# 2021 Annual Report

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

## U.S. Department of Commerce

*March 2022*

## Preface

The Visiting Committee on Advanced Technology (VCAT or the Committee) of the National Institute of Standards and Technology (NIST or the Institute) was established in its present form by the Omnibus Trade and Competitiveness Act of 1988 and updated by the America COMPETES Act in 2007 and the American Innovation and Competitiveness Act of 2017. The VCAT is a Federal Advisory Committee Act (FACA) committee, and its charter includes reviewing and making recommendations regarding general policy for NIST, its organization, budget, and programs within the framework of applicable national policies as set forth by the president and the Congress. This 2021 annual report covers the period from March 2021 through February 2022.

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

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

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

During this reporting period, three VCAT members completed their two consecutive three-year terms: Dr. Allen Adler (HRL Laboratories, LLC), Dr. Waguih Ishak (Corning Incorporated), and Dr. Theodore Sizer (Nokia Bell Labs), one VCAT member completed a three-year term: Mr. Jay Alexander (Keysight Technologies), and two new VCAT members, Dr. Anthony Johnson (University of Maryland Baltimore County (UMBC) and Dr. Michelle Parker (Boeing) were appointed.

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

# VCAT Members during the Period Covered by this Report

Dr. Allen Adler, Chair
HRL Laboratories, LLC
Term: January 25, 2016 – January 24, 2022

Ms. Katharine Ku, Vice Chair
Wilson Sonsini Goodrich and Rosati
Term: May 22, 2018 – May 21, 2024

Mr. Jay Alexander
Keysight Technologies
Term: May 22, 2018 – May 21, 2021

Dr. Vinton G. Cerf
Google
Term: December 21, 2018 – December 20, 2024

Mr. George Fischer
T-Mobile
Term: May 22, 2018 – May 21, 2024

Dr. Waguih Ishak
Corning Incorporated
Term: January 25, 2016 – January 24, 2022

Dr. Dana (Keoki) Jackson
MITRE Corporation
Term: May 22, 2018 – May 21, 2024

Dr. Anthony M. Johnson
University of Maryland Baltimore County (UMBC)
Term: October 4, 2021 – October 3, 2024

Dr. Eric Kaler
Case Western Reserve University
Term: December 21, 2018 – December 20, 2024

Dr. Mehmood Khan
Hevolution Foundation
Term: November 13, 2018 – November 12, 2024

Dr. Michelle Parker
Boeing
Term: January 14, 2022 – January 13, 2025

Dr. Theodore Sizer
Nokia Bell Labs
Term: August 28, 2015 – August 27, 2021

Mr. David Vasko
Rockwell Automation
Term: February 2, 2017 – February 1, 2023

Dr. Gail Folena-Wasserman
AstraZeneca
Term: January 30, 2017 – January 29, 2023

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## Executive Summary

NIST plays a critical role in furthering national goals around the development and deployment of critical emerging technologies including artificial intelligence (AI), quantum science, and advanced communications. NIST programs focused on manufacturing including the MEP, Manufacturing USA, and the research efforts of the NIST laboratories will be critical in supporting the post pandemic economic recovery. NIST has mitigated the challenges posed by COVID-19 in the steps they have taken to protect their staff while continuing essential research. Additionally, NIST has successfully executed $66 million in CARES Act funding and $150 million in American Recovery Plan funding that provided support for small and medium manufacturers and funded multiple projects across the network of Manufacturing USA Institutes that will strengthen resilience against COVID-19 and future pandemics. NIST strategic planning efforts have provided the agency with a framework to drive important cultural change around issues like diversity and inclusion, collaboration, and leadership, while also ensuring that NIST is well positioned to meet the needs of its stakeholders. Despite so many positive contributions across such a broad portfolio of activities, NIST remains under resourced. Perhaps nowhere is this more painfully obvious than in the status of NIST's facilities where NIST currently has a deferred maintenance backlog of over $800 million. Without sustained and stable investment, NIST faces an increased probability, which will approach near certainty, of catastrophic infrastructure failure which will escalate overall operational costs, decrease efficiency and lower productivity of the research laboratories, and could endanger the health and life safety of the NIST staff. The report provides further details of our deliberations and recommendations for NIST. The VCAT believes that the following issues deserve priority attention:

- NIST must be adequately resourced to meet the growing list of responsibilities that NIST is called upon to address—from supply chain security to advancing quantum science and trustworthy AI to strengthening U.S. engagement in international standards.
- Significant new investment in the NIST facilities must be part of any scientific research and development infrastructure initiative for the U.S. to effectively compete with China and other global competitors.
- The state of neutron science in the U.S. requires additional focus to ensure that the U.S. remains competitive in the global research environment, and NIST should bring together parties including National Science Foundation (NSF) and Department of Energy (DOE) to foster a national discussion on neutron research capability in the U.S.
- NIST has made impressive strides in its strategic planning efforts, leadership should continue ongoing efforts to strengthen collaboration across NIST, and improve diversity, equity, inclusion, and accessibility (DEIA) across the NIST workforce.

## 1. VCAT Focus in 2021

For the second year in a row VCAT met virtually due to the COVID-19 pandemic. Notwithstanding, VCAT had very productive interactions with NIST leadership and scientists and was able to carry out its mission effectively. In 2021, the VCAT focused their efforts on the following topics:

- NIST's evolving priority landscape – new opportunities and responsibilities under the Biden-Harris Administration
- Keeping NIST staff safe during COVID-19 pandemic
- The situation with the NIST Center for Neutron Research (NCNR) reactor
- NIST efforts in strategic planning implementation
- Ongoing efforts to strengthen DEIA at NIST.

Additionally, the VCAT was briefed on the NIST's budget outlook and the condition of facilities and infrastructure. The VCAT received detailed programmatic briefings in all these areas. This 2021 Annual report summarizes the VCAT's work, observations, and recommendations related to these topics.

## 2. NIST Evolving Priority Landscape

NIST is playing an important role to enhance overall U.S. innovation and competitiveness. In 2021 the VCAT continued to focus on NIST's role in advancing important critical and emerging technologies such as quantum science, AI, and advanced communications. It was also the year of presidential transition, and VCAT reviewed NIST's alignment with new Administration priorities: COVID-19, climate, racial equity, and the economy. In addition, the VCAT was updated on NIST's continuing efforts to advance and support work in advanced manufacturing as well as priorities and plans for potentially significant expansion of Manufacturing USA and MEP. Because 2021 has been a year of major cybersecurity breaches such as the SolarWinds cyber-attack, which affected thousands of organizations across the world including, the federal government, the VCAT reviewed the increasingly growing role that NIST plays in addressing the cybersecurity challenges under the new Administration's Executive Orders (EO).

### 2a. Emerging Technologies

NIST directly impacts the competitiveness of U.S. industry through fundamental research breakthroughs in emerging areas like quantum science and AI that accelerate the development and adoption of multiple critical and emerging technologies. These technologies transform our economy by delivering both economic and national security advantages to the U.S. Throughout the year the VCAT reviewed NIST plans and received updates on progress and achievements in the strategic focus areas of quantum information science, AI, engineering biology, manufacturing, as well as advanced communication.

The VCAT supports NIST's continued focus in these areas that are essential to support broader U.S. efforts to maintain a competitive advantage in high-value sectors. The NIST programs are oriented to ensure that researchers, manufacturers, and other stakeholders have the measurement and standards tools they need to drive discoveries and to facilitate the deployment, adoption, and interoperability of technologies. Over the past year NIST has had several significant accomplishments towards these efforts as described below.

The VCAT is pleased to see the continued progress NIST makes with the Quantum Economic Development Consortium (QED-C). In October 2021, QED-C introduced a novel approach to measuring

performance of quantum computers. This was a result of a multi-year collaborative effort by QED-C members companies. In addition, as part of a larger Quantum Marketplace initiative, QED-C launched a series of monthly webinars highlighting QED-C companies that are part of the quantum supply chain. This includes companies focused on quantum entanglement sources and quantum sensors.

With a significant concentration of world-leading talent in quantum science, especially in metrology, NIST continues to produce an impressive array of research outputs, paving the way for new quantum tool development. Among technical accomplishments, NIST physicists measured and controlled a superconducting quantum bit (qubit) using light-conducting fiber instead of metal electrical cables. By using fiber, researchers could potentially pack a million qubits into a quantum computer rather than just a few thousand. NIST physicists also demonstrated high-fidelity laser-free universal control of two trapped-ion qubits by creating both symmetric and antisymmetric maximally entangled states. This could lead to new ways to make more powerful quantum computers based on ions (charged atoms).

The VCAT was also pleased to see the progress that NIST has made in its efforts focused on AI. A major element of NIST's efforts in AI are aimed at defining and developing the key concepts of trustworthy AI. NIST continues to work collaboratively with the private and public sectors to develop the vocabulary and measurements needed for trustworthy AI to help realize the full promise of AI as an enabler of American innovation. NIST is engaged with the AI Standards Coordination Working Group (AISCWG) under the provisions of the charter of the Interagency Committee on Standards Policy (ICSP). The AISCWG's purpose is to facilitate the coordination of federal government agency activities related to the development and use of AI standards, and to develop recommendations relating to AI standards to the ICSP as appropriate. The AISCWG activities also support NIST's Federal Coordinator role for AI standards. The AISCWG reports to the Chair of the ICSP and advises the members of the ICSP on relevant issues.

Some of the major accomplishments include a draft report, *Artificial Intelligence and User Trust* (draft NISTIR 8332). The report asks: "How do we humans decide whether or not to trust a machine's recommendations?" to stimulate discussion about how humans trust AI systems. The issue being explored is whether human trust in AI systems is measurable, and if so, how we can measure it accurately and appropriately. Another draft report, *Machine Learning for Access Control Policy Verification* (draft NISTIR 8360) proposes an efficient and straightforward method for access control policy verification by applying a classification algorithm of machine learning in response to challenges of traditional verification methods. NIST also actively works in the area of reducing the risk of bias in AI. In an effort to counter the often pernicious effect of biases in AI, NIST outlines the approach in NIST Special Publication 1270 *A Proposal for Identifying and Managing Bias in Artificial Intelligence*, a new publication that forms part of the agency's broader effort to support the development of trustworthy and responsible AI.

In the area of engineering biology, NIST co-led a team in the Telomere-to-Telomere (T2T) Consortium, which completed the last 7 % of the human genome. The human genome was announced as "finished" 20 years ago, but ~7% of the genome was missing until the T2T Consortium completed it this year. The new complete reference genome corrects many errors in previous genome analyses, including up to 12-fold reduction in errors in 269 medically relevant genes. Preprints garnered extensive coverage from over 60 media outlets including The New York Times, New Scientist, and The Atlantic.

In addition to these efforts NIST has also made significant headway against the priorities and plans they have set in advanced communications, such as public safety, spectrum sharing, next generation wireless,

foundational metrology, core network technologies, smart infrastructure, and manufacturing. The Public Safety Communications Research division (PSCR) Open Innovation program provided financial awards for the First Responder Unmanned Aircraft System Challenge and Mobile Fingerprint Capture for the First Responders Challenge in 2021. This year, NIST has also joined NSF, the Department of Defense (DOD) Office of the Under Secretary of Defense for Research and Engineering and industry partners to establish the Resilient and Intelligent Next-Generation Systems (RINGS) program. RINGS brought together federal agency and industry partners to accelerate research on wireless and mobile communication networks and associated computing systems and large-scale services. The program will seek to advance the underlying technologies to guarantee worldwide availability, security and reliability of next-generation (NextG) systems.

NIST has continued to generate an impressive list of outputs and accomplishments two years into the global pandemic, but the VCAT is concerned that NIST's programs are stretched too thin, especially in the area of cybersecurity. Science and technology continue to evolve rapidly and bring transformational capabilities that cut across the entire economy, including in manufacturing processes, transportation systems, critical infrastructure, and healthcare. For these advances to have a positive impact on the U.S. economy and improve the quality of life requires the ability to address significant measurement and standards challenges in areas like interoperability, security, usability, performance, and resiliency. Despite the real need for expanded NIST capabilities, and the increasingly competitive global S&T (Science & Technology) environment in which the U.S. resides, NIST has faced four years of stagnant budgets and potential increases for fiscal year (FY) 2022 have not materialized by the time of writing of this report. The VCAT commends NIST for its efforts to prioritize and focus its investments in the areas most critical to U.S. competitiveness, as well as its efforts to leverage its capabilities and resources and to expand the impact of its research programs by partnering with both the public and private sector. However, without sustained increases in resources it will be extremely difficult for NIST to continue to deliver on its mission, compete for best technical talent, support a modern research infrastructure, and build the research depth necessary for sustained impact. The VCAT looks forward to working with the incoming new NIST Director to shape a proactive approach for NIST to address the S&T priorities of the nation.

## 2b. Climate and Sustainability

Biden-Harris Administration made addressing climate change one of their main priorities by releasing several EOs (14008, 13990, and Climate-related financial risk) and putting forward specific plans on how to tackle ambitious climate goals. VCAT reviewed NIST's climate portfolio and was impressed with the breadth and depth of NIST's work in this area.

To help address major environmental issues facing the country, NIST develops measurement capabilities that are fundamental to measuring environmental change, untangling natural variation from human-induced causes, predicting the consequences, and establishing a technical basis for effective incentives and regulations. In addition, advanced measurements often open paths to innovation, enabling the development of clean technologies that conserve resources, minimize the environmental footprint of economic activities, and generate new business and export opportunities. In 2021 VCAT explored NIST's climate portfolio in more detail. The VCAT reviewed NIST's work in key areas:

- Disaster-Resilient Buildings, Infrastructure, and Communities
- Circular Economy
- Greenhouse Gas Monitoring and Measurements

- Emerging Technologies for Sustainable Buildings
- Carbon Capture and Sequestration

Natural disasters lead to a substantial economic and life loss worldwide and their frequency and severity is increasing. To address these challenges, NIST leads two statutory mandated interagency programs, the National Windstorm Impact Reduction Program and the National Earthquake Hazard Reduction Program. Wildfires also are a cause and a contributor to the overall climate change problem. NIST develops, advances, and deploys measurement science to reduce risk of fire spread in Wildland-Urban Interface communities.

NIST has recently launched a new effort in the circular economy, specifically focused on polymers, plastics, and electronic waste. The goal is to solve challenges that include sorting and reprocessing polymers, including elimination of odors, and color of final products, as well as provide training for students to develop the future workforce for the growing plastics recycling industry.

The purpose of NIST's Greenhouse Gas Measurements Program is to equip decision-makers and managers with quantitative information tools to support strategic decisions and to measure progress. The program has focused on urban and regional greenhouse gas measurement tools, methods, and reference data. Urban areas are a focus because about 70 percent of global emissions occur from urban areas.

Buildings play a major role in climate change. Roughly a quarter of all carbon dioxide ($CO_2$) that is emitted into the air comes from the generation of electricity, and about three-quarters of all electricity is used in the building sector. One of the NIST flagship facilities is the Net-Zero Energy Residential Test Facility, which is a modern single-family home that operates on less energy than it produces.

There are several negative emission technologies that remove $CO_2$ from ambient air and permanently store it elsewhere. Currently, the focus is on direct air capture, which uses chemical processes. One advantage of DAC (direct air capture) over natural processes is that it is less vulnerable to reversal, but R&D (Research and Development) is needed. NIST can play an important role by developing benchmark materials, new measurement capabilities, data and models, and standards to help accelerate innovation and to validate the performance of direct capture technology.

## 2c. Cybersecurity

Since NIST was called out in EO 14028 Improving the Nation's Cybersecurity, VCAT reviewed progress that NIST has made in the Cybersecurity and Privacy Program. The main purpose of the program is to provide the technical underpinnings that can help lay that solid foundation of trust. NIST does this by working with the community to advance cybersecurity and privacy standards, technology, and measurement science across the spectrum of fundamental and applied research, all the way through to application.

The NIST Cybersecurity Framework has significantly improved cybersecurity awareness; facilitated regulatory streamlining; served as a foundation for international, standards-based cybersecurity activities; and promoted new and emerging markets for cybersecurity tools and technologies. Updated in 2018, the Framework has been downloaded over half a million times since 2014. NIST released a Privacy Framework in 2020 based on the Cybersecurity Framework that serves as a voluntary tool intended to help organizations identify and manage privacy risk so that they can build innovative

products and services while protecting individuals' privacy. The Privacy Framework is designed to be compatible with existing domestic and international legal and regulatory regimes and usable by any type of organization to enable widespread adoption.

The National Cybersecurity Center of Excellence (NCCoE) helps transition standards and technologies into practice. The NCCoE provides businesses with real-world cybersecurity solutions based on commercially available technologies. The Center brings together experts from industry, government, and academia to demonstrate integrated cybersecurity that is cost-effective, repeatable and scalable. NCCoE provides practical cybersecurity guides to accelerate adoption of commercially available cybersecurity technologies and speed innovation. The NCCoE is DOC's first Federally Funded Research and Development Center and the first dedicated to cybersecurity. Current NCCoE project include:

- Crypto Agility: Considerations for Migrating to Post-Quantum Crypto Algorithms
- Implementing a Zero Trust Architecture
- 5G Cybersecurity
- Ransomware Risk Management
- Supply Chain Assurance: Validating the Integrity of Computing Devices
- Securing the Industrial Internet of Things: Cybersecurity for Distributed Energy Resources
- Cybersecurity for Genomics Data

NIST's work in cybersecurity is heavily influenced by external laws, policies, and executive orders, to name a few; some examples of most recent mandates include:

- National Defense Authorization Act of 2021 Including the DIGIT, LEAP, and HACKED Acts
- Internet of Things Cybersecurity Improvement Act
- EO 14028, Improving the Nation's Cybersecurity
- National Security Memorandum on Improving Cybersecurity of Critical Infrastructure Control Systems
- National Strategy to Secure 5G

The EO 14028 was issued in May 2021 and has a one-year timeline. The requirements are very ambitious, but achievable. NIST will play a significant role primarily on enhancing the software supply chain, which leverages NIST's longstanding programs in cybersecurity supply chain risk management and software quality and security. This effort in combination of other NIST cybersecurity activities will lead to the U.S. having a much more sustained and enhanced cybersecurity posture. The VCAT recognizes the important role that NIST plays in cybersecurity but, is concerned that more responsibilities are being placed upon NIST without the resources necessary to effectively execute them.

## 2d. MEP and Manufacturing USA

NIST has a unique role in the U.S. innovation ecosystem with its role and mission to provide support targeted at strengthening manufacturing. NIST has been a strong partner of the manufacturing sector for over 100 years. The NIST portfolio of programs spans fundamental and applied research as well as programs designed to help U.S. industry develop and implement new technology, develop robust supply chains, and refine their systems for efficiency and effectiveness, all while making them more competitive in the global economy.

The pandemic exposed the fragility of U.S. manufacturing with significant disturbances to operations, disruptions in supply chains for critical components, and increased costs of production. Programs at

NIST, like MEP and Manufacturing USA will be critical in supporting a robust U.S. recovery. In turn, the research efforts in the laboratories will help in the rapid development and deployment of technological solutions, such as exposure notification tracking applications, that can help mitigate the impact of future pandemics.

The Biden-Harris Administration recognizes the impact that MEP and Manufacturing USA plays for the U.S. manufacturers and those programs were highlighted in EOs and received additional funding through American Rescue Plan (ARP). The VCAT focused its attention on reviewing progress in these two NIST flagship extramural programs over the course of 2021.

In FY 2021 NIST received $150 million in ARP to support high-impact pandemic response projects at the Manufacturing USA Institutes: $90 million for the NIST National Institute for Innovation in Manufacturing Biopharmaceuticals (NIIMBL) for technology innovation supporting response to COVID-19, and $60 million for Rapid Assistance (for) Coronavirus Economic Response (RACER) grants for high-impact projects for research, development, and testbeds to prevent, prepare for, and respond to coronavirus. In January 2022 NIIMBL announced 32 coronavirus response projects to multiple organizations across the U.S. The accomplishments from the $10 million CARES Act funding can be found here.

The additional ARP appropriations coincided with the final year of NIIMBL's cooperative agreement with NIST. The institute was evaluated in May 2021 by an independent review panel using a newly developed renewal assessment protocol. The panel consensus was that NIIMBL met all performance standards, and it was recommended it for renewal. NIST provided a $70 million award over five years with an equal, non-federal cost-matching requirement. This award will allow NIIMBL to continue driving innovation in domestic biopharmaceutical manufacturing by developing flexible, agile, and cost-effective manufacturing processes that can be scaled up quickly and are less reliant on foreign supply chains.

Among other accomplishments, in June 2021, Manufacturing USA announced a new competition for awards to support industry-driven consortia in developing technology roadmaps that will address high-priority research challenges to grow the advanced manufacturing sector in America. Manufacturing USA Technology Roadmaps (MfgTech) program anticipates awarding up to eight awards with a period of performance of up to 18 months each, with individual awards of up to $300 thousand and no cost-share requirement.

The President's FY 2022 budget proposed substantial increases for both Manufacturing USA and MEP programs. The President's budget grows and strengthens the Manufacturing USA program: continues support for program coordination and network support and fully funds NIIMBL; it also provides funding for two new Institutes. The FY 2022 request also nearly doubles MEP funding: it strengthens a network of 51 Centers in every state and Puerto Rico, and enables new investments to strengthen supply chains, support workforce training, and promote technology adoption. Although the FY 2022 budget has not been passed at the timing of preparation of this report, both Manufacturing USA and MEP have been developing plans for potential funding increases.

The Biden-Harris Administration released several EOs to strengthen manufacturing in the U.S. The EO 14005, Ensuring the Future Is Made in All of America by All of America's Workers, sets forth the new Administration's policy of utilizing the federal procurement process to maximize the use of goods, products, and materials that are of U.S. origin. The EO establishes a substantial role for the MEP

National Network in the Biden-Harris Administration's plans to bolster American manufacturing by leveraging MEP's supplier scouting in order to identify American companies that meet federal procurement needs. The EO 14017, America's Supply Chain, calls on MEP to look at and study the supply chain, especially in the semiconductor industry.

In terms of MEP's impact on pandemic response, the VCAT was briefed on the findings of a recent independent study by Summit Consulting and the W.E. Upjohn Institute for Employment Research that found the MEP program generated a substantial economic and financial return of nearly 13.6:1 for the $146 million invested in FY 2020 by the federal government. Despite enormous challenges and economic headwinds due to COVID-19, MEP Centers continued to deliver a consistent and significant return on investment to the nation, as they engaged manufacturers to pivot and address shortages in personal protective equipment (PPE). The study also found that total employment in the U.S. was nearly 252,000 higher because of MEP Center projects. Finally, the study examined additional areas of economic impact: personal income is $15.5 billion higher and gross domestic product is $20.9 billion larger than without the MEP program. This transitions into an increase of $1.99 billion in personal income tax revenue to the federal government.

In 2021 the VCAT was pleased to see NIST bring on Ms. Pravina Raghavan as the new MEP Director. The VCAT is highly supportive of her efforts to ensure our country has a strong manufacturing base by connecting companies with the resources they need to succeed. The VCAT looks forward to reviewing progress in future years on how these efforts have helped small and medium manufacturers expand their reach, identify new external partners, and help build more resilient supply chains.

The VCAT looks forward to working closely with the NIST leadership and the Biden-Harris Administration to realize the full potential of NIST to support advanced manufacturing and further U.S. economic recovery.

## 2e. NIST Efforts in Critical and Emerging Technology Standards Development

NIST leadership in research, measurement science and standards development are essential for keeping U.S. innovation at the forefront of critical emerging technology (CET) areas with strong connections to the economy. NIST is the only bureau in the government with unique responsibilities to coordinate federal government activities focusing on documentary standards development and conformity assessment procedures with those of the private sector and Office of Management and Budget. To effectively lead and participate in the development of standards, NIST leverages its workforce of technical experts with approximately 440+ NIST technical staff in more than 100 unique standards development organizations, contributing their expertise in over 1,750+ standards activities.

NIST technical expertise and leadership is needed to expand U.S leadership in significant standards activities in high-value sectors. Driven by the Chinese government, Chinese companies have greatly increased their participation in international standards development. Although participation is not necessarily an indicator of influence in technical standards outcomes, it is a part of a broader effort by China to gain more influence in areas that the U.S. has historically led. In particular, the Chinese are aggressively seeking leadership roles in standardization for strategic areas such as 5G, AI, and blockchain. The U.S. perspective that voluntary consensus standards must be industry-driven for greatest economic benefit hinges on a crucial issue – the need for robust U.S. private sector participation. The ability to continue to enable robust participation of U.S. technology companies in

international standards development activities is critical for the U.S. to maintain a competitive advantage. The VCAT emphasizes that the U.S. is lacking a consistent voice when it comes to standards development activities. The U.S. requires an agile and asymmetric approach built around three areas. First, sustained investment in R&D – a critical component of successfully influencing international standards, second, expanded collaborations between allied governments, industry, and academia, and third, a commitment to industry-led standards development processes. NIST and DOC efforts will ensure that the U.S. and its allies have a sustainable foundation for continued leadership in standards development organizations for critical and emerging technologies.

NIST is working to coordinate U.S. engagement in the areas of CET: quantum science, AI, advanced manufacturing, biotech and the bioeconomy, communications, cybersecurity, community resilience, and advanced microelectronics. Working with federal agencies and other stakeholders, NIST is taking steps to:

- Increase NIST standards participation and influence in critical and emerging technology standards development.
- Raise competence and ability of federal employees to influence standards development and enhance interagency coordination.
- Lead effort with DOC bureaus and the Department of State to provide timely, clear, and actionable information on international standards threats and opportunities, and work with like-minded countries to support industry-led open consensus standards development.

Standards activities are essential elements of NIST's mission and priorities, with two distinct categories: measurement standards and documentary standards. The VCAT commended NIST in its efforts to better communicate critical standards information to U.S. industry and to enhance influence of the U.S. experts in international standards development activities. Technology standards create opportunities for innovation and define future markets, therefore, NIST should continue working with Department of State to increase messaging about the importance of open consensus international standards.

## Recommendations:

- Industry has been investing substantial resources into identify new algorithms that might be executable on a quantum basis. NIST, in addition to quantum physics, should continue its processes to work with industry and the broader cryptography community to identify potentially useful algorithms to run in a quantum environment.
- NIST should investigate the intersection of manufacturing and sustainability in the area of plastics in terms of both manufacturing capacity, product quality, and ability to recycle. NIST's effort in the circular economy targets some of these issues, but this is a small investment compared to the magnitude of the problem.
- Manufacturing USA institutes are maturing and seem to be coming more into the mission of pushing adoption of the technology and workforce training, overlapping with MEPs role. MEP and Manufacturing USA programs should leverage each other's capabilities and enhance coordination to achieve common goals. The VCAT would like to see a plan on how NIST intends to mature manufacturing USA institutes to a higher Technology Readiness Level while working more closely with the MEP centers to advance technology transfer and workforce training.

- NIST should continue to support investment in R&D around critical and emerging technologies to maintain its ability to effectively engage in and support standards development activities. The value of NIST's convening role to facilitate consensus needs to be supported and strengthened.
- The VCAT recognizes the importance of NIST's nascent efforts in negative emissions technologies and would see this as an area for further increased investment in the area of test methods for negative emission technologies.

## 3. Keeping NIST Safe and Productive During COVID-19

The coronavirus pandemic has changed daily life globally since early 2020. While the full ramifications are still unknown, there is no doubt that the repercussions will be significant and lasting. NIST campuses operated on limited access from mid-March to mid-July and many staff continue to work remotely. Not being able to access research equipment and user facilities has limited the ability for some of NIST's mission-critical functions to be carried out, but publishing numbers have increased, and many researchers have pivoted to use their research to help with COVID-19 efforts.

NIST Gaithersburg campus remains in Phase 1 operation status: 25% maximum occupancy and maximum telework. NIST requested a waiver from the 25% occupancy cap for the Boulder campus due to mission impact. The request was justified based on a safety analysis, for example, room ventilation in laboratories is superior to that in typical offices, providing better mitigation of airborne viruses. In September, OMB granted this waiver, and NIST Boulder increased lab staff from 210 to 420, beginning September 13, 2021. Boulder remains in Phase 1 with a waiver from the 25% occupancy limit and all staff implement all COVID protocols during this waiver. NIST is closely monitoring the local case load around its campuses and has developed a thorough mitigation plan and training for all staff returning to campus.

To facilitate vaccine availability, the DOC COVID team members worked with Department of Health and Human Services to select a location for a COVID vaccine clinic for federal staff in the National Capital Region. NIST was selected based on the infrastructure available including a fully operational Health Unit, freezers with adequate capacity, temperature -80°C, indoor locations with sufficient space, adequate parking, etc. All-Hands-On-Deck in Management Resources enabled the vaccine clinic to proceed after the installation of additional security features; an upgrade of electrical service to the Health Unit to support a new freezer; the installation of wireless access point for clinic computers and internet connections to monitor freezers.

The VCAT commends NIST for the data-driven and science-based approaches that it has implemented to protect the health and safety of its workforce. NIST's ability to support 6,000+ federal employees and associates working remotely is an impressive feat that was executed with minimal disruption. The majority of staff have been able to fully perform their duties from a telework posture and many look forward to and expect an increased use of telework even after the pandemic has subsided. Increased use of telework in the future creates new opportunities for NIST with respect to space utilization, and the recruitment and retention of staff.

During this time employees also had to figure out how to replicate informal and random interactions that normally happen when working on-site, these interactions keep lines of communication open,

increase transparency, and help spur collaboration. Teams have become more siloed and a broad rethinking of the federal workplace to include remote and virtual options has motivated the NIST Program Coordination Office to develop the NIST Telework Strategy in collaboration with the Office of Human Resources Management. The Strategy is intended to assist staff in implementing telework to foster a modern, agile workforce. This started by outlining and describing eight key principles, the appendix also provides background information about telework and the NIST approach to telework. The strategy is intended to apply to all NIST federal employees and associates to the extent allowed by law and the terms of the associate's agreement. This strategy may be updated over time, consistent with any changes to the NIST Telework Policy.

As of the date of this report, NIST still does not know the full impact of the pandemic. The omicron variant wave exacerbated some of the existing challenges. Many staff are still juggling caregiving needs with telework; there is an increased number of retirements, impacting continuity of operation and succession planning; and new hires that need to be onboarded virtually. The full financial impact on the Institute's measurement services remains to be seen. The impact of inflation, increased construction costs, supply chain issues, delays in procurement, and increased material and equipment costs are a concern. The VCAT looks forward to hearing future updates from NIST on the longer-term impacts of the pandemic and on NIST's planned mitigation efforts.

### Recommendations:

- The VCAT commends NIST's efforts to limit community transmission on site and promote vaccine availability to the federal employees. The VCAT recommends that NIST continues to maintain open communication channels with its staff about the status of the pandemic and NIST plans for initiating a hybrid work environment.
- NIST should consider instituting a feedback system to track employee's satisfaction, team connectivity, equity, safety and security, and more under the existing maximum telework posture, both now and in the future, when NIST moves into hybrid work environment. This input will be a valuable component of how to evaluate and make improvements to the workplace conditions moving forward.
- As COVID-19 becomes an endemic disease, NIST needs to consider a new balance between on-site and off-site work, ensuring that all staff are safe and productive.

## 4. Investigation of the Champlain Towers South Collapse

NIST has the responsibility to establish teams to assess building and infrastructure performance and emergency response and evacuation procedures in the wake of disaster and failure events that resulted in, or had the potential for, substantial loss of life. By understanding the technical causes leading to structural failures and then making that information public, NIST engineers and researchers strive to prevent similar failures in the future and assist in recovery efforts to rebuild in a better manner, leading to more resilient communities. In 2018, in response to the devastation to Puerto Rico caused by Hurricane Maria, NIST initiated a multi-year study to document the performance of buildings and emergency communication systems during the storm in order to identify necessary changes to local building codes and emergency operations.

On June 24, 2021, Champlain Towers South, a 12-floor condominium in Surfside, Florida, partially collapsed at approximately 1:30 a.m. EDT. The collapse happened suddenly and has resulted in mass casualties. The Champlain Towers South investigation will be the fifth investigation NIST has conducted using authorities granted by the 2002 National Construction Safety Team (NCST) Act. The act gives NIST and its teams primary authority to investigate the site of a building disaster, access key pieces of evidence such as records and documents and collect and preserve evidence from the site of a failure or disaster. It also calls for NIST to issue reports and make recommendations to improve building codes and standards.

On June 25, NIST began deploying a team of six scientists and engineers to collect firsthand information on the collapse. Since then, NIST experts have been working with federal, state, and local authorities to identify and preserve materials and information that might be helpful in understanding why the collapse occurred. On June 30, NIST announced that it would launch a full technical investigation into what caused the partial collapse of the Champlain Towers South Condominium. The team is led by Dr. Judith Mitrani-Reiser, associate chief of the Materials and Structural Systems Division in NIST's Engineering Laboratory.

The technical investigation will be organized around specific projects that will seek to understand the full history of the building, including its design plans, construction, materials, modifications, site and environment, from its design to the moment of collapse. The projects are:

- Building and Code History
- Evidence Preservation
- Materials Science
- Geotechnical Engineering
- Structural Engineering

NIST provides regular updates on its progress during the investigation, including through public meetings with the NCST Advisory Committee, annual reports to Congress and progress reports. NIST will not issue preliminary findings or conclusions before publishing a draft report for public comment. Because of the amount of evidence and information that must be examined thoroughly, the investigation could take multiple years to complete. The VCAT notes that conducting an investigation without appropriate resources places an undue burden on NIST staff. Furthermore, conducting two high-profile investigations at the same time places NIST staff under even more strain.

## Recommendations:

- With aging infrastructure across the country, disasters like collapse of the Champlain Towers South are likely to happen again. NIST should consider future technological needs, such as modeling and simulation, surveillance, and remote sensing technologies, for future investigations of disaster events.
- The VCAT commends NIST for integrating different areas of science and technology into its investigative efforts. NIST should continue uncovering needs for new research areas to better understand the failure mechanisms.
- With the understanding that aging infrastructure will continue to be a problem for the nation the VCAT encourages NIST to pursue additional resource to expand efforts focusing on measurement capabilities and techniques to better assess risk of failure.

- The VCAT would like to see an evaluation of how NIST plans to manage and run the NCST program to deal with the increasing number of failures and subsequent investigation requests.
- NIST should take action to create a new program and secure a sustainable funding stream to develop predictive approaches and diagnostic measurement tools to evaluate building and infrastructure performance in advance of catastrophic infrastructure failures.

## 5. Diversity, Equity, Inclusivity, and Accessibility

A diverse and inclusive workplace is necessary for attracting and retaining an innovative and highly skilled scientific and technical workforce. Research shows that diverse workplaces lead to increased creativity, innovation, and organizational performance, and inclusive and equitable workplace cultures improve employee engagement and retention. To ensure NIST is taking a strategic and long-term approach to building a diverse workforce along with improving the workplace culture in parallel, a number of initiatives are underway to including examining promotion and pay equity, developing and adopting hiring best practices, expanding training on bias and allyship, offering mentoring training and leadership opportunities, and ensuring support for staff. Without evaluation and improving the current workplace culture and diversity, NIST will not be able to compete with other organizations making strides to foster inclusive and equitable workplaces.

NIST is at a risk to attract and retain a diverse workforce. In the past years the Civil Rights and Diversity Office has started discussions across campus on civility to help promote a respectful workplace culture to help bring these two values into alignment and create a One NIST culture. System issues impact the pipeline of STEM (Science, Technology, Engineering, and Mathematics) researchers recruited and retained and multiple reports have come out in the past few years address this, including from the American Institute of Physics and National Academies of Sciences, Engineering, and Medicine.

As a scientific institution, NIST leadership needs data to inform an approach to identifying and addressing barriers to a diverse, inclusive, and equitable workplace. There is an opportunity for improved communication and recognition of the importance of these issues; after all, inclusivity is one of NIST's four core values. Importantly, measures to track progress in creating a more diverse and inclusive workplace are largely lacking and need to be developed for NIST to take these issues seriously and ensure the organization benefits from all of these efforts.

NIST has a well-respected scientific and truth-seeking reputation, leading many staff to remain at NIST for the majority of their careers. This retains institutional knowledge but can reinforce behavior and practices that may benefit one group over others. Changing this culture is a difficult process that must be persistently worked at over a long period of time. In order to instill change, there must be buy-in and support from leadership that is communicated down. As a larger organization spread across multiple campuses, each group or division has adopted their own best practices for hiring and promotion, leading to differences in equity across NIST.

NIST has undertaken a number of initiatives to improve diversity and inclusivity. For example, NIST has established a Steering Group for Equity in Career Advancement with representatives across NIST that explores critical issues related to career advancement such as unintended impacts to promotion and

performance award opportunities for women and minority groups; unconscious or implicit biases within the agency; and disparities that can have a cumulative impact over the course of a career.

In 2019, COACh, an organization dedicated to developing equitable opportunities in science and engineering, contracted with NIST to "design and implement a data-driven study to examine the causes of inequity in promotions … and develop draft recommendations." The work began with "listening sessions" with NIST scientific staff and administrators (mainly ZPs and ZTs), which revealed that many employees held strong views about promotion opportunities and process. This was followed by analyses of NIST personnel actions from 2000 to 2019. In contrast to views often expressed in the listening sessions, extensive statistical analyses found little evidence that women were disadvantaged in promotions or salaries. A survey of ZP employees supported these conclusions. However, extensive statistical analyses and examination of open-ended comments indicated less than half of the employees believed that the promotion criteria were understood by employees or appropriate for the NIST mission or their unit or that the promotion process was fair. The final report was released in 2021 and the VCAT was briefed on the finding and recommendations by the COACh study.

The VCAT was also briefed on the results of two internal studies, performed by detailees to the Associate Director for the Laboratory Programs (ADLP):

- Assessing Inclusivity of Women at NIST
- Inclusivity Network Analysis as a First Step to Harness Human and Social Capital for Innovation at NIST

The purpose of the first effort, was to explore the experiences of NIST federal employees, at all levels, to identify the ways in which differential opportunities might exist, in this case related to gender. The study was conducted through in-depth interviews of staff members, survey, and analysis of Human Resource data. Existing data will be leveraged to inform both the quantitative and the qualitative phases. The Inclusivity Network Analysis, on the other hand, aimed to establish a baseline snapshot of the interaction patterns among members of the NIST workforce and the relationship of these patterns to perceptions of inclusion and influence, which generally affect employee engagement and thus innovation.

Most notably, in 2021 NIST hired Dr. Sesha Joi Moon as a new Director of Diversity, Equity, and Inclusion. This position was created as part of the NIST Strategic Plan implementation efforts. The VCAT is looking forward to receiving updates from Dr. Moon on actions under EO 14035 on Diversity, Equity, Inclusion, and Accessibility in the Federal Workforce, and EO 13985 on Advancing Racial Equity and Support for Underserved Communities, both of which support NIST's commitment to diversity, equity, and inclusion.

## Recommendations:

- Within the OPM rules and guidelines, NIST should consider a policy for a balanced candidate slate in terms of gender, race, and other attributes during the hiring and promotion process.
- Mentoring programs tend to come short and usually support a limited subset of people. NIST should consider other supporting programs, such as coaching and sponsorship, to facilitate the use of available development resources by underrepresented minorities. Also creating an infrastructure that will ensure that the developmental programs lead to career trajectories and

ladders will be very important. The VCAT encourages NIST to explore having each executive leader take on the role of a sponsor to a staff member from an underrepresented group.

- NIST should consider implementing exit interviews to inform future DEIA-related actions and collect feedback on employee experience.
- NIST should take advantage of the new positions that will be created with anticipated budget growth and think about who to recruit and how to define those positions so that NIST will get people who will move it towards a more diverse workforce.
- With regard to sponsorship of the employee resource groups (ERG), VCAT encourages NIST to select executive sponsors who are not a member of that specific ERG. If the sponsor is somebody from a different demographic, it is a big learning experience for that executive and it also helps to break those boundaries.

## 6. NIST Strategic Planning Implementation

The VCAT continued to receive ongoing updates on NIST's strategic planning efforts and their progress in implementation over the course of FY 2021. Throughout the year NIST has been working to implement eight actions that were identified as priorities for implementation based on input from the NIST Leadership Board and the NIST community. The VCAT was updated on the progress of the implementation efforts.

NIST successfully implemented all eight actions that were selected for implementation of the NIST Strategic Plan. Dr. Moon was brought in as a new Director of Diversity, Equity, and Inclusion as part of the overarching goal to strengthen NIST's ability to attract, retain, and retrain a diverse and inclusive talent base. The VCAT supports NIST's efforts to take a strategic and long-term approach to building a diverse workforce along with improving the workplace culture. The VCAT realizes that changing the culture at NIST is a difficult process that must be persistently worked at over a long period. As such the VCAT believes that it is important for NIST to develop good measures to track progress in creating a more diverse and inclusive workplace to maintain focus on these efforts and ensure the organization benefits from the ongoing actions.

To ensure that NIST is put in the best position to meet the challenges of the future, both from a programmatic and organizational perspective, another action in the Strategic Plan was focused on improving collaboration and agility across NIST programs. To increase agility, promote collaboration, and maintain technical excellence to strategically advance emerging technologies and address national needs, NIST piloted a new ADLP funding mechanism to foster cross-OU collaboration – Collaborating for Impact Now (CoIN). CoIN funded proposals from staff to test and evaluate novel or creative new approaches to address important problems for NIST and the Nation by forming agile teams that leverage meaningful collaboration across organizational boundaries at NIST. Postdoctoral and early career researchers were encouraged to participate in the program. Six pilot proposals were funded for approximately $250 thousand. The VCAT is looking forward to learning about the impact of this pilot program.

The VCAT continued to pay particular attention to NIST's efforts to improve stakeholder awareness by clarifying and sharpening NIST's strategic communication and brand. As NIST leadership and the VCAT have discussed, NIST does not have a consistent, recognizable brand that clearly communicates NIST's priorities, capabilities, and value. As part of the effort to address this issue NIST, through its Public

Affairs Office, has awarded a contract to conduct a branding study. The NIST branding study is aimed at improving stakeholder awareness of NIST by clarifying and sharpening NIST's strategic communications. The study team collected input from NIST leadership and staff, as well as external stakeholders – including members of the NIST VCAT. The VCAT looks forward to the results of this study and the proposed next steps. It is also the opinion of the VCAT that a well-articulated brand will not be enough so long as a large portion of NIST communications happens outside of the Public Affairs Office. Uncoordinated messaging, including competing outreach among internal NIST organizations, hurts a unified NIST brand. To achieve measurable strategic communications goals, NIST needs discipline and consistency in messaging.

Another workforce action in the NIST Strategic Plan was focused on providing support for a strong and accountable leadership corps at every level of the organization. Effective and accountable leadership is a hallmark of any high-functioning organization. Growing and strengthening the NIST leadership corps is essential to overcoming many of the challenges facing NIST today. Accordingly, NIST should strengthen our leadership corps by developing and implementing an expanded NIST leadership competencies model and increase support for development and growth of leaders at NIST. Forward-looking, consistent sets of competencies, behaviors, expectations, and support systems are needed to realize One NIST culture. Success will foster effective partnerships across the organization and enable NIST-wide innovation. To address these goals and gaps, the Action team has:

- Reviewed and assessed several leadership competency models including the current NIST list, the Zenger-Folkman framework used by LED, SES ECQs, and others.
- Discussed modalities of training and leadership development with focus on approaches to complement current NIST programs, e.g. experiential learning via detail assignments and other mechanisms.
- Developed guiding principles to assess strategies to accomplish this goal
- Discussed use cases at NIST to ground these principles and concepts with concrete examples
- Explored tool sets that may be used to enhance leadership development
- Launched a pilot program in selected Operational Units.

### Recommendations:

- Given the leadership changes that have occurred recently and the potential for large budget increases, elements of the Strategic Plan will benefit from a fresh look. Any significant budget increase beyond the $400 million will warrant consideration of structure for managing such significant increases in the budget.

## 7. NIST Facilities and Infrastructure

The VCAT has been tracking the status of NIST facilities and infrastructure for the past several years, and remains concerned that each year, NIST's ability to maintain and renovate its infrastructure has been falling further and further behind. NIST's ability to maintain and modernize its facilities has been stymied by several factors including inefficient Federal procurement processes and an unstable and unpredictable funding stream. The insufficient resources in NIST's general maintenance fund have necessitated unacceptable and impossible choices between (a) temporary fixes in NIST's general

laboratory spaces, administrative buildings, and plant facilities or (b) implementing a more strategic approach to improving the condition of NIST's campuses that was presented to the VCAT this year.

To develop a path forward NIST has been working with Congressional appropriators to establish a sustainable level of base funding for both meeting the needs of capital construction, as outlined in the master plan, as well as providing the ability for NIST to make significant headway in addressing its deferred maintenance backlog. This backlog was well over $750 million when the VCAT was briefed earlier in the year. NIST is proposing an annual investment of between $60 and 80 million for capital construction, to provide the flexibility and stability necessary to implement the NIST campus master plan. For ongoing maintenance needs and to address the backlog, federal and industry guidelines indicate that NIST would require between $115 to $144 million annually to maintain its facilities. Based on trends of the last 4 years, NIST is trying to establish an annual maintenance and repair funding level of $100 million. The VCAT has been briefed that this is a funding level that NIST can execute based on recent and ongoing improvements to staffing, procedures and proactive planning efforts.

The VCAT fully supports NIST's goal of establishing a base level of funding of $160 to $180 million a year to address its construction and renovation needs and will work to continue to point a spotlight on this issue which if left unaddressed will completely degrade the ability of NIST to support the research and development highlighted earlier in this report.

The VCAT was also briefed on the recent incident at the NCNR on its Gaithersburg, Maryland, campus. At approximately 9:15 a.m. EST, Feb. 3, 2021, staff at NIST responded to an alert of elevated radiation levels in the confinement building of NCNR. The alarm occurred during a restart of the research reactor after a regularly scheduled maintenance period. In response to the alarm, staff followed established procedures and immediately initiated a shutdown of the reactor. The Nuclear Regulatory Commission (NRC) has released its interim special inspection report on the Feb. 3, 2021, event. The report confirms that the public was safe at all times and that all safety systems and staff performed as expected. Radiation released during the event remained well below regulatory health and safety limits at all times. NIST has submitted two reports and supplemental information on the incident to the NRC. The reports include a root cause analysis of the alert, NIST's planned corrective actions, and a review of the NIST response to the incident. With the reports, NIST has submitted a request for permission to restart the reactor, contingent upon all necessary corrective actions and restart preparations being completed.

## Recommendations:

- NIST should continue exploring options for reactor replacement and backup alternatives to minimize the impact on the research community and support partnership with the NSF and the DOE.
- Continue working with OMB and Congressional appropriators to establish and sustain the annual level of investment required for the nation's critical infrastructure entrusted to NIST for advancement of standards, advanced technology, and manufacturing excellence.
- Invest in the information technology (IT), business process and digital transformation capabilities needed for NIST to sustain world leadership in standards and technology in today's virtual and collaborative work environment.
- Provide NIST with increased flexibility in the use of its Construction of Research Facilities (CRF) resources with authorities to create capital investment resources through monetization of NIST

properties and facilities; move activities to lower cost venues; and remove restrictions on modification or demolition of designated historic structures.

## 8. NIST Budget (House and Senate Marks)

| | FY 2021 Enacted | FY 2021[2/] ARP Act P.L. 117-2 | FY 2022 President's Request | FY 2022 House Mark | FY 2022 Senate Mark | FY 2022 Under (CR) | FY 2022[4/] Emergency Act P.L. 117-43 |
|---|---|---|---|---|---|---|---|
| **STRS** | **$788.0** | **$0.0** | **$915.6** | **$937.57** | **$913.07** | **TBD** | **$22.0** |
| Laboratory Programs | 687.1 | 0.0 | 806.0 | TBD | TBD | TBD | 22.0 |
| Corporate Services | 17.5 | 0.0 | 18.1 | TBD | TBD | TBD | 0.0 |
| Stds Coord & Special Pgms [1/] | 83.4 | 0.0 | 91.5 | TBD | TBD [3/] | TBD | 0.0 |
| **ITS** | **$166.5** | **$150.0** | **$441.6** | **$331.5** | **$213.0** | **TBD** | **$0.0** |
| Hollings Mfg Ext Partnership | 150.0 | 0.0 | 275.0 | 275.0 | 175.0 | TBD | 0.0 |
| Manufacturing USA | 16.5 | 150.0 | 166.6 | 56.5 | 38.0 | TBD | 0.0 |
| **CRF** | **$80.0** | **$0.0** | **$140.0** | **$100.0** | **$268.06** | **TBD** | **$0.0** |
| Construc & Major Renovations | 6.1 | 0.0 | 0.0 | TBD | 2.5 | TBD | 0.0 |
| Saf, Cap, Maint & Maj Repairs | 73.9 | 0.0 | 140.0 | TBD | 140.0 | TBD | 0.0 |
| Extramural Construc projects | | | | | 125.56 | | |
| **Total, NIST Discretionary** | **1,034.5** | **150.0** | **1,497.2** | **1,369.07** | **1,394.13** | **TBD** | **22.0** |

1/ Includes Baldrige Performance Excellence Program funding for $2.5M in FY 2021, $2.6M in FY 2022.

2/ From supplemental funding of American Rescue Plan Act of 2021.

3/ Includes $37.6M for NIST External Projects.

4/ From enacted $22M to carry out investigations of Surfside building failures from Extending Government Funding and Delivering Emergency Assistance Act.

The VCAT was briefed on the FY 2022 budget and appropriations cycle. At the time of writing this report, resolution of the FY 2022 has not yet occurred, therefore, VCAT reviewed FY 2022 House and Senate Appropriations Budget Bills. The NIST FY 2022 Senate Appropriations Budget contains significant earmarks for the first time in 15 years. Specifically, the bill outlines 27 total new projects across the STRS (Scientific and Technical Research and Services) and CRF accounts:

- $37,598,000 across 20 STRS External Projects
- $125,563,000 for 7 CRF Extramural Construction Projects

To assess the ability of NIST to successfully implement and execute the new funding projects, NIST convened staff from legal, legislative affairs, grants and acquisitions, facilities, and the laboratory programs to examine and identify potential legal, procedural, administrative, and programmatic issues that could pose an obstacle to or prevent the implementation and oversight of the projects within one year of enactment. While NIST expects that it will be able to implement the proposed programs the ability to bring on needed administrative staff, the required level of project oversight, and the potential impact of National Environmental Protection Act (NEPA) requirements on the execution of the Construction projects were identified as potential issues that could affect the timing of execution.

While the VCAT was pleased to see increases for NIST across the board, it is conserved that those increases have not yet been reconciled in Q2 of 2022. Furthermore, the VCAT is concerned that those increases will not be permanent, and therefore will lead to further the decline of NIST's facilities, delay progress on ongoing projects, and increase the already astronomical deferred maintenance costs. To remain internationally competitive, to fulfill the increased demands to advance emerging technology

areas, and to strengthen U.S. manufacturing requires a sustained investment not only for the Laboratory Programs, but also for Construction and Major Repairs.

## Recommendations:

- CHIPS Act would have a substantial impact on semiconductor industry in the U.S. The VCAT recommends that NIST engages with the other chip makers and fabs in the U.S. to collaborate on the design on the incentives program. NIST should also ensure that the individual awards leverage the capabilities of the industry to maximize the impact of the federal investment.
- FY 2022 does not have any increases for cybersecurity despite the increasing responsibilities in that area and growing external threats. NIST should evaluate programmatic needs within this and other unaddressed priorities.