National Institute of Standards and Technology (NIST)

NIST, founded in 1901, is a non-regulatory federal agency within the Department of Commerce. NIST's mission is to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve our quality of life.

Open Data

The Evidence Act

Public Law 115-435, Foundations for Evidence-Based Policymaking Act of 2018 (The Evidence Act), requires that federal agencies make strategic data assets accessible to the public in machine-readable formats and discoverable through a single, government-wide catalog. The Office of Science and Technology Policy (OSTP) had previously identified research data as a high-value federal asset, and NIST's efforts to make data public began with research data, as discussed below. NIST generates and collects other mission-related data assets that may already be publicly available (see, for example, https://www.nist.gov/tpo), but which are not currently catalogued for discovery through https://data.gov. These assets will be inventoried and, if not already publicly available, will be prioritized by NIST's Chief Data Officer for release.

Public Access to the Results of Federally Funded Research[1]

NIST developed a Public Access Plan in response to a February 22, 2013 memorandum from the Executive Office of the President on increasing access to the results of federally funded scientific research. The Plan was approved by the Office of Science and Technology Policy (OSTP) and the OMB in December 2014. NIST staff are required to provide public access to the results of federally funded research under a set of NIST directives that went into effect in

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[1] Certain commercial products are identified here, but such identification is not intended to imply recommendation or endorsement by the National Institute of Standards and Technology, nor is it intended to imply that the products are necessarily the best available for the purpose.

2015. Language requiring provision of public access to scientific research results is included in agreements for research supported by NIST through grants, contracts, cooperative agreements, or other awards, including research conducted at joint institutes and federally funded research and development centers, as they come up for renewal. The plan and public comments are available as NISTIR 8084. NIST's Public Access Policy, which was derived from the plan, is available at https://www.nist.gov/open.

NIST has partnered with the National Institutes of Health (NIH) to use the PubMed Central (PMC) repository system to provide public access to full-text peer-reviewed scholarly publications authored by NIST staff, leveraging the well-established search, archival, and dissemination features of PMC. NIST Technical Series publications are available through the Government Publishing Office's (GPO's) govinfo. NIST also has a participation agreement with CHORUS, facilitating access to published papers.

To allow researchers to make data public, NIST has developed an infrastructure through which researchers' data management plans (DMPs) can be linked to records in NIST's Enterprise Data Inventory (EDI). The EDI allows researchers to upload datasets to a secure repository in the cloud, assign digital object identifiers (DOIs), and obtain the necessary review and approval prior to release of information to the public. Information about available data is sent through the Department to https://data.gov. NIST research data is accessible through links on data.gov and through a portal on NIST's website at https://data.nist.gov. Software produced by NIST for research purposes is also discoverable through this portal. Software may be located, for example, in NIST's GitHub repository at https://github.com/usnistgov or on the NIST website.

Membership in CrossRef, DataCite, and ORCiD allows NIST to mint DOIs for authors, NIST Technical Series publications, and datasets, taking advantage of the evolving ecosystem of persistent identifiers that can link funders, authors, and research products.

Recognizing the importance of collaboration for scientific research efforts, NIST's CIO has authorized the use of several collaboration tools for sharing information with internal and external colleagues. Via an internal website, staff now have access to lists of tools that are available and tools that are in the assessment and authorization process, making the assessment and authorization process more transparent.

Improved Access to Archival Materials

NIST, formerly the National Bureau of Standards (NBS), has worked with *The Internet Archive* under an arrangement with the Library of Congress to digitize nearly 25,000 technical reports the agency has published over the last 100+ years. As the publications are digitized, they are made accessible to the public through appropriate sources:

- GPO *govinfo*, https://www.govinfo.gov/collection/nist

- WorldCat, https://www.worldcat.org/
- *The Internet Archive*, https://archive.org/details/NISTresearchlibrary
- Internet search engines.

Photographs and other materials portraying NBS/NIST history are made available to the public through the NIST Digital Archives, https://www.nist.gov/digitalarchives. Information about and images of the scientific instruments and other artifacts in the NIST Museum collections are also accessible to the public through this site.

Configurable Data Curation System

The NIST Configurable Data Curation System (CDCS), a platform developed to support the Materials Genome Initiative discussed below, provides a means for capturing and transforming data into a structured format that is XML-based and amenable to transformation to other formats so that the data can be shared across academia, the government, and industry. The platform was developed for materials data (Materials Data Curation System, MDCS), but is now also deployed as the NIST Materials Resource Registry (NMRR) as well as the International Metrology Resource Registry (IMRR), a tool for National Metrology Institutes and the International Bureau of Weights and Measures (BIPM) to provide federated discovery and access to the world's knowledge about the science of making measurements.

Proactive Disclosure

To the extent feasible and consistent with law, agency mission, resource constraints, U.S. national, homeland, and economic security, NIST promotes the availability of results of federally funded research in publicly accessible repositories.

NIST has begun an initiative to make NIST directives of significant public interest available on our website.

Privacy

NIST follows departmental guidance from the Office of Privacy and Open Government. NIST's privacy program is described at https://www.nist.gov/privacy, and Privacy Impact Assessments are available at http://www.osec.doc.gov/opog/privacy/NIST-pias.html.

Whistleblower Protection

The NIST follows departmental guidance from the Office of Inspector General.

Websites

Several years ago, as part of an effort to expand dissemination of its research results, NIST implemented Drupal, an open-source CMS, in which content is "tagged" by topic, enabling the public to subscribe to receive new information posted on the website on specific topics of interest such as nanotechnology or energy-related research. Currently, there are more than 240,000 subscribers who receive information on approximately 108 different topics. The NIST website also includes several blogs that allow members of the public to comment or ask questions about posted articles and the CMS includes icons to easily share content from the NIST site with social media websites.

NIST has created sites on YouTube (more than 15,000 subscribers, more than 3 million video views), Facebook (more than 72,000 followers), Twitter (more than 59,600 followers), LinkedIn (more than 48,700 followers), and Instagram (more than 2,300 followers). To ensure that as many people as possible benefit from NIST's work, news of major research results posted on the NIST website is routinely announced through these additional social media sites.

Open Innovation Methods

NIST uses prizes and challenges to stimulate engagement to solve ambitious problems in support of the NIST mission. Many long-standing NIST programs have created challenges by leveraging NIST authorities (e.g., the NIST Organic Act and Federal Information Security Management Act) to bring people together to advance research by providing an evaluation infrastructure; others have a winner who receives public recognition. Examples of recent and ongoing challenges include:

Global City Teams Challenge

NIST Transactive Energy Challenge

Text Retrieval Conference (TREC).

NIST prize competitions, involving the award of cash prizes to winners under Prize Competition Authority (15 U.S.C. 3719, as amended), are managed through NIST's Program Coordination Office. Prize competitions are announced on challenge.gov and program websites. Prize competitions completed or in progress include:

2017 Reusable Abstractions of Manufacturing Processes (RAMP) Challenge

2018 Reusable Abstractions of Manufacturing Processes (RAMP) Challenge

Agile Robotics for Industrial Automation Competition (ARIAC)

Federal Impact Assessment Challenge

NIST the Future of Public Safety Technology 100K Video Series Challenge

[NIST Virtual Public Safety Test Environment Challenge](#)

[PerfLoc: Performance Evaluation of Smartphone Indoor Localization Apps](#)

[The Unmanned Aerial Systems Flight and Payload Challenge](#)

[Virtual Reality Heads-Up-Display Navigation Challenge](#)

[The Unlinkable Data Challenge - Advancing Methods in Differential Privacy](#)

[Differential Privacy Synthetic Data Challenge](#)

[Expanding the SIM Card Use for Public Safety Challenge](#)

[Haptic Interfaces for Public Safety Challenge](#)

[Tech to Protect Challenge](#)

[First Responder UAS Endurance Challenge](#)

[Automated Streams Analysis for Public Safety (ASAPS) Prize Challenge](#)

[CHARIoT Challenge – Advancing First Responder Communications](#)

Access to Scientific Data and Publications

NIST provides public access to scientific data through https://data.gov as well as a data portal on NIST's website, https://data.nist.gov. Publications are available within 12 months of publication through the National Institutes of Health's PubMed Central at https://www.ncbi.nlm.nih.gov/pmc/funder/nist/ and through the Government Publishing Office's govinfo at https://www.govinfo.gov/collection/nist.

Open Source Software

Most programming code written at NIST is developed as part of our research programs and is developed to address specific and unique mission-related research problems. NIST openly shares this software through [public Github repositories](#) for potential re-use by our stakeholders, including other researchers, and so that our research processes are fully open and transparent. NIST's Open Source Code directive is available from https://www.nist.gov/open.

Spending Information

NIST spending information is available at https://www.nist.gov/about-nist/our-organization/budget-planning and is embedded in Department of Commerce information on USAspending.gov.

Transparency

NIST strives to be consistently open and transparent in its interactions with the public and news media. Information from and about NIST is available on analytics.usa.gov, cfda.gov, challenge.gov, data.gov, grants.gov, ITdashboard.gov, labs.data.gov/dashboard, usa.gov, USAspending.gov as well as on the NIST website and social media, and in news releases, publications, and reports. In some cases, NIST information is embedded in Department of Commerce information.

NIST follows the Department of Commerce Public Communications Policy, which includes explicit approval for research staff to talk with the news media and the public directly – without prior permission from the Public Affairs Office – about the results of their peer-reviewed research.

NIST Public Affairs Office regularly offers communications training to its research staff, including describing this portion of the policy, to ensure that they are committed to broadly disseminating NIST results to a wide variety of audiences. Plain language training is available online and through mentoring and in-person training of NIST employees.

NIST provides a dedicated referral service for phone and email public inquiries during all business hours to ensure that any member of the public may request assistance in locating specialized technical reports or experts or in resolving customer service concerns they may have. The NIST website "Contact Us" page includes several different ways for the public to obtain help with many different types of inquiries. The Public Affairs Office strives to answer general NIST inquiries within 48 hours.

Public Notice

The NIST follows departmental guidance from the Office of Public Affairs.

Records Management

NIST manages its records in accordance with NARA and Department of Commerce regulations, ensuring that records are economically and effectively created to meet business needs, kept long enough to protect rights and assure accountability, and preserved and available for future generations. Records are retained in accordance with NARA-approved records schedules. NIST's records management directives are clear and concise, conveying records management requirements and responsibilities to all NIST staff.

Freedom of Information Act Requests

NIST responds to Freedom of Information Act requests in accordance with Department of Commerce regulations and Department of Justice guidance. NIST emphasizes the importance of transparency of its operations and regularly performs discretionary releases of documents and information that could qualify for exemption from release, but for which there is no foreseeable harm. The NIST FOIA Office works collaboratively with NIST Operating Units to obtain information in response to requests in a timely manner and to encourage proactive disclosure of information.

Congressional Requests

NIST follows Department of Commerce guidance from the Office of Legislative and Intergovernmental Affairs.

Declassification

NIST follows Department of Commerce guidance from the Office of the Secretary.

Participation

NIST has a rich history of connecting our technological advances to the American economy through interactions with stakeholders and the public, some of which are described in an annual report on technology transfer. Technology transfer plays an important role in the Department of Commerce's mission to promote job creation, economic growth, sustainable development, and improved standards of living for all Americans. NIST works in partnership with academia, businesses, state and local governments, other federal agencies, and communities to promote innovation and improve the nation's overall competitiveness in the global economy.

To increase citizen involvement in the development of standards to address new technological challenges, NIST has reached out to stakeholder communities to convene workshops at key locations around the country, organize diverse stakeholder groups, and establish consensus-developing organizations. This strategy has been used successfully for developing standards frameworks for the smart grid sector, critical infrastructure cybersecurity, disaster resilience, and forensic standards.

Framework for Improving Critical Infrastructure Cybersecurity

Starting in 2013, NIST worked with stakeholders to develop a voluntary framework – based on existing standards, guidelines, and practices – for reducing cyber risks to critical infrastructure. The first version of the Framework for Improving Critical Infrastructure Cybersecurity was released on February 12, 2014. Since then, NIST has collected user feedback and experience through Requests for Information and public workshops. NIST also facilitated working sessions on specific technical areas that have been used to enhance the

Framework. On April 16, 2018, NIST published the final Version 1.1 of the Framework for Improving Critical Infrastructure Cybersecurity (Framework). Among other refinements and enhancements, the document provides a more comprehensive treatment of identity management and additional description of how to manage supply chain cybersecurity. Additional details about Version 1.1 are available in the NIST Fact Sheet.

Privacy Engineering

The NIST Privacy Engineering Program (PEP) supports the development of trustworthy information systems by applying measurement science and system engineering principles to the creation of frameworks, risk models, guidance, tools, and standards that protect privacy and, by extension, civil liberties. In January 2017, the PEP reached a major milestone in advancing the development of privacy engineering and risk management processes with the finalization of NISTIR 8062, *An Introduction to Privacy Engineering and Risk Management in Federal Systems*. NISTIR 8062 introduces the concept of applying systems engineering practices to privacy and provides a new model for conducting privacy risk assessments on federal systems. To develop NISTIR 8062 and understand the activities and concepts required for effective privacy engineering, the PEP sought the perspectives and experiences of privacy experts across a variety of sectors in an open and transparent process, including hosting workshops, soliciting public comments, and engaging stakeholders in outreach activities in a broad range of settings.

To help organizations meet the challenge of designing, operating, and using technologies in ways that are mindful of diverse privacy needs in an increasingly connected and complex environment NIST led a public-private partnership to develop a Privacy Framework. The Framework was the result of a robust, transparent, consensus-based collaboration with private and public sector stakeholders that began in September 2018. To develop this tool, NIST released iterative drafts of the Framework and collected feedback through three (3) public workshops, a request for information, a request for comment, five (5) webinars, and many direct interactions with stakeholders. NIST published Version 1.0 of the Privacy Framework on January 16, 2020.

The NIST Privacy Framework was rolled out at a public event at the Center for Strategic and International Studies on February 19, 2020. The Privacy Framework is a voluntary tool intended to help organizations identify and manage privacy risk to build innovative products and services while protecting individuals' privacy. The Privacy Framework approach to privacy risk is to consider privacy events as potential problems individuals could experience arising from system, product, or service operations with data, whether in digital or non-digital form, through a complete lifecycle from data collection through disposal.

Artificial Intelligence (AI)

NIST has been working with the AI community to identify the technical requirements needed to cultivate trust that AI systems are accurate and reliable, safe and secure, explainable, and free from bias. This is important to build trust in AI technologies and to promote the adoption of new AI technologies.

The Plan for Federal Engagement in AI Technical Standards that NIST released in August 2019 (drafted pursuant to the EO on Maintaining American Leadership in Artificial Intelligence) is the product of significant input from other federal agencies and the public. The plan recommends that the federal government "commit to deeper, consistent, long-term engagement" in activities to help the United States speed the pace of reliable, robust, and trustworthy AI technology development. NIST received comments from more than 40 organizations in industry, academia, and government on a draft plan released July 2, 2019. The report lists existing IT standards applicable to AI, and ongoing activities regarding AI standards and related tools. The plan recommends that the federal government bolster AI standards-related knowledge, leadership, and coordination among agencies that develop or use AI; promote focused research on the trustworthiness of AI systems; support and expand public-private partnerships; and engage with international parties.

Organization for Scientific Area Committees

The Organization of Scientific Committees for Forensic Science (OSAC) is an initiative by the National Institute of Standards and Technology (NIST) and the Department of Justice (DOJ) focused on strengthening forensic science in the United States. OSAC provides technical leadership to facilitate the development and promulgation of consensus-based documentary standards and guidelines for forensic science that are fit-for-purpose and based on sound scientific principles. OSAC is uniquely qualified to undertake this mission because of the deep and varied expertise of its members. OSAC consists of more than 560 members and 260 affiliates representing key stakeholder groups, including practitioners, laboratory managers, academic researchers, metrologists, statisticians, human factors experts, accreditation and standards development experts, attorneys, and judges. This diverse group represents federal, state, and local agencies, academic institutions, and private sector entities from all 50 states and more than a dozen nations.

OSAC continues to make steady progress toward its goal of achieving technically sound, consensus-based standards and guidelines. OSAC committees are working on hundreds of discipline-specific and interdisciplinary forensic science standards projects, have posted hundreds of discipline-specific baseline documents to the OSAC website, and have recently identified 92 research and development needs.

Community Resilience Planning Guide

[NIST's Community Resilience Planning Guide for Buildings and Infrastructure Systems](#) provides a practical and flexible approach to help all communities improve their resilience by setting priorities and allocating resources to manage risks for their prevailing hazards. Using the Guide can help communities to integrate consistent resilience goals into their comprehensive, economic development, zoning, mitigation, and other local planning activities that impact buildings, public utilities, and other infrastructure systems. The Guide was released in late 2015 and is being supplemented by Guide Briefs with more information on supporting methods and best practices.

Big Data Public Working Group

Big Data is another important area in which NIST is leading public participation in standards development. Although there is broad agreement about the remarkable potential of "Big Data" to spark innovation, fuel commerce, and drive progress, the rate at which data volumes, speeds, and complexity are growing is outpacing scientific and technological advances in data analytics, management, and transport.

NIST is leading the NIST Big Data Public Working Group (NBD-PWG) to develop consensus definitions, taxonomies, reference architectures, and technology roadmaps to accelerate the deployment of robust Big Data solutions. The NBD-PWG, open to the public with active membership from industry, academia, and government, has five (5) subgroups that have developed the NIST Big Data Interoperability Framework (NBDIF). The goal is to create vendor-neutral, technology- and infrastructure-agnostic systems to enable data scientists to perform analytics processing for their given data sources without worrying about the underlying computing environment. The NBDIF has been released in three (3) versions, which correspond to the three (3) stages of the NBD-PWG work with respect to the NIST Big Data Reference Architecture (NBDRA). In Stage 1, we identified the high-level NBDRA key components (seven (7) volumes were published on September 16, 2015). In Stage 2, NIST created the general interfaces between the NBDRA components and enhanced Version 1 content (two (2) new volumes added). For Stage 3, the aim was to validate the NBDRA by building Big Data general applications through the general interfaces. The final version of the nine (9) -volume NBDIF was published in October 2019 by more than 80 contributors from more than 70 organizations.

NBD-PWG is exploring the level of interest from industry, government, and academia in extending the NBDIF for packaging scalable analytics as services to meet the challenges of so much information. These services would be reusable, deployable, and operational for Big Data, High-Performance Computing, and AI machine learning (ML) and deep learning (DL) applications, regardless of the underlying computing environment.

All NBDIF documents are available at https://bigdatawg.nist.gov/.

Education

NIST has several partnerships and programs related to science, technology, engineering, and mathematics (STEM) education and workforce and business development. NIST welcomes postdoctoral associates identified through a competitive program administered by the National Research Council as well as students participating in the Graduate Student Measurement Science and Engineering Fellowship Program, the Summer Undergraduate Research Fellowship (SURF) Program, and the Summer High School Internship Program (SHIP). Additionally, the Professional Research Experience Program (PREP) provides lab experience to undergraduate, graduate, and post-graduate students, and the NIST Summer Institute for Middle School Science Teachers provides instruction in cutting-edge research that is coordinated with a middle school curriculum.

Under the Standards Services Curricula Development Cooperative Agreement Program, recipients work with NIST to integrate instruction related to standards and standardization into undergraduate and graduate curriculums at U.S. colleges and universities. Standards provide industries and innovators with a common language that facilitates trade, simplifies transactions, and enables people to work together toward greater common goals that cut across disciplines and borders. NIST supports the development of standards by identifying areas where they are needed, convening stakeholders, and providing technical and scientific guidance and expertise to help stakeholder groups reach a consensus.

Metrics

Performance related to open government is evaluated through quarterly metrics reported to the Department of Commerce on usage of websites; "posts," "views," and "tweets" on social media; and blog posts. FOIAs that have been closed are reported. Metrics are collected for numbers of purchases of calibration services, Standard Reference Data, and Standard Reference Materials, and customer satisfaction is evaluated via surveys and customer contacts. The numbers of research papers, data, and code published by NIST staff are reported, as are the numbers of Cooperative Research and Development Agreements (CRADAs), patents, licenses, and research associates, participants, and postdocs. This information is included in NIST's annual report to OMB on technology transfer, required by 15 USC 3710(f) and available on line at https://www.nist.gov/tpo/department-commerce.

Collaborations

To meet its mission in the face of rapidly evolving priority areas and a widening stakeholder base, NIST is increasingly partnering with academic, industrial, and governmental institutions. National priorities require the united efforts of diverse participants, and NIST has the unique convening power and technical independence to bring those participants together. Each year, NIST hosts about 2,700 associates and facility users who collaborate with its scientists. NIST works with over

1,300 manufacturing specialists around the country to help small and medium-sized manufacturers improve and grow. NIST has two user facilities available for both proprietary and non-proprietary research. Access to these facilities is generally provided on a first-come, first-served cost-reimbursable basis. Through a Partnership Intermediary Agreement, NIST and the Maryland Technology Development Corporation (TEDCO) work with researchers to turn promising NIST technologies and know-how into high-tech businesses.

In addition, NIST jointly operates research organizations explicitly established to promote the kind of cross-disciplinary collaborations that accelerate research results. NIST hosts as many as 100 conferences, workshops, symposia, and other meetings annually. Many are co-sponsored with other federal agencies, academic institutions, professional societies, or industry groups.

Public Safety Communications Research

Since 2002, NIST's Public Safety Communications Research program (PSCR) has worked to drive innovation and advance public safety communication technologies through cutting-edge research and development. PSCR works directly with public safety stakeholders and extramural researchers to address public safety's urgent need to access the same broadband communications and state-of-the-art technologies that consumers on commercial networks now expect. In February 2012, the enactment of the Middle Class Tax Relief and Job Creation Act marked an unparalleled push toward next-generation technologies for public safety. The legislation contained landmark provisions for the development and build out of the Nationwide Public Safety Broadband Network (NPSBN), a dedicated, interoperable network for emergency responders. The Public Safety Trust Fund (PSTF) was established to support the design and implementation of the Network. The Act charged NIST with utilizing up to $300 million of PSTF allocations to establish an R&D program to support the development and deployment of NPSBN. PSCR established the Innovation Accelerator Program to drive R&D and transform public safety communications capabilities. PSCR relies on its collaboration with public safety practitioners, fire, police, and EMS, industry, academia, and local, state, and federal agencies to guide R&D initiatives. PSCR works to continuously engage these communities and regularly communicate R&D progress and results through outreach events, conferences, reports, and an online newsletter.

In 2013, PSCR initiated an R&D planning process to determine which technology investments were of highest priority to first responders. Over the course of three (3) days, 150 public safety stakeholders convened to discuss new technology capabilities, feasibility, uniqueness, cost of investment, cost of ownership, and impact. The result was technology roadmaps, which informed the research/technology areas PSCR would pursue; these areas became the research portfolios which comprise PSCR's division structure. To further socialize and validate the R&D Roadmaps with stakeholders, PSCR held Summits; these events and the resulting reports have informed PSCR research initiatives and provided crucial traceability back to public safety requirements and industry analysis.

National Cybersecurity Center of Excellence

NIST's National Cybersecurity Center of Excellence (NCCoE) brings together experts from industry, government, and academia to develop and effectively transfer practical cybersecurity standards, technologies, and best practices to the nation's business sectors. By accelerating dissemination and use of standards, best practices, and integrated tools and technologies for protecting information technology assets and processes, the NCCoE fosters trust in U.S. business sectors and improvements to the overall security of the economy. The NCCoE supports implementation of existing cybersecurity guidelines and frameworks, serves as a technical resource for both public and private sectors, and contributes to the development of cybersecurity practices and practitioners.

Today, the NCCoE has programs working with the health care, energy, financial services, manufacturing, public safety, transportation, and retail sectors. In addition, the center is addressing challenges that cut across sectors, including mobile device security, software asset management, cloud security, identity management, internet of things, data integrity, and secure email.

National Initiative for Cybersecurity Education

Employers are struggling to find workers who have cybersecurity-related skills. The National Initiative for Cybersecurity Education (NICE) is a partnership between government, academia, and the private sector focused on cybersecurity education, training, and workforce development.

On November 13, 2017, the First Annual National Cybersecurity Career Awareness Week began with a kick-off event at the National Cybersecurity Center of Excellence. The event featured experts who spoke about how the cybersecurity community can effectively reach and encourage more students to consider a future career in cybersecurity, how career development strategies can be utilized for college graduates seeking to land their first cybersecurity positions, and how current workers can transition into this exciting field. The National Cybersecurity Career Awareness Week Cybersecurity Challenge was also launched to ignite interest in cybersecurity careers by enabling participants to test drive cybersecurity careers with a free online cybersecurity career exploration platform.

NICE, Burning Glass Technologies, and the Computing Technology Industry Association have developed an interactive map, CyberSeek. Cybersecurity talent gaps exist across the country. Closing these gaps requires detailed knowledge of the cybersecurity workforce in each region. CyberSeek is an interactive heat map that provides a snapshot of supply and demand data for cybersecurity jobs at the state and metropolitan area levels, and career pathways for cybersecurity positions. CyberSeek can be used by students, educators, career counselors, and employers looking to identify or develop skills needed in cybersecurity careers.

Centers of Excellence

NIST has also created Centers of Excellence to provide an interdisciplinary environment where researchers from NIST, academia, and industry collaborate on emerging areas of basic and applied research and innovations in measurement science. The first of these centers, the Center for Hierarchical Materials Design (CHiMaD), was established in 2013 to accelerate materials discovery and development; provide opportunities to transition new breakthroughs in advanced materials to industry; convene multidisciplinary and multi-sector communities for in-depth discussions; and provide training opportunities for scientists and engineers in materials metrology.

Two Centers of Excellence were established in 2015 after selection through a merit-based competition. The Center for Risk-Based Community Resilience Planning focuses on tools to support community disaster resilience. The center works on developing integrated, systems-based computational models to assess community infrastructure resilience and guide community-level resilience investment decisions. The center also provides a scientific basis for developing resilience metrics and decision-making tools and for evaluating cascading effects that arise in interconnected physical and social infrastructures.

The Center for Statistics and Applications in Forensic Evidence was announced in May of 2015. This center supports NIST's efforts to advance the utility of probabilistic methods to enhance forensic analysis. Working with NIST researchers and partners from four (4) universities led by Iowa State University, the Forensic Science Center of Excellence evaluates and solidifies the statistical foundation for fingerprint, firearm, toolmark, and other pattern evidence analyses, and for multimedia evidence analyses. The center also develops and implements an education and training program to ensure that judges, lawyers, and forensic science investigators can effectively decipher the results of statistical analysis on pattern and digital evidence.

Materials Genome Initiative

The Materials Genome Initiative (MGI) is a multi-agency initiative designed to create new policy, resources, and infrastructure to support U.S. institutions in the effort to discover, manufacture, and deploy advanced materials twice as fast, at a fraction of the cost. It can take 20 or more years to move a material after initial discovery to market because the discovery and optimization of new materials for innovative products is a time-consuming and laborious process, but computational design of materials has emerged as a powerful new tool for materials discovery and optimization. Major efforts in both theory and experiment are needed to provide the data that underlies successful modeling. Given its expertise in the integration, curation, and provisioning of critically evaluated data and models, NIST has assumed a leadership role within the MGI, establishing essential data exchange protocols and the means

to ensure the quality of materials data and models. These efforts will yield the new methods, metrologies, and capabilities necessary for accelerated materials development.

Quantum Economic Development Consortium (QED-C)

The Quantum Economic Development Consortium (QED-C) aims to expand U.S. leadership in global quantum research and development and the emerging quantum industry in computing, communications, and sensing. Quantum technologies take advantage of the unusual rules that govern the behavior of the fundamental building blocks of matter, including electrons, protons, neutrons, and photons. With funding from both the government and private-sector member organizations, the QED-C will determine workforce needs essential to the development of quantum technologies; provide efficient public-private sector coordination; identify technology solutions for filling gaps in research or infrastructure; highlight use cases and grand challenges to accelerate development efforts; and foster sharing of intellectual property, efficient supply chains, technology forecasting, and quantum literacy.

Partnership Facilities

In addition to the Centers of Excellence above, NIST collaborates in partnership facilities with academic institutions and other federal agencies.

Brookhaven National Laboratory

Brookhaven National Laboratory is a multipurpose research institution located on Long Island, New York. In partnership with Brookhaven, NIST develops and disseminates synchrotron measurement science and technology needed by U.S. industry to measure nanoscale electronic, chemical, and spatial structure of advanced materials.

Hollings Marine Laboratory

The Hollings Marine Laboratory (HML) is a joint research facility among NOAA's National Ocean Service, the South Carolina Department of Natural Resources, the College of Charleston, the Medical University of South Carolina, and NIST, with a mission to provide science and biotechnology applications to sustain, protect, and restore coastal ecosystems, with emphasis on links between environmental conditions and the health of marine organisms and humans.

Institute for Bioscience and Biotechnology Research

The Institute for Bioscience and Biotechnology Research (IBBR) exists to foster integrated, cross-disciplinary team approaches to scientific discovery, translational development and education, and to create commercialization relationships and initiatives that serve the

expanding economic base of biosciences and technology in the state of Maryland and across the country.

Joint Center for Quantum Information and Computer Science

The Quantum Information and Computer Science (QuICS) is a partnership between the University of Maryland and NIST to advance research and education in quantum computer science and quantum information theory.

Joint Initiative for Metrology in Biology

The Joint Initiative for Metrology in Biology (JIMB) was established in 2014 as a joint initiative between Stanford and NIST, providing standards-based research and innovation in biometrology. JIMB is now operated by SLAC National Accelerator Laboratory in partnership with NIST. JIMB's mission is to motivate standards-based measurement innovation to facilitate translation of basic science and technology development breakthroughs in genomics and synthetic biology

Joint Institute for Laboratory Astrophysics

The Joint Institute for Laboratory Astrophysics (JILA) is a joint physics institute of the University of Colorado at Boulder and NIST. (The institute was previously known as the Joint Institute for Laboratory Astrophysics, but its current research now spans a wide range of physics topic areas).

Joint Quantum Institute

The Joint Quantum Institute (JQI) is a joint institute of the University of Maryland, NIST, and the Laboratory for Physical Sciences.

National Advanced Spectrum and Communications Test Network

The National Advanced Spectrum and Communications Test Network (NASTCN) is a partnership amongst NTIA NOAA, the National Science Foundation (NSF), the National Aeronautics and Space Administration (NASA) and the Department of Defense, and is organizing a national network of federal, academic, and commercial test facilities that will provide the testing, modeling, and analyses needed to develop and deploy spectrum-sharing facilities.

Advanced Manufacturing National Program Office

NIST provides leadership and coordination across federal agencies with programs in advanced manufacturing – including the Departments of Agriculture, Defense, Commerce, Education, Energy, Health and Human Services, and Labor, NASA, and NSF – by leading the interagency

Advanced Manufacturing National Program Office (AMNPO). The AMNPO oversees the planning, management, and coordination of Manufacturing USA®, which brings together public and private investments to improve the competitiveness and productivity of U.S. manufacturing through a robust network of manufacturing innovation institutes. Each of the 14 Manufacturing USA institutes is a public-private partnership focusing on a specific, promising advanced manufacturing technology area.

The institutes advance domestic manufacturing innovation by creating the infrastructure needed to allow domestic industry and academia to work together to solve industry-relevant manufacturing problems in research and development, technology transition, workforce training, and education. Manufacturing USA has garnered significant attention in the manufacturing sector; two-thirds of the 1900 member organizations are manufacturers and 70% of those are small and medium sized enterprises. Members also include Fortune 50 U.S. manufacturers and top-ranked research and engineering universities.

The AMNPO provides information to the public about Manufacturing USA through a variety of means – especially through the website, www.ManufacturingUSA.com. The website includes news about the institutes, media exposure, announcements of upcoming events, information about program funding opportunities, videos, an archive of reports and policy papers, and guidance about how to engage with the institutes. The AMNPO also releases an annual report on the program's performance and a triennial strategic plan. The AMNPO maintains Twitter and LinkedIn accounts to communicate advanced manufacturing news and successes about Manufacturing USA to the public. Additionally, the AMNPO maintains the Manufacturing.gov website, which contains links to information about U.S. government programs that support advanced manufacturing.

NIST Technology Transfer

NIST regularly works with multiple other organizations through Cooperative Research and Development Agreements. These agreements allow NIST to work directly with other parties through a public-private partnership to achieve specific scientific outcomes. In addition, NIST patents and licenses new technologies developed in our laboratories. NIST regularly organizes technology showcase events to bring together innovative technologies, licensable inventions, research and engineering facilities, small business support resources at the federal and state levels, and sources of funding, all under one (1) roof. NIST also hosts "listening sessions" to hear from local communities about how federal labs can contribute to economic development. Information on NIST technologies available for licensing is on data.gov in a machine-readable format for other parties to use.

NIST regularly conducts economic assessments on the results of our research programs. NIST economic reports and assessments are available on the NIST website at https://www.nist.gov/tpo/reports-and-publications. Technology Transfer partnership activities

across Commerce are described in an annual report. A selection of NIST activities with impacts in industry is provided at https://www.nist.gov/industry-impacts.

Interagency Technology Transfer

NIST has an interagency leadership role in technology transfer as delegated by the Secretary of Commerce. NIST has worked with other agencies to place information on all federal laboratory technologies available for licensing and information on available research facilities and equipment on data.gov in a machine-readable format for other parties to use.

As part of NIST's leadership role, a Return on Investment (ROI) Initiative was begun in FY18 and concluded with the publication of a NIST Green Paper in FY19. Working collaboratively with other agencies, NIST received and analyzed information from the private sector, universities, and other partners to identify critically needed improvements to federal technology transfer efforts. Some findings are now in the process of being implemented through the National Science and Technology Council's Lab-to-Market subcommittee, and milestones are reported publicly through performance.gov. Our goal is to streamline and accelerate the transfer of technology from federal laboratories to promote U.S. economic growth and national security through innovative products and services, and new businesses and industries.

Small Business Innovation Research

Small Business Innovation Research (SBIR) is a highly competitive federal grant program that opens opportunities and encourages U.S. owned and controlled small- and mid-sized businesses to engage in Research and Development (R&D) with commercialization potential.

Manufacturing Extension Partnership (MEP)

The MEP Program is a unique, public-private partnership that delivers comprehensive, proven solutions to U.S. manufacturers, fueling growth and advancing U.S. manufacturing. The MEP Centers in all 50 states and Puerto Rico, which are part of the MEP National Network™, work with U.S. manufacturers to develop new products and adopt new technologies. MEP National Network services can track with the maturity of a technology as well as help strengthen the business side of a company and can play a pivotal role in helping manufacturers move from concept to market through services in areas such as product design, manufacturing engineering, product concept testing, quality control/management, supplier scouting, and certification. The MEP Program serves as a bridge to other organizations and federal research labs that share a passion for enhancing the manufacturing community. From MEP's inception through FY 2018, the MEP Program has worked with 102,443 manufacturers, leading to $127.3 billion in sales and $20.5 billion in cost savings, and it has helped create and retain more than

1,107,346 jobs. Note: MEP has been proposed for elimination in the FY 2021 President's Budget.

NIST Open Government Initiatives

The table below shows a list of initiatives for *NIST.*

Table 10 - NIST Initiatives

Operating Unit	Project	Status	Estimated Completion
NIST	Modernization of Standard Reference Data	Ongoing/Continuous	
	Return on Investment (ROI) Initiative	Completed	
	Improve Website Information Related to Public Access	Completed	
	Make Directives of Public Interest Available on NIST's Website	In Progress	September 2020
	TREC-COVID Challenge	In Progress	TBD
	Develop a Portal for NIST-Developed Code	In Progress	May 2021
	Develop a Research Data Management Framework (RDaF)	In Progress	June 2022

Project – Modernization of Standard Reference Data (SRD) – Ongoing/Continuous

For more than 50 years, NIST has been making standard reference databases available for a broad range of chemical and physical properties for use in many scientific disciplines including biology, chemistry, engineering, forensics, materials science, and physics. Customer expectations for a "useable" data product have changed as technology has evolved. Most of the 100 databases are currently available as searchable tables. NIST is modernizing the look and feel of these databases and incorporating APIs to make the databases easier to use and to allow access to the data through code rather than requiring users to perform multiple manual searches. To date, ten of the SRDs have been revamped with improved user interfaces. NIST also undertook an internal review of the entire SRD portfolio and reclassified and reorganized the collection to make clear which datasets fully satisfied the SRD criteria.

Project – Return on Investment (ROI) Initiative – Completed

Following a Request for Information (RFI) published in the Federal Register and three (3) public forums, a white paper was published that summarizes public comments and

recommendations. This publication is available free of charge from https://doi.org/10.6028/NIST.SP.1234.

Project – Improve Website Information Related to Public Access – Completed

A webpage at https://www.nist.gov/open directs visitors to content that was initially prescribed by OSTP, including NIST's plans for providing public access to results of our research. In addition, it provides information about how to access NIST papers, data, and software, performance metrics, licensing and fair use information, and guidance for external recipients of NIST funds.

Project – Make Directives of Public Interest Available on NIST's Website – In Progress

Currently, only the NIST policy and order for providing public access to results of federally funded research are publicly available, with the understanding that any directive that may be of public interest must be disclosed under the Freedom of Information Act. NIST continues to make progress migrating the existing Administrative Manual subchapters to a directives system as evidenced by a reduction of 39% since 2018. As work progresses with migration, we will make directives available to the public as appropriate.

Project – TREC-COVID Challenge – In Progress

Researchers, clinicians, and policy makers involved with the response to COVID-19 are constantly searching for reliable information on the virus and its impact. This presents a unique opportunity for the information retrieval (IR) and text processing communities to contribute to the response to this pandemic, as well as to study methods for quickly standing up information systems for similar future events. The results of the TREC-COVID Challenge will identify answers for some of today's questions while building infrastructure to improve tomorrow's search systems.

TREC-COVID will follow the TREC model for building IR test collections through community evaluations of search systems. The document set to be used in the challenge is the COVID-19 Open Research Dataset (CORD-19). This is a collection of biomedical literature articles that will be updated weekly. Accordingly, TREC-COVID will consist of a series of rounds, with each round using a later version of the document set and a larger set of COVID-related topics. Participants in a round will create ranked lists of documents for each topic ("runs") and submit their runs to NIST. Based on the collective set of participants' runs, NIST will create small sets of documents to be assessed for relevance by human annotators with biomedical expertise. The results of the human annotation, known as relevance judgments, will then be used to score the submitted runs. After all rounds are complete, the final document and topic sets together with the cumulative relevance judgments will comprise

a COVID test collection. The incremental nature of the collection will support research on search systems for dynamic environments.

Project – Develop a Portal for NIST-Developed Code – In Progress

The Federal Source Code Policy is designed to support reuse and public access to custom-developed Federal source code. It requires that source code developed by or for the Federal government be made available for sharing and re-use. Most of the code produced by NIST is intended for research purposes, and is available via GitHub and in other locations. Using repurposed open source code from the Lawrence Livermore National Laboratory, NIST is currently working to implement the code.nist.gov web portal as a companion site to our data portal, https://data.nist.gov. The code portal will export a code.json file for use by code.gov and allow users to locate and access NIST's code products.

Project – Develop a Research Data Management Framework (RDaF) – In Progress

NIST is working with stakeholders to develop a structured approach to data management, modeled on the process used to develop NIST's Cybersecurity Framework, to enable organizations to optimize use of their data assets. After a thorough review of current guidance, NIST will develop a common language and a basis for coordination across that landscape, developing a framework that describes who needs to do what, why, and when in order to make their data useful and maximize its value.