NIST THREE YEAR PROGRAMMATIC PLAN

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY

2016
2018

1 INTRODUCTION

The National Institute of Standards and Technology (NIST) promotes U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in a range of strategic areas critical to the nation's economy. The America COMPETES Act (Pub. L. 110-69, 121 Stat. 572) outlines major roles for NIST in promoting national competitiveness and innovation, and also calls for NIST to submit a three-year programmatic plan concurrent with the submission of the President's budget request to Congress. This document summarizes the focus of NIST programs for use in planning and prioritizing investments over this three-year period. NIST will continue to refine this plan as it works with the Administration to address national priorities.

2 NIST OVERVIEW AND PROGRAMMATIC OBJECTIVES

Since 1901, NIST (known as the National Bureau of Standards until 1988) has developed and maintained key standards for the Nation, a role that the U.S. Constitution assigns to the Federal government, and has been supplying the measurements and tools to help U.S. industry compete. As a non-regulatory agency in the U.S. Department of Commerce, an experienced partner of industry, and the Federal research agency specifically focused on promoting U.S. economic competitiveness, NIST is well-positioned to accelerate and promote innovation and advanced technologies through its Laboratory programs and its Innovation and Industry Services programs.

MISSION:

TO PROMOTE U.S. INNOVATION AND INDUSTRIAL COMPETITIVENESS BY ADVANCING MEASUREMENT SCIENCE, STANDARDS, AND TECHNOLOGY IN WAYS THAT ENHANCE ECONOMIC SECURITY AND IMPROVE THE QUALITY OF LIFE.

NIST plays a key role in the Department of Commerce's 2014–2018 Strategic Plan. Specifically, NIST leads DOC's Innovation Pillar, which aims to "foster a more innovative U.S. economy — one that is better at inventing, improving, and commercializing products and technologies that lead to higher productivity and competitiveness".

NIST's mission to promote innovation and industry competitiveness is best served when we support activities throughout the research and development pipeline, from the most basic science to the deployment of advanced technologies. NIST programs are designed to span this pipeline, enabling organizational excellence for institutions from non-profits and universities to manufacturers, supporting advanced manufacturing by facilitating pre-competitive and applied research as well as technology deployment, and performing world-class metrology and technology research and services.

The following goals will ensure NIST develops the technical capabilities and adaptability necessary to carry out its key role in the Nation's innovation ecosystem:

GOALS:

STRENGTHEN NIST'S LABORATORIES AND FACILITIES TO ENSURE U.S. LEADERSHIP IN MEASUREMENT SCIENCE.

The vitality of the NIST laboratories is crucial to meeting the complex and demanding measurement and standards challenges associated with new technologies. NIST will continue to invest in high-performing facilities, equipment, infrastructure, and personnel.

FORTIFY U.S. ADVANCED MANUFACTURING CAPABILITIES.

The Nation's long-term competitiveness relies on its global leadership in advanced manufacturing capabilities. NIST will develop and deploy unique tools to support U.S. advanced manufacturing through programs including the Hollings Manufacturing Extension Partnership, the Advanced Manufacturing Technology Consortia Program, and the National Network for Manufacturing Innovation.

MAXIMIZE NIST'S IMPACT THROUGH EFFECTIVE COLLABORATION AND COORDINATION.

NIST's research and development activities have the greatest impact when the knowledge and technology generated is transferred to industry, universities, standards organizations, and other government agencies. NIST will continue to pursue partnership opportunities to better deliver measurement solutions and best leadership and management practices to industry and other government agencies, provide access to unique measurement capabilities through its user facilities, participate in standards-setting organizations, convene consortia, license intellectual property, and attract and train high-quality research associates.

DEVELOP WORLD CLASS OPERATIONS AND SUPPORT.

NIST's activities are most efficient and effective when supported by exceptional business practices, strategic planning, and operational offices. NIST will improve its practices to enhance the business of NIST.

2.1 THE NIST LABORATORIES

The NIST laboratory programs work at the frontiers of measurement science to ensure that the U.S. system of measurements is firmly grounded on sound scientific and technical principles. Today, the NIST laboratories address increasingly complex measurement challenges, ranging from the very small (nanoscale devices) to the very large (vehicles and buildings), and from the physical (renewable energy sources) to the virtual (cybersecurity and cloud computing). As new technologies develop and evolve, NIST's measurement research and services remain central to innovation, productivity, trade, and public safety.

The NIST laboratory programs provide industry, academia, and other federal agencies with:

- Scientific underpinnings for basic and derived measurement units, international standards, measurement and calibration services, and certified reference materials;
- Impartial expertise and leadership in basic and applied research that enables development of test methods and verified data to support efficient commercialization and commerce;
- Expertise and support for consensus-based standards development, with associated test methods for conformity; and
- Unique, cutting-edge user facilities that support innovation in emerging technology areas.

Driving innovation through measurement

NIST creates the infrastructure necessary to measure the performance and quality of products and services. In close cooperation with industry, academia, and other federal agencies, NIST continually advances measurement science, develops standard protocols and test methods, and evaluates and generates data. These tools, which the private sector cannot provide due to the high cost and unique skills needed, are the foundations for interoperability between products and systems, enabling global trade.

Industry relies on NIST for the physical measurements and standards needed to enable advanced manufacturing, to develop and test new materials, to enable innovation, and to ensure compliance with regulations. In addition, NIST provides measurement and calibration products and services via its Standard Reference Materials®, calibration services, and Standard Reference Data programs. These products and services assure the accuracy of measurements made daily throughout the United States.

Accelerating the adoption and deployment of advanced technology solutions

Technology is rapidly evolving to integrate new capabilities across the economy, including manufacturing processes, transportation systems, critical infrastructure, and healthcare. While these innovations will contribute to the U.S. economy and quality of life, they have associated challenges in interoperability, security, and resiliency. The NIST Laboratory programs respond to these challenges by engaging with government and industry stakeholders to develop the standards, prototypes, and guidelines essential for technology adoption and dissemination. In addition, NIST provides test-beds, testing and validation methodologies, and support for certification to support technology deployment.

World class, unique, cutting-edge research facilities

Industry, academia, and other government agencies have access to unique NIST user facilities that support innovation in emerging technology areas. The NIST Center for Neutron Research (NCNR) provides world-class neutron measurement capabilities to the U.S. research community, and the NIST Center for Nanoscale Science and Technology (CNST) supports the U.S. nanotechnology enterprise from discovery to production by providing access to world-class nanoscale measurement and fabrication methods and technology. The customer-focused missions of both NCNR and CNST include the development and application of entirely new measurement and fabrication techniques while ensuring safe and reliable facility operations.

2.2 NIST INNOVATION AND INDUSTRY SERVICES

In support of the Administration's emphasis on serving industry through outreach services, NIST provides two important externally-focused services: The Hollings Manufacturing Extension Partnership (MEP) and the Baldrige Performance Excellence Program (BPEP). NIST is also the home of the Advanced Manufacturing Technology Consortia (AMTech) program, and the National Network for Manufacturing Innovation.

BPEP manages the Malcolm Baldrige Quality Improvement Act of 1987 (Public Law 100-107), in cooperation with senior U.S. business, education, health care, government, and nonprofit leaders. The associated Malcolm Baldrige National Quality Award recognizes high-performing, role-model U.S. organizations. Through the award process, conferences, training, social media, and other outreach, BPEP supports these organizations as they disseminate their best practices in leadership; strategy; customer focus; measurement, analysis, and knowledge management; workforce focus; and operational effectiveness. To enable the further competitiveness and success of U.S. organizations, BPEP's focus is to promote broad participation in the use of the Baldrige Excellence Framework and award program by organizations in all sectors of the economy. The Baldrige Foundation, the private non-profit organization that has supported BPEP for over 25 years with the contributions of the private sector, has agreed to support operations of the Baldrige Program through 2016, while key program partners explore alternative business and funding models to sustain the mission of BPEP in the future.

NIST's MEP provides technical and business assistance to smaller manufacturers through grant-supported partnerships between Federal and state governments and non-profit organizations in all 50 states and Puerto Rico. Field agents and programs in 60 centers nationwide help manufacturers understand, adopt, and apply new technologies and business practices, resulting in increased productivity, better performance, cost savings, waste reduction, and creation and retention of manufacturing jobs. MEP also acts as a strategic advisor to promote business growth and innovation and to connect manufacturers to public and private resources essential for expanding into new markets, developing efficient processes, and training an advanced workforce. To enable future profitable manufacturing growth, NIST's MEP program has developed a "Technology Acceleration" program to ensure that federally funded technologies, particularly those developed by NIST, are accessible to America's small manufacturers.

NIST plays a coordinating role for the National Network for Manufacturing Innovation (NNMI), serving the existing Institutes for Manufacturing Innovation (IMI) and future IMIs. The Federal investment in the NNMI serves to create an effective manufacturing research infrastructure for U.S. industry and academia to solve industry-relevant problems. The NNMI will work to maximize the integrated impact of the IMIs on US manufacturing competitiveness. In an IMI, industry, academia, and government partners leverage existing resources, collaborate, and co-invest to nurture manufacturing innovation and accelerate commercialization.

With the America COMPETES Reauthorization Act of 2010, the Under Secretary for Standards and Technology—the NIST Director—was provided Federal government-wide responsibilities for technology transfer, which include coordinating Federal agency activities for the commercialization of technology developed at Federal laboratories. NIST leads interagency workgroups that promote the transfer of technology developed from Federal laboratories, as well as federally funded research performed by partners at universities, businesses, and non-government organizations. NIST is also the host agency for the Federal Laboratory Consortium for Technology Transfer and plays a lead role in evaluating the performance of government efforts to develop technology through external partnerships and transfer technology to support U.S. economic development.

3 THE NIST STRATEGIC FRAMEWORK

To most effectively accomplish its mission, NIST must be capable, relevant, and effective. This means that NIST must be forward-looking in order to build and maintain world-leading scientific capacity in the technology areas that will shape future industries, while at the same time having the agility to build programs that apply NIST's technical capabilities to the Nation's most immediate needs. In addition, NIST must continue to strengthen and improve the internal processes necessary to accomplish its mission with the greatest efficiency and effectiveness possible.

NIST continually collects information on major national issues, shifting trends in science and technology, and the performance of key operational processes through a variety of mechanisms including meetings, workshops, industry visits, and objective peer review of its programs. This input is viewed in the context of the NIST mission to make decisions on where NIST needs to develop specific capabilities, how to best marshal existing resources to address current issues, and how to continually optimize the organization for improved performance.

NIST has identified four long-term trends against which to optimize its capacity: precision measurements, systems, data, and partnerships and collaborations. These trends reflect broader societal and technological changes that may require fundamental changes in perspective or focus for maximum effectiveness of NIST's programs over the long-term. Generally, these trends are outcomes of a more connected society — one where our economy is based on multifaceted systems-of-systems that present challenges of interoperability, awareness, prediction, and information-sharing. This future requires NIST to continue to develop relevant measurement solutions and to provide trusted data, to convene stakeholders and be a trusted technical expert, and to support highly productive partnerships that address shared challenges.

NIST STRATEGIC FRAMEWORK

SPOTLIGHT ON: CYBERSECURITY

The growing integration of information technology with our physical, economic, and social worlds is one of the greatest sources of innovation in the 21st century. Interconnected networks of computers have become essential for every aspect of our lives including air traffic control, factory operation, and electric power distribution. However, these networks also present an opportunity for malicious attacks with effects from irritating to catastrophic. Not a day goes by without a new story of consumer and financial data stolen, government networks attacked, or people's personal data being stolen and used against them in acts of intimidation or humiliation.

NIST is a recognized world leader in cybersecurity, with a track record of accelerating the development and deployment of cybersecurity solutions and standards that are reliable, usable, interoperable, and secure, as well as the measurements and standards infrastructure for emerging cybersecurity applications. NIST is committed to growing its technical capabilities to ensure excellence and independence. NIST continually explores opportunities for new collaboration mechanisms to strengthen and support the cybersecurity of U.S. businesses, government, and individuals, with a special focus on the cybersecurity of critical infrastructure.

Cryptographic standards, guidelines, reference materials, and conformance programs for protecting sensitive information in transit or storage are a key component of NIST's effort to supply standards, guidelines, tests, and metrics to protect non-national security federal information systems. These standards must be robust and have the confidence of the cryptographic community to be widely adopted and effective at securing information systems worldwide. To ensure these standards provide high-quality, cost-effective security mechanisms, NIST works closely with a broad stakeholder community to select, define, and promulgate these standards and guidelines. NIST continually works to strengthen its internal capabilities and its partnerships to ensure the best standards and guidelines possible.

The Framework for Improving Critical Infrastructure Cybersecurity, produced by NIST in collaboration with stakeholders, will help organizations charged with providing the nation's financial, energy, health care and other critical systems better protect their information and physical assets from cyber attack. The framework provides a structure that organizations, suppliers, and customers can use to create, guide, assess, communicate, or improve comprehensive cybersecurity programs.

The National Cybersecurity Center of Excellence (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. Hosted by NIST, the center fosters collaboration with industry to identify and solve today's most pressing cybersecurity challenges.

The National Strategy for Trusted Identities in Cyberspace (NSTIC) is a White House initiative to work collaboratively with the private sector, advocacy groups, public sector agencies, and other organizations to improve the privacy, security, and convenience of online transactions. The vision of NSTIC is for individuals and organizations to use secure, efficient, easy-to-use, and interoperable identity solutions to access online services in a manner that promotes confidence, privacy, choice, and innovation.

The National Initiative for Cybersecurity Education (NICE) seeks to establish an operational, sustainable, and continually improving cybersecurity education and awareness programs for the nation.

3.1 PRECISION MEASUREMENTS

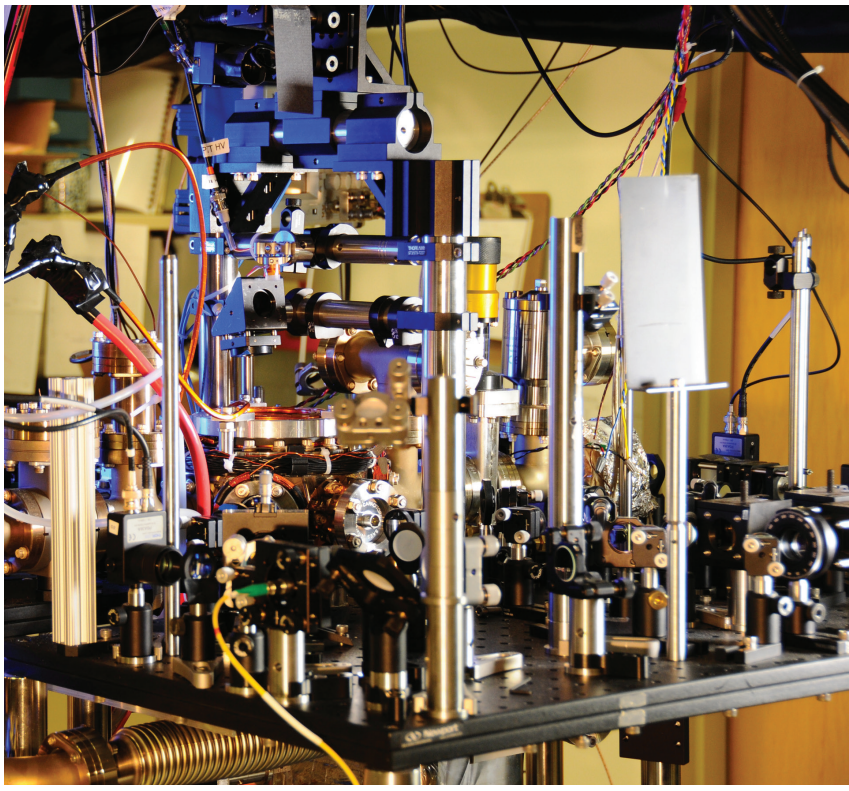
Recent advances in computing, communications, and manufacturing technologies have enabled the rapid expansion of sensor use. Sensors measuring physical, chemical, biological, and material properties are being used in everything from military equipment to smartphones. Still, the performance of these sensors is inadequate for many applications—for example, reliability, and accuracy are required qualities for manufacturing, defense, and health-care. Such high-performance, mobile sensors would also unlock untold consumer applications, from quantified health to smart-systems for the home.

NIST has the unique mission to address these challenges—bringing precision measurement to the ubiquitous sensing revolution. While continuing to do leading-edge metrology research to ensure US leadership in measurement science, NIST will begin to not just ask ***what's the best measurement that can be made in a laboratory,*** but ***what's the best measurement that can be made anywhere.***

NIST will use its strong ties to industry, state and local governments, and other federal agencies to determine the most important sensor qualities for a given application—for example, size, energy efficiency, robustness, or cost—ensuring maximum utility and optimizing technology transfer. Our proven expertise in nanotechnology, miniaturization, quantum devices, and precision measurement will enable rapid development in this area.

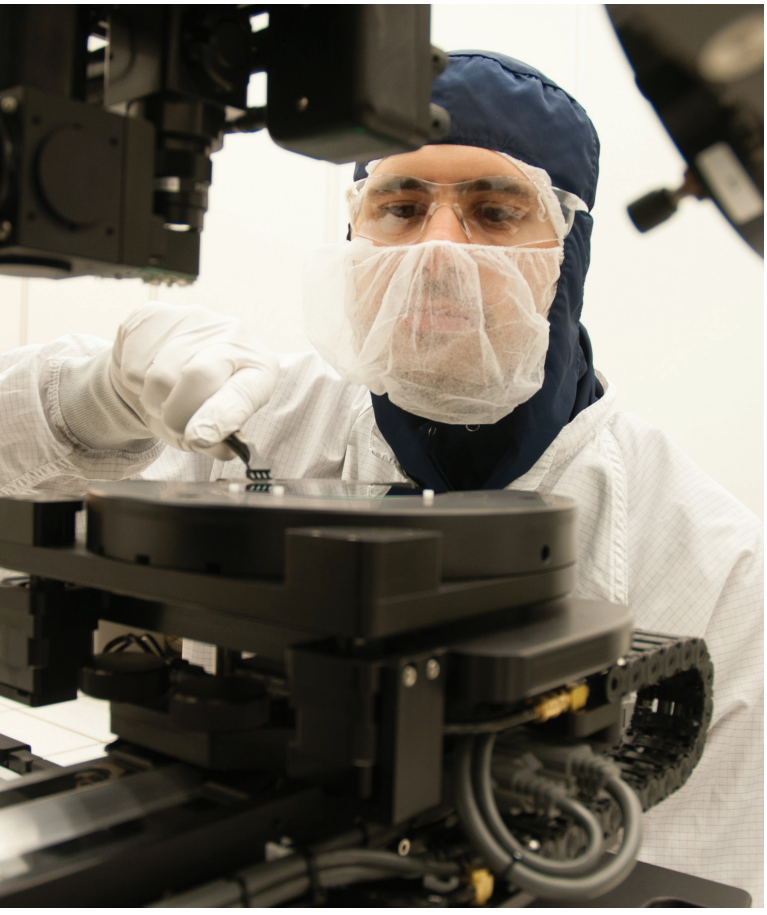
ADVANCED SENSING FOR MANUFACTURING

NIST will expand efforts to develop measurement science and standards that will accelerate the design, development, and manufacturability of advanced electronic and photonic devices—those that require new concepts, architectures, materials, and manufacturing methods. NIST will address a rapidly emerging trend in manufacturing: the need for advanced sensing using non-invasive sensing and real-time process analysis to reduce the rejection rate associated with the manufacture of high-value added products that involves multiple complex steps. Industry needs breakthrough technologies and new device architectures to realize necessary future sensor performance. NIST will provide measurement science and standards to support the development of distributed and ubiquitous devices that can be integrated everywhere by consumers and manufacturers, to meet diverse needs.



BIOMANUFACTURING

The industrial potential of biomanufacturing is to use living organisms to produce a commodity, such as fuel, chemicals, pharmaceuticals, or medical therapies. Creating efficient, reliable biomanufacturing processes requires the development of tools to explore, manipulate, and ultimately explain the intricate complexities of biological cells. NIST will address the technical challenges faced by the biomanufacturing industry by developing a suite of quantitative methods for accurate measurement of biological systems, creating the necessary tools to methodically design and test engineered organisms. Such tools are badly needed but challenging to develop since biological cells are inherently complex and interact with the environment in unexpected ways. NIST will use its convening power and its expertise in precision measurement to coordinate the strategic development and implementation of accurate and quantitative measurements of engineered biological systems.



EMERGING NANOTECHNOLOGIES

NIST's CNST provides a uniquely designed nanotechnology user facility that serves the NIST laboratories, government agencies, academia, and industry. The CNST user facility consists of the NanoFab, providing all users with rapid access to state of the art commercial nanofabrication and nanoscale measurement equipment, and the NanoLab, affording the opportunity for users to collaborate on developing fabrication and measurement solutions not yet available on a commercial basis through collaboration with a talented staff of CNST scientists. Its research program, equipment base, and services offered to the users are continually refined and adjusted to reflect user needs and provide excellent coverage of the broad spectrum of nanotechnology research.

QUANTUM-BASED SENSORS AND MEASUREMENTS

Quantum information science is an emerging research field with the potential to revolutionize computation, communication, precision measurement, and fundamental quantum science. This field seeks to harness the fundamental laws of physics to dramatically improve information acquisition, transmission, and processing. NIST will expand efforts to advance quantum information science to improve information security and assurance, improve standards, and develop more-sensitive sensors for a variety of applications.

3.2 SYSTEMS

The complexity of engineered systems is rapidly growing beyond what the world has seen before. These systems cannot be fully understood with conventional analytical and modeling techniques. Furthermore, these systems are being applied in new application areas, forging new partnerships between providers. For example, the proliferation of cyber-physical systems (CPS), where remote decision making and control is enabled by analytical techniques and embedded measurements, is not just expanding the types and complexity of systems operating worldwide, but it's bringing together new such new technologies and groups that communication and standards are more necessary than ever. These CPS could have an outsized impact on our economy – by one estimate, the deployment of next-generation CPS across the transportation, energy, and health sectors alone has the potential to boost U.S. productivity growth by as much as 1.5% and increase per capita GDP by 25%–40% percent by 2030.[1]

At the same time, improved measurement, modeling, and data analytic techniques are enabling better understanding of existing systems and processes—whether physical, chemical, engineering, or biological—at the system level. Fundamental research into the measurement science of these systems—science elucidating how to understand, predict, and even control such systems—is needed.

To meet the needs of the future economy, one that is increasingly dependent on system-level phenomena, NIST must both invest in fundamental research to understand the behaviors of systems, and in its convening role to ensure all system stakeholders can benefit from these new technologies.

ADVANCED COMMUNICATIONS

New and improved spectrum sharing technologies are promising technologies that can address spectrum scarcity due to strict, exclusive, and static allocation of frequency bands. Spectrum sharing technologies could benefit many applications, such as device-to-device communications in mobile cellular networks and sensor networks. Spectrum sharing can also play an important role in prioritizing traffic in the unlicensed spectrum. However, spectrum sharing involves multiple users with diverse technologies interacting with the system, which could produce unwanted interference or performance degradation for primary users. To promote industry adoption of spectrum sharing technologies, NIST will build a multi-purpose test facility that can replicate a variety of complex electromagnetic environments to accurately determine the interference, coexistence, and electromagnetic compatibility of these wireless devices and systems, as well as develop spectrum sensing and spectrum coordination technologies, thus providing industry a way to identify potential issues with the next generation of wireless systems before they are commercialized and deployed.

CYBER PHYSICAL SYSTEMS (CPS)

Facing rapid population growth, inefficient and aging infrastructures, and the needs of an increasingly digital society, communities across the nation look to harness the power of emerging CPS technologies to improve livability, workability, resilience, and sustainability. Among the largest barriers to meeting these goals are limitations in the interoperability and scalability of many of today's smart city solutions. These barriers mean that today's smart city systems are often custom implementations that are costly and inefficient; create stranded systems that cannot readily be upgraded or extended; and stifle innovation and growth. NIST will develop measurement science and technical standards required for the design and performance measurement

[1] http://files.gereports.com/wp-content/uploads/2012/11/ge-industrial-internet-vision-paper.pdf

of scalable, extensible, and interoperable smart city solutions that empower U.S. communities and ensure American companies can be competitive in the rapidly growing global smart city market.

DISASTER RESILIENCE

Preventing hazards (e.g., earthquakes, hurricanes, and community-scale fires) from becoming debilitating disasters depends upon the disaster resilience of our buildings and infrastructure. Disaster resilience can be enhanced by developing a robust capability to predict the effects of hazards on the performance of complex structural systems. Realizing this will require data to characterize the hazard, validated physics-based models to predict performance, metrics for measuring performance, and mitigation strategies based on performance evaluation. NIST will develop the measurement science required to achieve disaster resilient buildings and infrastructure in a timely manner.

3.3 DATA

With the rapid increase—40% year over year—of global data over the past decade, new research opportunities and business models have been built on the generation, analysis, and use of new and old data sources. By 2015, according to Gartner, data-driven innovation is projected to help create 4.4 million IT jobs globally, of which 1.9 million will be in the U.S.

While the promise of data-driven innovation is obvious, studies have shown[2] that most data in this information age resides in silos, is often not interoperable, and is not easily accessible or machine/human readable, all of which impedes access to the underlying knowledge. NIST will develop the measurement science needed to foster continued innovation and deployment of data-driven technology and will provide leadership in characterization of the critically important factors related to data quality and the automation used to generate and analyze this data.

Researchers are able to collect ever increasing volumes of data—whether because the measurements are higher fidelity, more frequent, or broader—presenting both an opportunity and a challenge. NIST is investing in organizations, talent, and infrastructures to ensure that this data is properly analyzed, curated, stored, and shared, maximizing the utility of every measurement. These actions also support recent policy directives from the administration[3] require Federal Departments and Agencies to take steps to make scientific data and publications more readily available and accessible by the public.

Above all, NIST's role in data must remain as a standard-bearer for quality, characterization, and integrity. NIST's Standard Reference Data (SRD) collection is a national asset for research and industry, containing physical, material, chemical, and biological data covering a broad range of substances and properties. This data is among the best

[2] The Open Data Economy: Unlocking Economic Value by Opening Government and Public Data, Capgemini Consulting

[3] OMB Memo M-10-06 Open Government Directive; OMB Memo M-13-13 Open Data Policy — Managing Information as an Asset; and, the February 22, 2013 Memo Increasing Access to the Results of Federally Funded Scientific Research

characterized, high-quality data available. NIST will continue to find ways to make this SRD more usable and accessible, and to expand the suite of SRD to meet stakeholders' needs.

CRYPTOGRAPHY AND PRIVACY

The proliferation of data generation, storage, and use associated with the digital economy is making it increasingly important to protect that data with effective cryptography and privacy standards. NIST's core technical capabilities cannot stagnate if NIST is to keep pace in what has become a rapidly escalating arms race to protect our individual, corporate, and public sector data, information, and systems from attacks from individual actors, criminal organizations, and nation-states. NIST must immediately build out its technical talent in cryptography to effectively address the rapidly emerging threats in this field with new and needed cryptographic standards and technologies. Simultaneously, with more citizens using web-based tools for everyday activities ranging from holiday shopping to online bill payment to using social media tools to stay connected with friends and family there is a pressing need for robust tools that provide users assurance about the privacy of their information and their online transactions and allowing systems to provide essential privacy capabilities.

MATERIALS GENOME INITIATIVE

NIST has a key role in the Materials Genome Initiative (MGI), an interagency effort to capitalize on recent breakthroughs in materials modeling, theory, and data mining to significantly accelerate discovery and deployment of advanced materials while decreasing their cost. To support this effort, NIST is developing an advanced materials innovation infrastructure, including data assessment and validation, data standards, and modeling and simulation tools. As the leadership of the public-private partnership Materials Project (one of the inspirations for the MGI) noted recently, "data is only useful if it is accessible, characterized (e.g. through its metadata), contains uncertainty quantification, and if an ontology exists to connect diverse data items." By leveraging resources and partnerships, NIST will assist U.S. manufacturers in achieving materials-by-design for high-tech products in a range of industrial sectors. New measurement science and standards developed based on this infrastructure will enable industrial researchers to effectively discover data and models, assess their quality, and use them to maximum effect.

LAB TO MARKET

In support of the Administration's Cross Agency Priority Goals, NIST will execute a set of pilot programs to designed to empower effective collaborations, open R&D assets, and develop entrepreneurial skills. A particular NIST focus will be to make R&D assets more accessible to the private sector. Filling a significant gap in existing efforts to increase the transfer of technology developed through federally-funded research and development, NIST will lead the development of digital platforms to enhance cross-agency collaborations on technology transfer and development. Building on efforts to streamline access to assets from the federally funded R&D enterprise, these digital platforms will increase visibility of and connectivity between those assets. They will promote collaboration between agencies on specific national priority technology areas, enabling stakeholders to identify available, complementary technology components, thus accelerating development of new technological systems. These platforms will also enable large-scale dissemination of information while providing advanced capabilities to collect and organize information in ways that better address national priorities and business needs.

3.4 COLLABORATION AND PARTNERSHIP

To meet its mission in the face of growing national priorities, a widening stakeholder base, and a constrained budget environment, NIST is increasingly partnering with academic, industrial, and governmental institutions. More than ever before, national priorities require the united efforts of diverse participants. NIST's convening power and technical independence can help bring those participants together to meet those needs.

This trend builds on NIST's historical success with partnerships and stakeholder engagement. NIST's user facilities, the NIST Center for Neutron Research (NCNR) and the Center for Nanoscale Science and Technology (CNST) allow industry, academia, and government researchers to use state-of-the-art technical equipment to accelerate innovation. NIST has long-standing research partnerships with universities in JILA, the Hollings Marine Laboratory, the Joint Quantum Institute, and the Institute for Bioscience and Biotechnology Research, all of which have produced unparalleled technical breakthroughs. The Baldrige Performance Excellence Program partners with the Baldrige Foundation and the Alliance for Performance Excellence, a network of more than 30 independent Baldrige-based programs, to provide services and improve organizational performance and competitiveness in nearly every state and territory. The NIST Hollings Manufacturing Extension Partnership (MEP) program partners with Centers in every state across the country to help small and mid-sized U.S. manufacturers create and retain jobs, increase profits, and save time and money.

More recently, NIST has worked with diverse stakeholders to develop standards frameworks that promote interoperability and measurement science. Examples of these frameworks include the Smart Grid Framework and Roadmap and the Framework for Critical Infrastructure Cybersecurity. These frameworks, which have been well-received by their stakeholders, provide the foundation for interoperability and performance in these national priority areas.

NIST has also developed a Center of Excellence program, which provides an interdisciplinary environment where researchers from NIST, academia, and industry collaborate on emerging areas of basic and applied research and innovations in measurement science. This program expands NIST's capabilities in areas of critical national need. In FY14, NIST partnered with a consortium led by Northwestern University to establish the Center for Hierarchical Materials Design (CHiMaD), which focuses on advanced materials. NIST also expanded the Center of Excellence program with two additional Centers, one focused on Disaster Resilience and another on Forensic Science. NIST will expand this program in additional areas of need as they arise.

PUBLIC SAFETY COMMUNICATIONS

The Middle Class Tax Relief and Job Creation Act of 2012 (the "Act") established the First Responder Network Authority ("FirstNet") as an independent authority within the National Telecommunications and Information Administration to ensure the building, deployment, and operation of the first nationwide public safety broadband network ("NPSBN").

This Act also charged NIST to, in consultation with other Federal entities, conduct research and assist with the development of standards, technologies, and applications to advance wireless public safety communications. Moreover, NIST is to coordinate with FirstNet and others in its activities under this program. NIST has a robust plan to engage the full spectrum of stakeholders in this research and development (R&D) program — from the first responder users and the Public Safety Advisory Committee established under the Act to Federal government agencies, from academic researchers to the information technology and communications industry leaders. This will include stakeholder-driven summits to establish and refine R&D roadmaps, a competitive industry collaboration program, and continued partnerships with FirstNet and other Federal agencies.

HOLLINGS MANUFACTURING EXTENSION PARTNERSHIP

A robust advanced manufacturing base is essential for a sustainable regional innovation ecosystem. NIST, through its national network of 60 MEP Centers, will play a central role in transferring manufacturing technology to small and mid-sized firms, working in close collaboration with regional partners NIST has initiated a systematic, multi-year, full and open re-competition of the national system of MEP Centers that will optimize program effectiveness, enhance administrative efficiency, and provide greater financial accountability. The re-competition will enable Centers to more fully support regional initiatives, participate in responses to Federal multi-agency solicitations, serve very small, rural, and start-up firms, and develop innovative approaches to national priorities such as workforce development and exports.

NATIONAL NETWORK FOR MANUFACTURING INNOVATION

In December 2014, Congress passed and President Obama signed the Revitalize American Manufacturing and Innovation (RAMI) Act of 2014, calling for the establishment of a National Network for Manufacturing Innovation (NNMI). Based on broad public input,[4] NNMI represents a powerful new model of public-private partnerships in technology development and transfer. Institutes established by NIST will be in topics identified and led by industry, enabling the development of an interrelated innovation ecosystem that builds both competitiveness and human capital readiness. The Advanced Manufacturing National Program Office (AMNPO) at NIST will work with other federal partners and existing institutes to establish network governance processes and frameworks for performance evaluation, risk management, communication and operations, and engagement with the manufacturing supply chain. In support of this effort, the AMNPO will leverage the MEP network to ensure that small manufacturers inform institute research priorities and deploy resulting innovations. NIST will also run an open competition for additional institutes on topics most important to industry. As new institutes are created, NIST play a critical role coordinating issues, opportunities, and resources to ensure an efficient and effective network.

[4] January 2013, "National Network for Manufacturing Innovation: A Preliminary Design," prepared by the Executive Office of the President, the National Science and Technology Council, and the Advanced Manufacturing National Program Office, January 2013, http://www.manufacturing.gov/docs/nnmi_prelim_design.pdf.

WORLD CLASS NEUTRON RESEARCH FACILITY

Developing the products of tomorrow require providing industry access to sophisticated measurement tools. Neutrons provide information about material structure and dynamics that simply cannot be obtained using methods available in researchers' own laboratories. That's why worldwide demand for neutron measurement capabilities far exceeds supply. It is essential to U.S. industry and the long-term economic growth of the U.S. that the NCNR—with its unique focus on industrial competitiveness—is optimally equipped to provide state-of-the-art measurement tools to the U.S. scientific and engineering community. Rising reactor fuel costs and required maintenance threatens efficient, optimal operation of the NCNR.

MANUFACTURING ENTREPRENEURSHIP

Easier access to technologies like 3D printers, design software, and desktop machine tools has democratized manufacturing and spurred grass-roots entrepreneurship — developing a "maker" economy. NIST will foster and accelerate the maker trend by providing infrastructure and education needed to promote knowledge transfer, facilitate experimentation, and connect makers to the manufacturing eco-system.

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