies during transition;
- Timing for NIST patenting a technology that could help bring commercial product to the table; and
- Manufacturing USA institutes to become self-sufficient and later commercialize technologies.

The Expanding Role of Partnerships in the Delivery of NIST's Measurement Science Mission - *Dr. James Olthoff, Associate Director for Laboratory Programs*

Dr. Olthoff explained the NIST mission to promote U.S. innovation and industrial competitiveness has caused NIST to form partnerships from the very beginning. Over time NIST went from becoming strictly a measurement laboratory to a laboratory focused more on innovation and research related to economic competitiveness of the U.S. The number of institutes and partnerships has grown since the days of JILA, 60 years ago, and the way NIST interacts with the rest of the world has also evolved within the last 20 years. Dr. Olthoff stated the number

of institutions and physical locations have grown over the years as NIST has promoted and developed new partnerships.

The National Cybersecurity Center of Excellence (NCCoE) is the Department of Commerce's first federally funded research and development center established in partnership with Maryland and Montgomery County. It provides NIST with great capability in cybersecurity and the ability to go out and partner with institutions. Last count, NCCoE had 47 different technology partners. Oversight and management, however, can be burdensome with an institution this large.

Dr. Olthoff said the Centers of Excellence (COE) program, established in 2013, was meant to allow NIST to grow in fields where there were great measurement needs. Partnering with institutions brought in a great deal of expertise. There are three COEs: CHIMaD (Center for Hierarchical Materials Design) with Northwestern University on advanced materials; Resilience, focused on community resilience with Colorado State University; and CSAFE (Center for Statistics and Applications in Forensic Evidence) on forensic science with Iowa State University. The challenge is that institutions tend to want to be autonomous, it takes time to establish productive relationships, and COEs need to ensure their own sustainability after 10 years of funding from NIST.

The joint institutes and centers provide longstanding institutional commitments and embedded NIST staff with the University of Colorado, the University of Maryland, the National Oceanic and Atmospheric Administration, and the Department of Energy. The advantages are access to expertise, ability to build long-term capabilities, provide a pipeline for future skilled workforce, and ability to work with academic and industry in an effective manner. Challenges are loss of NIST culture at off-site centers and difficulty to disengage from the commitment.

Grants programs help to expand the reach of NIST programs, initiate new areas of research, and build new partnerships, but the challenges are minimal engagement with NIST researchers and monitoring to ensure alignment with NIST programs.

Frameworks have provided a way for NIST to engage with external partners and bring the community together. Many industrial and technology sectors are interested in frameworks and ask NIST to do this, but there are times NIST does not have the expertise or resources to pursue all of them.

nSoft consortia revolve around NCNR user facilities and share the cost of operation of various instruments. Dr. Olthoff said these consortia offer great expectations. QED-C is the newest consortium, where NIST has brought together many companies and partners that are working on cutting-edge quantum computing technology.

Prize competitions stimulate innovation to advance the NIST mission and crowdsource expertise of the whole country to solve a problem. Advantages include establishing ambitious goals without predicting who is most likely to succeed, reaching beyond the “usual suspects”, and inspiring risk-taking by offering a level playing field. Challenges are the requirement for the prize competition expertise and infrastructure, and the need to sustain the community and follow-on investments after competition ends.

Because of connections with various partners and relationships with industries and companies, NIST was able to respond to the COVID crisis. The combination of having measurement capability and connections already in place allowed NIST to implement solutions very rapidly.

In closing, Dr. Olthoff said NIST has lots of the different tools to partner and advance our measurement science mission It's an interesting time for NIST to consider all of these tools, whether all of them are equally effective, whether some of them are better than others, whether or not we should pursue different ones.

For more information, see Dr. Olthoff’s presentation.

Discussion

The group discussed the following topics:

- Success of consortia versus centers of excellence;
- Future of centers of excellence beyond their 10-year lifetime;

- Dilution of resources and understanding fundamental role of NIST; and
- Develop a rigorous framework to compare and contrast results to determine ROI.

Looking Ahead: Opportunities for NIST in America's Innovation Ecosystem – *Dr. Walter Copan, Under Secretary of Commerce for Standards and Technology and NIST Director*

- Dr. Copan stated that looking at the future NIST priorities and opportunities for sustained impact in the coming years have been grouped into five high-level categories. Advanced Communications Technology and Standards for 5G and Beyond
- Standards Leadership for the Nation
- Advanced Manufacturing and Supply Chain
- Cybersecurity and Privacy
- Strengthening America's Competitive Position in the World

Advanced communications are enabling dramatic changes in how consumers, manufacturers, governments and others consume information, transact business, provide and use essential services, and shop. The NIST Communications Technology Laboratory headquartered in Boulder, CO is the hub of NIST's advanced communications efforts, home to over 200 NIST staff and associates and the Department's lead in technical outputs for 5G and beyond, with over 330 technical publications in the past five years.

In the face of increasing competition from Asia (most prominently from the People's Republic of China), NIST research and work in standards development are critical for keeping the U.S. innovation at the forefront of critical emerging technology areas including quantum science, AI, advanced manufacturing, biotech and the bioeconomy, communications, cybersecurity, community resilience, and advanced microelectronics.

The Department of Commerce is uniquely positioned to lead government-wide and national stakeholder dialogues on manufacturing policy. An important leader in this effort is NIST, with its strong connections throughout the manufacturing community engaging on a broad range of issues from research, innovation, technology adoption, standardization, supply chains, security, and workforce. NIST laboratories help companies create products and services more efficiently by providing data and measurement tools to inform their products and processes -- whether a new vehicle design or a biopharmaceutical. Further, NIST research is informing technology and standards development for a secure wireless communications supply chain. Cybersecurity and privacy are at the forefront of concern for the U.S. whether from the perspective of the federal government, private sector, or private citizen. The Department of Commerce, via NIST, has critical roles in setting the cybersecurity policy for the federal government. NIST is the Department's lead agency on cybersecurity and privacy issues, with products and services that comprise a portfolio that bridges foundational cybersecurity research, applied cybersecurity research and development, and through the development of publicly available standards, frameworks and technical guidance.

Lastly, Dr. Copan stated that NIST continues to play a key role in strengthening America's competitive position in the world and its programs support the U.S. innovation base with research and standards in high-value emerging technology areas. While the U.S. remains a leader in key areas, continued focus and growth is imperative. NIST is dedicated to maintaining the necessary talent, research infrastructure, innovation leadership and public-private partnerships.

For more information, see Dr. Copan's presentation.

SESSION IV: DISCUSSION WITH VCAT

Discussion with VCAT

Dr. Boehm asked the VCAT for their input on the areas or issues where NIST is missing or not focusing enough attention; the right balance of intramural and extramural programs, the best models and where NIST is stretched too thin; and international standards development.

The group discussed the following:

- More analysis needed for an uncertain future;
- NIST could play a part in providing visibility into resiliency and flexibility;
- Development of extensive modeling and simulation to provide insight into various levels of manufacturing;
- Resist pressure to do things faster;
- Changes in the standards community for using tools that maximize effectiveness in standardization process;
- NIST has a niche position in manufacturing that can be leveraged in the country at this time;
- New incentives to drive industrial competitiveness in manufacturing sector and innovation system forward;
- Building material standards related to energy use;
- Aligning in another area besides manufacturing to gain visibility on the Hill for scientific support;
- A national priority is a qualified workforce to address quantum industries of the future;
- Partnering with industry to build internships into academic programs;
- Develop advanced technology by bringing people from diverse backgrounds;
- MEP opening the door to new technology adoption for small manufacturers;
- Critical gap of education institutions for students in technical areas;
- Strengthening the U.S. innovation system through core research from lab to market;
- Workforce challenges and ability to attract brightest here in U.S.;
- VCAT mission is to look for priorities that give greatest return for America's investment;
- NIST should play larger role in the growing area of Internet of Things;
- Advanced communication is the core of the future in NIST priorities;
- Public Safety Communications Research (PSCR) potential for innovative products and services in world marketplace;
- Standards development efforts can help the economy of U.S. and maximize the footprint of NIST globally;
- VCAT's input to educational community on how to embed key elements for future of U.S. competitiveness; and
- Prospective collaboration between NIST and Department of Commerce ITA (International Trade Administration) on development of measurement science.

Administrative Business

Dr. Adler thanked the NIST leadership for the thought-provoking presentations and discussion of the virtual meeting. He also stated the drafting materials for the upcoming VCAT report should be circulated via email to members.

Dr. Adler thanked Dr. Copan for his leadership, contributions, and service to the nation. The VCAT members also expressed their appreciation.

Dr. Copan thanked the entire VCAT for investing their time and expertise with NIST to improve the mission of this institute for the nation.

There were no public comments offered.

Adjournment

The meeting was adjourned at 5:00 PM.

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. E. Allen Adler, Chair, NIST Visiting Committee on Advanced Technology