NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY

NATIONAL TECHNICAL INFORMATION SERVICE

FISCAL YEAR 2014

BUDGET SUBMISSION TO CONGRESS

Exhibit 1

Department of Commerce
National Institute of Standards and Technology
BUDGET ESTIMATES, FISCAL YEAR 2014
CONGRESSIONAL SUBMISSION

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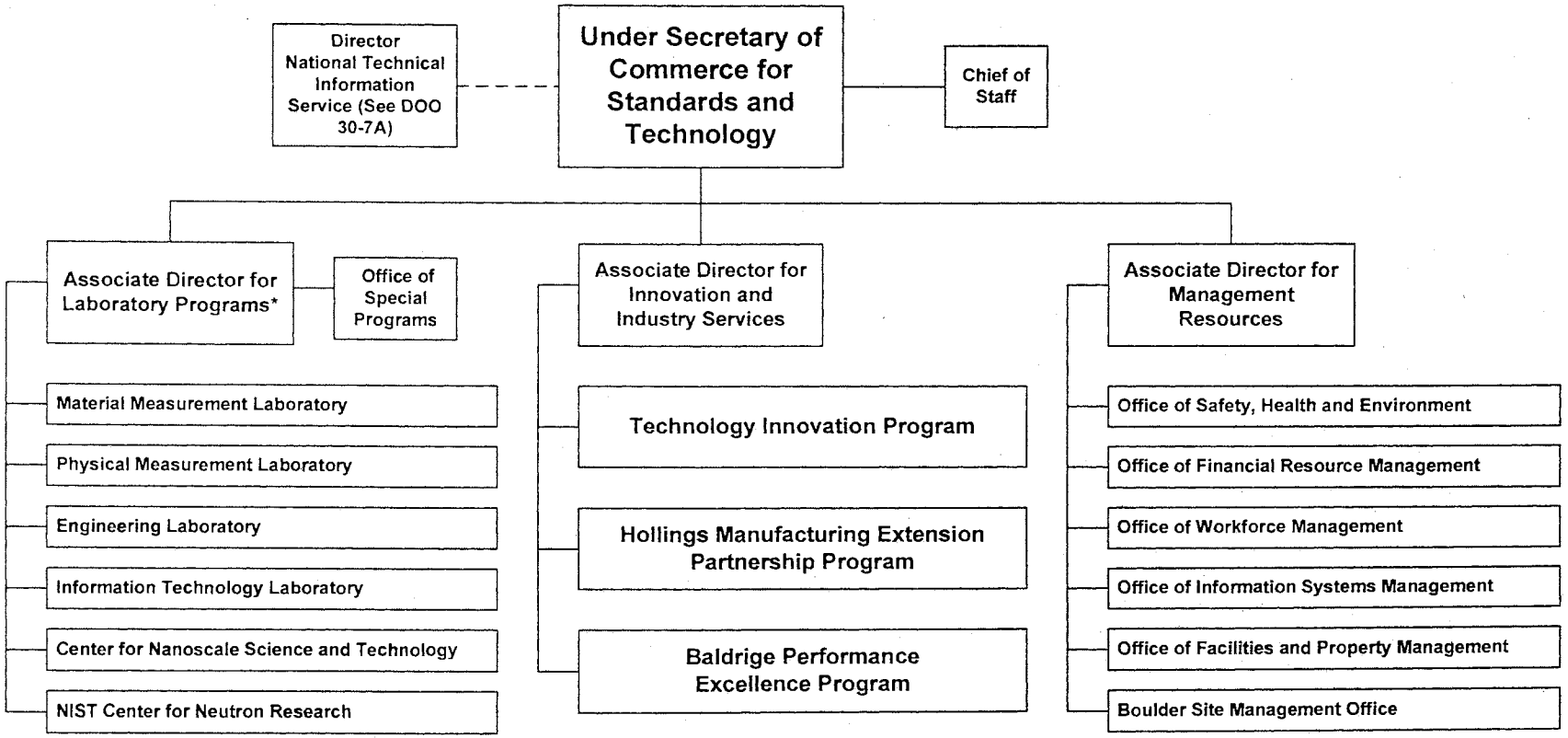
National Institute of Standards
and Technology

Exhibit 2

U.S. DEPARTMENT OF COMMERCE
National Institute of Standards and Technology



*The Associate Director for Laboratory Programs serves as the Principal Deputy for NIST.

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EXECUTIVE SUMMARY

For FY 2014, NIST is submitting a total discretionary request level of $928.3 million. Within this total discretionary request level, Scientific and Technical Research and Services (STRS) appropriation is $693.7 million, Industrial Technology Services (ITS) is $174.5 million, and Construction of Research Facilities (CRF) is $60.0 million. In addition, the budget includes a request of $1.0 billion in mandatory appropriations for a National Network for Manufacturing Innovation (NNMI) initiative as part of the Administration's efforts to strengthen and revitalize the U.S. manufacturing sector.

The increased resources requested would enable NIST to expand and strengthen programs to more effectively address a number of scientific and technological issues of high-priority to the U.S., and that are critical for U.S. economic competitiveness and innovative capacity. Additional information on the budget request, by appropriation, is provided below.

The mission of the National Institute of Standards and Technology (NIST) 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. For more than 110 years, NIST has maintained the national standards of measurement, a role that the U.S. Constitution assigns to the Federal Government to ensure fairness in the marketplace. Today, the NIST Laboratories, funded by the STRS and CRF appropriations, address increasingly complex measurement challenges. For example, NIST develops measurements focusing on the very small (e.g., nanotechnology devices) and the very large (e.g., skyscrapers), the physical (e.g., methods for characterizing strands of DNA for forensic testing) and the virtual (e.g., methodologies and best practices for securing cyberspace). NIST promotes the use of measurements based on the international system of units (SI). The measurement science research at NIST is useful to all science and engineering disciplines.

NIST's portfolio also includes the Hollings Manufacturing Extension Partnership (MEP), funded by the ITS appropriation. MEP is a Federal-state-industry partnership that provides U.S. manufacturers with access to technologies, resources, and industry experts. The MEP program consists of Manufacturing Extension Partnership Centers located across the country that work directly with their local manufacturing communities to strengthen the competitiveness of our Nation's domestic manufacturing base. Funding for the MEP Centers is a cost-sharing arrangement consisting of support from the Federal government, state and local government/entities, and fees charged to the manufacturing clients for services provided by the MEP Centers. The ITS appropriation includes a request to fund an Advanced Manufacturing Technology Consortia (AMTech) initiative.

DISCRETIONARY APPROPRIATIONS

Scientific and Technical Research and Service (STRS) Appropriation

The objectives of the STRS programs are to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology that drive technological change. NIST resources are devoted to meeting today's economic and societal challenges and to laying the foundation for future success. NIST activities help address a broad range of critical science and innovation challenges for the Nation. NIST's Laboratories funded by STRS play a unique role in the Nation's scientific, industrial, and business communities. NIST anchors the national measurement and standards system that is the language of research and commerce. NIST's

presence and leadership in the Nation's measurement and standards system enables companies, researchers, government agencies, and universities to work with each other more easily, improving the Nation's economic security and quality of life. NIST also supports enacted legislation such as the America COMPETES Act, which outlines major roles for NIST in promoting national competitiveness and innovation, and the National Technology Transfer Advancement Act (NTTAA), which designates NIST as the coordinator for all Federal agencies using documentary standards.

The 2014 President's Budget recognizes the important role of NIST programs to advancing innovation by requesting $693.7 million for the Scientific and Technical Research and Services (STRS) appropriation which includes increases totaling $122.6 million. Within the $693.7 million request, current Administration priority areas targeted for budget increases include Advanced Manufacturing, Cybersecurity, Healthcare IT, Disaster Resilience, Forensics, Advanced Communications, and NIST Centers of Excellence in measurement science and new technology areas.

Brief summaries of NIST's FY 2014 STRS initiatives and other program changes are provided below.

1. +$50.0 million for Advanced Manufacturing.

Manufacturing plays a central role in realizing the benefits of technological innovation and in the overall growth and health of the U.S. economy. The ability to rapidly introduce product innovations will provide a foundation for future U.S. manufacturing market growth, competitiveness, and creation and retention of high skill, well-paying jobs. With its FY 2014 budget request, NIST is expanding its laboratory efforts in the following areas critical to advanced manufacturing:

Developing the measurement science and data infrastructure for the manufacture of emerging materials – Much of advanced manufacturing depends upon the ability to make at scale or integrate the use of new materials into existing manufacturing processes. To support this need NIST will continue to invest in strengthening its efforts to develop the standards and data needed to support advanced materials modeling and design. These efforts are central to NIST's role in the Material's Genome Initiative.

Supporting the manufacture of emerging technologies – There is enormous potential for U.S. leadership in the manufacture of products in emerging technology areas, which have grown out of the U.S. investment in the biosciences and Nanotechnology. NIST will provide the measurement science, data, and tools that are needed for efficient manufacturing in these areas. NIST programs in nanomanufacturing will ensure that materials can be produced at scale and at viable cost. NIST research in biomanufacturing will help create new manufacturing paradigms that use cells as factories for fuels, pharmaceuticals and specialty chemicals.

Precision measurements for manufacturers – Precise manufacturing metrology enables high-quality, high-throughput production, increasing the competitiveness of U.S. manufacturers. Current methods for calibrating machinery and assessing quality can introduce cost and time delays to manufacturing processes. Through increased investment in miniaturization techniques and quantum-based measurement capabilities, NIST will be able to deliver self-calibrating measurement science technology that can be directly integrated into instruments and processes on the manufacturing floor, and thus, eliminate the need for costly calibrations.

Enabling the integration and use of smart manufacturing technologies – The next generation of smart manufacturing processes and equipment such as automation, distributed sensing, and advanced control systems need to be optimized to enable cost-effective and agile manufacturing of high-tech products and systems. NIST will continue to strengthen its efforts focused on standards for the closer integration of robotics and humans in the manufacturing environment, and in the development of a testbed to evaluate the performance of automated in-process quality monitoring and control systems which are critical to the efficient operation of modern factories.

2. +$15.0 million for Cybersecurity R&D and Standards.

Protecting the Nation's cyber infrastructure is a top priority of the Administration. This initiative will enable NIST to strengthen its core cybersecurity R&D programs that are the critical foundation upon which NIST's ability to effectively engage in cybersecurity standards development are built. R&D supported by this effort will specifically target challenges facing the delivery of security for Federal mobile environments, as well as the development of better methods for measuring and managing the security status of systems -- from mobile devices, to networks, to cloud systems. The increased funding will also enable NIST to increase the number of cybersecurity challenges addressed by the National Cybersecurity Center of Excellence, which will help accelerate the delivery of implementable cybersecurity solutions to industry. Finally, the increased funding will provide additional support for NIST efforts under the February 12, 2013 Executive Order "*Improving Critical Infrastructure Cybersecurity,*" under which NIST will establish a framework of voluntary guidelines for improving the cybersecurity of the Nation's critical infrastructure, such as power plants, financial operations, transportation and communications.

3. +$10.0 million for Advanced Communications.

Rapid advances in communications technology have fundamentally changed the way we work and live. With these advances have come significant challenges that if not addressed will significantly impact our Nation's ability to reap the benefits while ensuring that our national security needs are met. Examples of these challenges include: the exponential growth of wireless data usage – scarce spectrum must be more efficiently used to meet the demand; the evolution of broadband access in the home – this has moved from a luxury to a necessity with increasing needs for ever-higher bandwidth; and, the vulnerability of all internet capable devices to various security threats. To address these challenges, the budget request includes funds for research, testing, and evaluation in the areas of spectrum sharing, testing, standards coordination, public safety communications, electromagnetics and quantum electronics, among others. By taking advantage of and leveraging the critical mass of NIST and NTIA research and engineering capabilities concentrated in Boulder, Colorado the Department of Commerce will create a unique national asset that will provide the infrastructure necessary for effective engagement and collaboration with industry and government partners that is required to effectively and efficiently address current and future communications challenges. NIST's efforts in this area will:

- Promote interdisciplinary research, development, and testing in advanced communication related areas such as Radio Frequency (RF) technology, digital information processing, cybersecurity, interoperability, and usability.

- Provide a single focal point for engaging both industry and other government agencies on advanced communication technologies, including testing, validation, and conformity assessment.

4. +$10.0 million for Cyber-Physical Systems.

The convergence of networking and information technology with manufactured products, engineered systems of products, and associated services are enabling a new generation of "smart" or cyber-physical systems (CPS). These CPS are critical components and key value added features of items that consumers use every day from cars and telecommunications to buildings and medical devices. As CPS have grown exponentially in complexity, dramatic improvements in the systems engineering, integration and testing are needed. This initiative will enable NIST to develop the measurement tools and standards to address three key problem areas that cut across all CPS: model-based diagnostics and prognostics needed to manage and optimize the performance of CPS (like electric grids, and transportation networks); time synchronization, which is critical to the efficient operation of systems; and, secure operation in order to ensure that widely deployed CPS systems have appropriate risk-based security solutions.

5. +$20.0 million for NIST Centers of Excellence.

The request will be used to provide grants for establishing four, competitively selected Centers of Excellence in measurement science areas defined by NIST. These grants to multi-university and/or single university Centers will be awarded for 5-7 year periods, after which the grants would be re-competed. Each Center of Excellence will provide an interdisciplinary environment in which NIST, academia and industry would collaborate in pursuing basic and applied research focused on innovations in measurement science and new technology development focused on critical emerging technology areas.

6. +$3.0 million Health Information Technology (Health IT).

NIST will work in coordination with the Department of Health and Human Services Office of the National Coordinator for Health Information Technology (HHS/ONC) to develop the interoperability standards and the supporting testing and validation infrastructure to support the meaningful use of electronic health records.

7. +$5.0 million for Forensic Science.

There is a critical need to strengthen the utility and reliability of forensic science in the U.S. justice system. The National Academies in their 2009 report highlighted the need for improved measurement and validation processes, clearly defined standards, and the dissemination of best practices to strengthen the precision and reliability of forensic analyses. With the requested funds, NIST will support the forensic science community through: the research and development of traceable standard materials, reference data, and calibration systems; working with the forensics science community to facilitate standards development; and providing measurement science research and training opportunities for forensic science practitioners.

8. +$5.0 million for Disaster Resilience.

U.S. communities can and do suffer catastrophic loss, due to extreme events such as hurricanes, tornadoes, wildfires, earthquakes, and flooding. Critically needed metrics, tools, and standards to ensure community-level resilience will enable communities to recover more rapidly from these disasters with minimal loss of life, minimal damage to buildings and infrastructure lifelines, and minimal business disruption. Through an integrated multi-year, public-private partnership program strategy, this funding will enable NIST to accelerate research, development, adoption, and implementation of critical science-based metrics, tools, standards, and other innovations essential to achieve national infrastructure resilience. The Federal government, through NIST leadership, will play a critical convener role by bringing together the highly diverse stakeholder interests across all hazards in developing and adopting a national resilience framework and associated model resilience standards and policies.

9. +$8.0 million for the National Strategy for Trusted Identities in Cyberspace (NSTIC).

The request continues to support the Administration's National Strategy for Trusted Identities in Cyberspace that is in direct response to the recommendations of the *White House Cyberspace Policy Review*. The Administration through the National Strategy for Trusted Identities in Cyberspace (NSTIC) has called for raising the level of trust associated with the identities of individuals, organizations, services, and devices involved in online transactions. NIST received $16.5 million in FY 2012 enacted appropriations for the NSTIC initiative and the requested increase funds additional grants to ramp up efforts begun in FY 2012.

10. +1.0 million for the National Initiative for Cybersecurity Education (NICE).

The request supports work under the National Initiative for Cybersecurity Education (NICE). Cybersecurity is much more than technological solutions to technical problems; it is also highly dependent on educated users who are aware of and routinely employ sound practices when dealing with cyberspace. NIST will work with Federal, State, local, and regional governments to improve cybersecurity education. In collaboration with other agencies, NIST will support the implementation of the cybersecurity education framework that addresses: national cybersecurity awareness; formal cybersecurity education; Federal cybersecurity workforce structure; and cybersecurity workforce training and professional development.

11. -$0.3 million for STEM Education-Summer Institute for Middle School Science Teachers Decrease.

As part of the Administration's comprehensive reorganization of Science, Technology, Engineering and Mathematics (STEM) education programs to increase the impact of Federal investments, funding for the NIST Summer Institute for Middle School Science Teachers will be redirected to implement a Department of Education initiative to improve K-12 STEM instruction.

12. -$4.1 million for Reduction to NIST's STRS extramural grants.

NIST's budget includes a proposed decrease to extramural grants for redirection to higher priority activities within the STRS appropriation.

Construction and Research Facilities (CRF) Appropriation

This appropriation supports the construction of new facilities and the renovation and maintenance of NIST's current buildings and laboratories to comply with scientific and engineering requirements and to keep pace with Federal, State, and local health and safety regulations. The budget request for CRF is $60.0 million.

1. +$4.2 million for Safety, Capacity, Maintenance, and Major Repair (SCMMR) and Construction and Major Renovations.

NIST requests an increase of $4.230 million to expedite the maintenance and repair of facilities and reduce the impact of facility deficiencies on laboratory projects. The increased funding will allow NIST to reduce the backlog of renovation projects across NIST facilities, as well as, continue work on Building 1 renovation, wing 5.

Industrial Technology Services (ITS) Appropriation

For the ITS appropriation, NIST requests a total of $174.5 million, which includes increases totaling $46.4 million. The ITS appropriation consists of two extramural programs in FY 2014, the Hollings Manufacturing Extension Partnership (MEP) and a proposed Advanced Manufacturing Technology Consortia (AMTech).

Hollings Manufacturing Extension Partnership (MEP)

The request includes $153.1 million for MEP. The budget request for MEP includes newly requested funding of $25.0 million for MEP Manufacturing Technology Acceleration Centers (M-TAC). MEP is a Federal-State-industry partnership that provides U.S. manufacturers with access to technologies, resources, and industry experts. The program consists of 60 MEP Centers that work directly with their local manufacturing communities to strengthen the competitiveness of our Nation's domestic manufacturing base.

1. +$25.0 million for MEP Manufacturing Technology Acceleration Centers.

U.S. small manufacturers are a critical segment of our economy, comprising 90 percent of all manufacturing establishments and 45 percent of employment. U.S. small and mid-sized manufacturers play a growing role in technology innovation, including product development and process improvement. This trend has been supported by the expanded portfolio of services for small and mid-sized manufacturers offered by NIST's Hollings Manufacturing Extension Partnership (MEP) through MEP's *Next Generation Strategies*. These strategies include specialized programs to promote technology acceleration, supply chain reinforcement, sustainability, continuous improvement and workforce development.

A critical component of the Administration's goal of enhancing U.S. competitiveness in advanced manufacturing is support for highly effective supply chains in technology intensive manufacturing sectors. To advance this objective NIST plans to establish through the MEP program M-TAC's teams of experts in specific technology/industrial sectors, offering specialized services to groups of firms. M-TACs will deploy content and services through the well-established national network of local centers, utilizing "tiger teams" and direct consulting for centers and manufacturers. M-TACs would serve as national centers of expertise aligned with

industry specific associations, trade groups, and OEMs to identify key barriers to supply chain development and draw upon their resources to develop new approaches and establish/reinforce supply chain networks.

The M-TACs will provide technology acceleration support to U.S. small and mid-sized manufacturers through a program that is nationally connected and locally deployed, enhancing the ability of supply chains to adopt advanced technologies into their manufacturing processes and products.

Advanced Manufacturing Technology Consortia (AMTech)

2. +$21.4 million for AMTech.

The request includes $21.4 million for the Advanced Manufacturing Technology Consortia (AMTech). AMTech will provide grants to leverage existing consortia or establish new industry-led consortia to develop road-maps of critical long-term industrial research needs as well as fund research at leading universities and government laboratories directed at meeting these needs. This program would be based on NIST's experience with the Nanoelectronics Research Initiative (NRI) partnership and would expand and improve on that model.

MANDATORY APPROPRIATIONS

National Network for Manufacturing Innovation (NNMI)

1. +$1.0 billion for the NNMI.

As part of the Administration's efforts to revitalize U.S. manufacturing, the Budget proposes a one-time $1 billion investment to launch a network of up to 15 manufacturing innovation institutes across the country. Each institute would bring together companies, university and community colleges, and government to co-invest in the development of cutting-edge manufacturing technologies and capabilities that U.S. manufacturers can apply in production. The NNMI will fill a gap in the innovation infrastructure, allowing new manufacturing processes and technologies to progress more smoothly from basic research to implementation in manufacturing. A network leadership council will disseminate best practices and facilitate collaboration among the institutes. Program coordination will be led by the NIST-hosted, inter-agency Advanced Manufacturing National Program Office.

Resources

The following is a comparison of NIST's FY 2014 request level with the FY 2013 CR (annualized) level.

(Dollar amounts in millions)						
Appropriation	**FY 2013 CR (annualized)**		**FY 2014 Request**		**Change from FY 2013 CR (annualized)**	
	FTE	**Amount**	**FTE**	**Amount**	**FTE**	**Amount**
Scientific and Technical Research and Services	2,202	570.5	2,362	693.8	160	123.3
Industrial Technology Services	94	129.2	94	174.5	0	45.3
Construction of Research Facilities	89	55.7	89	60.0	0	4.3
Working Capital Fund	756	0	756	0	0	0
TOTAL DISCRETIONARY	**3,141**	**755.4**	**3,301**	**928.3**	**160**	**172.9**
MANDATORY						
NNMI	**0**	**0**	**19**	**1,000.0**	**19**	**1,000.0**
TOTAL RESOURCES	**3,141**	**755.4**	**3,320**	**1,928.3**	**179**	**1,172.9**

Reimbursable Program

NIST's reimbursable services consist of technical work performed for other Federal agencies, state and local governments, and the private sector. These services include calibrations and special tests, advisory services, and the sale of Standard Reference Materials. The unique measurements and standards expertise developed with appropriated funding gives NIST the capability to perform these services on a reimbursable basis. NIST accepts other agency work based on an established set of criteria which include: the need for traceability of measurements to national standards; the need for work that cannot or will not be addressed by the private sector; work supported by legislation that authorizes or mandates certain services; work that would result in an unavoidable conflict of interest if carried out by the private sector or regulatory agencies; and requests by the private sector for NIST action or services. NIST's reimbursable program is estimated to be $170.3 million in FY 2013 and $150.0 million in FY 2014.

FY 2014 Annual Performance Plan

National Institute of Standards and Technology (NIST)/
National Technical Information Service (NTIS)

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FY 2014 Annual Performance Plan

National Institute of Standards and Technology (NIST)

NIST Information

NIST Mission:

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.

NIST Vision:

NIST will be the world's leader in creating critical measurement solutions and promoting equitable standards. Our efforts stimulate innovation, foster industrial competitiveness, and improve the quality of life.

NIST Scope and Responsibilities:

NIST addresses critical national needs and emerging challenges in a wide variety of industry sectors, including energy, cybersecurity, manufacturing, healthcare, cyberphysical systems, biotechnology, and nanotechnology. NIST serves stakeholders in industry, academia, non-profit and industry organizations, and other government agencies, by providing:

- Scientific foundation for basic and derived measurement units in the national and international standards community, and maintenance of the national standards of measurement;
- Basic and applied research to enable development of test methods and verified data to support commercialization and exchange of goods and services in industry and commerce;
- Measurement science tools to support technology development (including advanced materials, nano- and bio-materials, sensors, quality control processes, robotics, and other enabling technologies);
- Standard reference materials, standard reference data, and calibration services;
- User facilities that support innovation in materials science, nanotechnology discovery and fabrication, and other emerging technology areas through the NIST Center for Neutron Research and the Center for Nanoscale Science and Technology; and
- Technical and business assistance to smaller manufacturers in every state and Puerto Rico, through the Manufacturing Extension Partnership (MEP).

NIST's technical work is carried out at its two main research campuses in Gaithersburg, Md., and in Boulder, Colo. At these campuses, NIST hosts about 2,600 associates and facility users from academia, industry, and other government agencies. NIST also

participates in four external institutes in basic physics, quantum physics, biology/biotechnology, and marine science, located in Boulder, Colo., College Park, Md., Rockville, Md., and Charleston, S.C., respectively. In addition, NIST partners with nearly 1,300 manufacturing specialists and staff at about 350 MEP service locations around the country.

Cross-Agency Priority Goals for NIST Programs

NIST is a participant in the Cybersecurity Cross-Agency Priority Goal (CAP) to achieve 95 percent use of the Administration's priority cybersecurity capabilities on Federal executive branch information systems by the end of FY 2014. NIST's responsibilities under this CAP include the following:

- Update and maintain technical standards to facilitate use, expand the industry and build in flexibility, security and interoperability, and support increased adoption of administration cybersecurity priorities by Federal Departments and Agencies. This will enhance organizational maturity, technology use, and visibility through Open Standards.
- Support strong authentication for information systems through U.S. Government smartcard technical standards, reference materials, tools, tests, and validations.
- Develop and deploy U.S. Government Guidelines, testing capabilities, and tools supporting automated security assessments, risk mitigation processes, and automated data feeds with standardized machine readable formats.

Corresponding DOC Strategic Theme and Goals for NIST Programs

DOC Strategic Theme: Economic Growth

DOC Strategic Goal: Innovation and Entrepreneurship

Advanced Manufacturing Technology Consortia (AMTech):

The AMTech program has been proposed for FY 2014 to establish industry-led consortia to identify and prioritize directed basic research projects supporting long-term industrial research needs. AMTech creates the incentive for multiple industry stakeholders to share financial and scientific resources, together with state and local government interests, as well as technical innovators at universities and government laboratories. The program provides funding to industry-led consortia for the development of detailed roadmaps of long-term research challenges. Further, the program will provide cost-shared funding to consortia to support the research needed to help them achieve future desired technology developments. The AMTech program supports the Administration's priorities to invest in advanced manufacturing to foster innovation, create high-quality jobs, and enhance global competitiveness. By supporting consortia, the AMTech program will address multiple components of the innovation cycle, from discovery to commercialization, to accelerate the pace of innovation through various industry sectors.

NIST National Measurement and Standards Laboratories:

The NIST Laboratory Programs play a unique role in the Nation's scientific, industrial, and business communities and anchor the national measurement and standards system that is the language of research and commerce. NIST's presence and leadership in the Nation's measurement and standards system enables companies, government agencies, and universities to work with each other more easily, improving the Nation's economic security and quality of life. NIST's activities also help address a broad range of critical challenges for the Nation to lay the foundation for future success in priority areas such as advanced manufacturing, cybersecurity, Smart Grid, Healthcare IT, alternative energies, and improved sustainability.

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. 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 in the international standards community, measurement and calibration services, and certified reference materials;

- Impartial expertise and leadership in basic and applied research to enable development of test methods and verified data to support the efficient commercialization and exchange of goods and services in industry and commerce; and
- Support for the development of open, consensus-based standards and specifications that define technical and performance requirements for goods and services, with associated measurements and test methods for conformity.

NIST is host to the interagency Advanced Manufacturing National Program Office (AMNPO), an office created in response to the Administration's advanced manufacturing and innovation priorities. The purpose of the AMNPO is two-fold: 1) to create a whole-of-government response to the national needs in advanced manufacturing; and 2) to convene and foster regional public-private partnerships. The AMNPO is envisioned as a true interagency office with representatives from other agencies as well as fellows representing academia and industry. The AMNPO work plan is informed by the recommendations of the Advanced Manufacturing Partnership and the President's Council of Advisors on Science and Technology (PCAST, described in their report, *Capturing Domestic Competitive Advantage in Advanced Manufacturing* (July 2012) as well as the National Science and Technology Council's (NSTC) *National Strategic Plan for Advanced Manufacturing* (February 2012). The AMNPO is responsible for planning and executing the National Network for Manufacturing Innovation (NNMI), a new $1 billion program proposed in the President's FY 2013 budget. The NNMI is envisioned as up to 15 dynamically linked regional Institutes for Manufacturing Innovation, which individually and collectively will bridge the nation's economically damaging gap separating research discoveries, inventions, and promising ideas from product development and eventual commercialization.

NIST User Facilities:

NIST has two User Facilities, the Center for Nanoscale Science and Technology (CNST) and the NIST Center for Neutron Research (NCNR).

The CNST user facility was created to reduce barriers to innovation by providing industry, academia, and other government agencies with access to world-class nanoscale measurement and fabrication methods and technology. The unique CNST operating model is designed to support both the current and future needs of the national nanotechnology enterprise. The shared-use NanoFab facility provides convenient, rapid access to a comprehensive, state-of-the-art commercial tool set for nanoscale measurement and fabrication. To meet specific needs of industry, the NIST NanoFab facility has created a quick and easy process for researchers to obtain equitable access to the equipment. Looking beyond the current state of the art, CNST research creates the next generation of nanoscale measurement instruments and methods, which are made available to the scientific community through collaboration. CNST's measurement and instrumentation research is currently focused on three nanotechnology areas broadly covering (1) nanoscale devices, architectures, and interconnects for future electronics; (2) nanomanufacturing and nanofabrication; and (3) energy conversion, storage, and transport at nanostructured interfaces. In the few years since its inception, the CNST has become a major national resource for nanoscale science and the development of nanotechnology.

As the Nation's premiere neutron research facility, the NCNR develops, delivers and maintains world-class neutron measurement capabilities and applies them to science and engineering problems of national interest. The NCNR is operated as a national user facility with merit-based access made available to the entire U.S. scientific and technological community. Neutron-based research

covers a broad spectrum of disciplines, including engineering, biology, materials science, polymers, chemistry, and physics. Use of the NCNR facilities for proprietary research is possible on a full-cost recovery basis. As a result, researchers from industry, academia, and other Federal agencies depend on NCNR's unique research capabilities to work on cutting edge science. The capabilities of the NCNR are further leveraged through a variety of cost-sharing partnerships with other agencies, industries, and universities to expand specific measurement capabilities, and to broaden the access to unique neutron instrumentation. The NCNR is significantly expanding its collaboration with the Nation's industrial and academic researchers with new instrumentation and analysis methods for macromolecular dynamics, neutron trace analysis, neutron chemical spectroscopy, neutron imaging, and neutron spectroscopy.

DOC Strategic Goal: Market Development and Commercialization

Hollings Manufacturing Extension Partnership (MEP) Program:

Operating under the authority of 15 U.S.C. 278k, the Hollings Manufacturing Extension Partnership (MEP) is a Federal-state-industry partnership that provides small U.S. manufacturers with access to technologies, resources, and industry experts. Through a nationwide network of 60 manufacturing centers, linked to state, university, community college, and private sources of technology and expertise, MEP works directly with the local manufacturing community to strengthen the competitiveness of our Nation's domestic manufacturing base. Funding for the MEP Centers is a cost-sharing arrangement consisting of support from the Federal government, state and local government/entities, and fees charged to the manufacturing clients for services provided by the MEP Centers.

A strong domestic manufacturing base is essential to supporting our Nation. Now more than ever, strong manufacturing businesses are needed to create good jobs and help the U.S. economy regain its momentum and U.S. manufacturers are facing significant challenges. There is a constant pressure to cut costs, improve quality, meet environmental and international standards, and get to market faster with new and improved products, all in a larger, more competitive, global playing field. As manufacturers struggle to keep pace with accelerating changes, MEP's mission has become more critical than ever to individual manufacturing firms, industrial communities, and the American manufacturing sector as a whole. With centers in every state and in Puerto Rico, MEP is uniquely positioned to connect manufacturers with the opportunities being made available through Federal and state governments to invest in environmentally sustainable manufacturing practices, develop innovative products, and diversify into new markets. MEP Centers know their communities and understand their local manufacturing industries. Across the country, they serve as trusted advisors to their manufacturing clients and help them navigate economic and business challenges, capitalize on opportunities that fit their business goals, and develop pathways leading to company growth.

With a focus on business growth and increased profitability, MEP works to position and transform manufacturers to compete in the global economy. MEP provides an integrated framework for business growth that promotes continuous improvement efforts to reduce costs while encouraging the adoption of tools focused on new product development, sustainable manufacturing processes, integrating supply chains, and increasing the technical skills of the workforce.

MEP's ultimate goal is to measurably improve the productivity, profitability and competitiveness of all of its U.S. manufacturing clients.

NIST Strategic Objectives

NIST will align its programs with the following strategic objectives to ensure that investments in its programs meet its mission of advancing U.S. innovation and industrial competitiveness.

1. **Driving Innovation through Measurement Science:** NIST is providing and maintaining an internationally recognized measurement science program that underpins the system of weights and measures essential for global commerce, facilitates the entry of U.S. companies into new markets, and enables fair science-based regulation of emerging technologies. NIST will:

   - Continue to strengthen the coordination and international dissemination of U.S.-developed measurement standards;
   - Invest in the measurement science research and the development and delivery of new measurement services (calibrations, data, and standard reference materials) that support the manufacture, adoption, and utilization of technological solutions that increase U.S. competitiveness and standard of living; and
   - Strengthen collaborations with key regulatory agencies by providing state-of-the-art measurement technologies and methodologies to support regulatory decision making processes.

2. **Accelerating the adoption and deployment of advanced technology solutions:** NIST is developing and delivering unique measurement capabilities and technical standards to accelerate the integration of transformational information technologies with physical processes and entities to revolutionize functionality and performance of manufacturing plants, energy utilities, and communication systems. NIST will:

   - Strengthen its research capabilities in advanced networking, systems engineering, and mathematics to achieve the critical fundamental science base necessary to support ongoing and future advances in emerging technology areas;
   - Provide the measurements, standards, testbeds, and other supporting services to enable the widespread application and integration of smart systems that will transform manufacturing, energy delivery, and communications; and
   - Ensure the security of these revolutionary systems and applications through the establishment of a world leading Cybersecurity Center of Excellence that will bridge the gap between the public and private sectors and provide U.S. companies with technical resources for developing, evaluating, and transferring the technology needed to fight cyber crime.

3. **Providing unique cutting edge research facilities:** NIST is ensuring continued access to cutting edge world-class user facilities and equipment that are part of the scientific infrastructure that enable the U.S. to be a world leader in innovation. NIST will:

- Ensure the availability of neutron measurement capabilities to meet the needs of U.S. researchers from industry, university and other government agencies; and
- Support researchers from industry, academia, NIST and other government agencies in nanoscale fabrication and measurement by developing innovative nanoscale measurement and fabrication capabilities.

4. **Strengthening U.S. advanced manufacturing capabilities:** NIST is supporting long-term U.S. economic competitiveness by strengthening development and deployment of advanced manufacturing capabilities throughout the United States. NIST will:

   - Develop and deliver the measurement science tools and technologies that will support advanced manufacturing technologies and capabilities (including materials modeling, nano- and biomanufacturing, sensors, measurement tools, robotics, and other enabling technologies);
   - Work with small and medium manufacturers, universities, state and local governments, through the Hollings Manufacturing Extension Partnership to support technologies and practices that increase the competitiveness and resiliency of our nation's small and medium manufacturers; and
   - Launch the Advanced Manufacturing Partnership National Program Office to coordinate private sector/government collaboration on the development and implementation of U.S. advanced manufacturing capabilities and policies through:
     - Investments in precompetitive technologies that will form the basis of new and innovative industries;
     - Development of a high-skilled advanced manufacturing workforce of the future; and
     - Programs to facilitate the deployment of innovative technologies into new and existing domestic production facilities.

NIST Management Challenges

1. Effectively Promote Exports, Stimulate Economic Growth, and Create Jobs - As a non-regulatory agency in the 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 improve technical and financial assistance to promote trade and job growth through its Laboratory Programs and its Innovation and Industry Services Programs.

2. Achieve Operational Efficiency and Economy – NIST is working to enhance operational efficiency and economy to support a world-class research program. For example:

   - NIST is continuing to implement the policies and practices that will lead NIST toward a world-class safety culture; and
   - NIST is working to develop radical improvements in the management of NIST business functions to better support a culture of outstanding research by improving the efficiency of the procurement and award process.

NIST Target and Performance Summary Table / Validation and Verification

Objective 5: Provide measurement tools and standards to strengthen manufacturing, enable innovation, and enhance efficiency.						
Measure 1A: Qualitative assessment and review of technical quality and merit using peer review	**FY 2009 Actual**	**FY 2010 Actual**	**FY 2011 Actual**	**FY 2012 Actual**	**FY 2013 Target**	**FY 2014 Target**
	Completed	Completed	Completed	Completed	Complete	Complete

Description: From FY 2007-FY 2011, the National Research Council (NRC) assessed half of the NIST Laboratories each year. The assessment process focused on the quality, relevance, and technical merit of the NIST Laboratories Programs. Overall, these assessments attest to NIST's high quality programs, relevance of work to the measurement and standards needs, and impressive technical merit. In FY 2012, the NRC assessments were restructured to focus on NIST-wide ongoing needs and activities. The FY2012 assessment focused on the crosscutting area of NIST laboratory efforts supporting advanced manufacturing. For FY 2013 and beyond, the NRC has proposed that the NRC return to conducting technical assessments of selected NIST laboratories for their scientific impact, beginning with the NIST Center for Neutron Research. The NRC Assessment Reports are available at: http://www.nist.gov/director/nrc/.

Comments on Changes to Targets: N/A

Relevant Program Change(s): N/A	**Title:** N/A	**Exhibit 13 Page no:** N/A

Validation and Verification

Data Source	Frequency	Data Storage	Internal Control Procedures	Data Limitations	Actions to be Taken
On-site interviews and discussions with NIST management and research staff by independent external scientific and technical experts, managed by the NRC.	For FY 2013 and beyond, the NRC has proposed that the NRC return to conducting annual technical assessments of selected NIST laboratories.	NRC	Oversight of expert review panels provided by the NRC.	Data are qualitative in nature	None

Measure 1B: Citation impact of NIST-authored publications	FY 2009 Actual	FY 20010 Actual	FY 2011 Actual	FY 2012 Target	FY 2013 Target	FY 2014 Target
	>1.1	>1.1	>1.1	>1.1*	>1.1	>1.1

Description: This measure demonstrates that NIST consistently produces relevant scientific and technical publications. Citation impact reflects the utility and relevance of NIST research and is outcome-oriented. The measure represents NIST's "relative citation impact" which is the average citation rate per NIST publication relative to Thomson Reuters' baseline citation rate number for a large group of peer scientific and technical organizations. *The FY 2012 actual for this measure will lag at least six months.

Comments on Changes to Targets: N/A

Relevant Program Change(s): N/A	**Title:** N/A	**Exhibit 13 Page no:** N/A

Validation and Verification

Data Source	Frequency	Data Storage	Internal Control Procedures	Data Limitations	Actions to be Taken
Thomson Reuters	Ongoing	NIST	Data represents NIST's "relative citation impact" - that is, the average citation rate per NIST publication relative to Thomson Reuters' baseline citation rate number for a large group of peer scientific and technical organizations. Internal controls include verification and review by NIST Information Services Office and the NIST Program Coordination Office.	Factors such as self-citations, citation circles, and multiple authorship may affect the reliability of any data of this nature.	None

Measure 1C: Peer-reviewed technical publications	FY 2009 Actual	FY 2010 Actual	FY 2011 Actual	FY 2012 Actual	FY 2013 Target	FY 2014 Target
	1,463	1,243	1,210	1,335	1,210	1,250

Description: This measure reflects the quality and demand for NIST publications used to transfer its research results to support the Nation's infrastructure and to provide measurements and standards to those in industry, academia, and government agencies. This measure is a direct count of NIST technical manuscripts that have been published in an elite body of influential scientific peer-reviewed journals as compiled in the Web of Science® bibliographic database maintained by Thomson Reuters. While publications are a good indicator of scientific productivity, their number does not readily correlate to increases in funding or other influences that may be expected to drive up other metrics. NIST number of publications is well within acceptable rates for an institution of its size. Publications typically lag by a minimum of two years due to the time needed for research, writing, journal peer review, and publication processes.

Comments on Changes to Targets: N/A

Relevant Program Change(s): N/A	**Title**: N/A	**Exhibit 13 Page no:** N/A

Validation and Verification

Data Source	Frequency	Data Storage	Internal Control Procedures	Data Limitations	Actions to be Taken
Web of Science® bibliographic database compiled by Thomson Reuters.	Ongoing	NIST	Publication data is collected by Thomson Reuters. Data represents analysis performed by NIST's Information Services Office.	Output Only	None

Measure 1D: Standard Reference Materials sold	FY 2009 Actual	FY 2010 Actual	FY 2011 Actual	FY 2012 Actual	FY 2013 Target	FY 2014 Target
	29,769	31,667	32,864	33,441	31,000	33,000

Description: Standard Reference Materials (SRM) is the definitive artifact-based source of measurement traceability in the United States. SRMs are certified in the NIST Laboratories for their specific chemical and material properties. Customers use SRMs to achieve measurement quality and conformance to process requirements that address both national and international needs for commerce and trade and public safety and health. This measure represents a direct count of the number of SRM units sold to customers in industry, academia, and other government agencies. The conversion of research results into robust, deliverable measurement services typically takes at least three additional years. SRMs are one of the measurement service outputs possible, and as new, more relevant SRM types are produced, older less relevant SRMs are discontinued. Production capacity at current staffing levels has stabilized at about 1,300 different SRMs available. Nonetheless, NIST predicts that the number of SRM units sold will increase modestly in the out-years as a result of the new and expanded programs that are leading to critically needed new SRMs.

Comments on Changes to Targets: N/A

Relevant Program Change(s): $+55.0 Million	**Title**: NIST Laboratories Advanced Manufacturing ($50M), Forensic Science (5M)	**Exhibit 13 Page no:** NIST- 86 and NIST - 139

Validation and Verification

Data Source	Frequency	Data Storage	Internal Control Procedures	Data Limitations	Actions to be Taken
NIST Measurement Services Division	Ongoing	NIST Measurement Services Division	Data represents direct and verifiable counts. Internal controls include verification and review by the NIST Material Measurement Laboratory.	Data provide information on output levels only.	None

Measure 1E: NIST-maintained datasets downloaded	FY 2009 Actual	FY 2010 Actual	FY 2011 Actual	FY 2012 Actual	FY 2013 Target	FY 2014 Target
Original Methodology	226M	NA*	NA*	NA*	NA*	NA*
Revised Methodology	34.2M	25.0M	19.1M	22.6M	18M	18M

* Not Applicable. Beginning in FY 2010, NIST has revised the methodology for this measure by excluding the hundreds of millions of annual downloads associated with web-based time-related services which dominated the total number of downloads in previous years. This adjusted measure will more clearly demonstrate the use of NIST's other on-line datasets covering scientific and technical databases throughout the NIST laboratories.

Description: NIST's online data systems are heavily used by industry, academia, other government agencies, and the general public and represent another method NIST uses to deliver its measurements and standards tools, data, and information. This measure is a direct count of the annual number of downloads of NIST-maintained data, with the exception of web-based time related services. This measure also excludes the NIST Internet Time Service synchronizations which now average about three billion events per day. The lower out-year targets are due to a change in the methodology for this measure. Beginning in FY 2011, web robot index searches are being filtered out of the count to more accurately reflect customer interest.

Comments on Changes to Targets: N/A

Relevant Program Change(s)	Title:	Exhibit 13 Page no:
$+68.0 Million	NIST Laboratories Advanced Manufacturing ($50M), Cyber-Physical Systems ($10M), Health IT ($3M), and Disaster Resilience ($5M)	NIST- 86, NIST-120, NIST-128, and NIST-133

Validation and Verification

Data Source	Frequency	Data Storage	Internal Control Procedures	Data Limitations
NIST Measurement Services Division	Ongoing	NIST Measurement Services Division	Data represents direct and verifiable counts. Internal controls include verification and review by the NIST Material Measurement Laboratory.	Data provide information on output levels only. This measure reflects the number of times users access these datasets; it does not reflect unique users or capture how the data was used.

Measure 1F: Number of calibration tests performed	FY 2009 Actual	FY 2010 Actual	FY 2011 Actual	FY 2012 Actual	FY 2013 Target	FY 2014 Target
	18,609	17,697	18,195	17,206	13,000	12,500

Description: NIST calibrations are the definitive service-based source of measurement traceability in the United States. Customers use calibrations to achieve measurement quality and traceability to address both national and international needs for commerce and trade and public safety and health. This measure represents a direct count of the number of units calibrated by NIST for customers in industry, academia, and other government agencies. The conditions and events described below that prompted the reduction in the FY 2013 target are expected to continue, thus resulting in a further reduction in the projected number of calibration tests performed in FY 2014.

Comments on Changes to Targets: Several factors are contributing to a continuing decline in the number of calibration tests performed annually by NIST, although the rate of decline is difficult to predict. Where possible and appropriate, NIST is transferring calibration capabilities to the private sector and to other agencies so that traceability is obtainable from other sources thereby improving the accessibility of industry to precision measurements. Secondly, NIST has experienced a reduction in calibrations work performed for the Defense Primary Standards Labs. Lastly, increasing international application of the Mutual Recognition Arrangement has resulted in the acceptance and use of calibrations from other national measurement institutes, thereby reducing the dependency upon traceablity to NIST.

Relevant Program Change(s) $+50.0 Million	**Title:** NIST Laboratories Advanced Manufacturing ($50M)	**Exhibit 13 Page no:** NIST- 86

Validation and Verification

Data Source	Frequency	Data Storage	Internal Control Procedures	Data Limitations	Actions to be Taken
NIST Measurement Services Division	Ongoing	NIST Measurement Services Division	Data represents direct and verifiable counts. Internal controls include verification and review by the NIST Physical Measurement Laboratory.	Data provide information on output levels only.	None

Objective 8: Improve the competitiveness of small and medium-sized firms in manufacturing and service industries.

Measure 2A: Number of clients served by MEP Centers receiving Federal funding	**FY 2009 Actual**	**FY 2010 Actual**	**FY 2011 Actual**	**FY 2012 Actual**	**FY 2013 Target**	**FY 2014 Target**
	32,926	34,299	33,838	32,123	32,500	32,500

Description: This measure represents the annual number of new and repeat clients served by MEP Centers who received training, technical, and business assistance ranging from informational seminars and training classes to in-depth technical assistance typically beginning with the implementation of lean enterprise concepts and progressing to strategic re-positioning and access to new markets. The targets for FY 2012 and beyond reflect MEP's transition to focus manufacturers on longer term innovation efforts and new product development.

Comments on Changes to Targets: FY 2014 MEP targets do not account for the impacts of the newly proposed M-TAC initiative. M-TAC performance measures and targets will be established as NIST further develops and refines program services during FY 2013 and FY 2014.

Relevant Program Change(s): $+25.0 Million	**Title:** Hollings Manufacturing Extension Partnership	**Exhibit 13 Page no:** NIST - 208

Measure 2B: Increased sales attributed to MEP Centers receiving Federal funding ($ in Billions)	**FY 2009 Actual**	**FY 2010 Actual[1]**	**FY 2011 Actual[1]**	**FY 2012 Target[2]**	**FY 2013 Target**	**FY 2014 Target**
	$3.5	$3.6	$2.5	$2.2	$2.5	$2.5

Measure 2C: Capital investment attributed to MEP Centers receiving Federal funding ($ in Billions)	**FY 2009 Actual**	**FY 2010 Actual[1]**	**FY 2011 Actual[1]**	**FY 2012 Target[2]**	**FY 2013 Target**	**FY 2014 Target**
	$1.9	$1.9	$2.5	$1.3	$1.4	$1.4

Measure 2D: Cost savings attributed to MEP Centers receiving Federal funding ($ in Billions)	**FY 2009 Actual**	**FY 2010 Actual[1]**	**FY 2011 Actual[1]**	**FY 2012 Target[2]**	**FY 2013 Target**	**FY 2014 Target**
	$1.3	$1.3	$0.9	$1.1	$1.1	$1.1

Description: These measures indicate the changes that are positively associated with productivity growth and competitiveness, which are the two factors that are crucial for American manufacturers to manage and succeed in the rapidly changing manufacturing environment. Data is collected through an annual survey of clients receiving services from MEP Centers. The targets for FY 2012 and beyond reflect MEP's transition to focus manufacturers on longer term innovation efforts and new product development. Client impacts from these activities take a longer time to reach fruition.

[1] Actuals are reported for the funding tied to the fiscal year. Due to the lag time associated with collecting and analyzing this data, the "actual" data reported for this measure in the FY 2012 DOC Performance and Accountability Report (PAR) was an estimate based on three-quarters of actual and one-quarter of estimated client impacts. This data reflects a full year of actual client impacts and is an update to the PAR.

[2] The FY 2012 actual will be available in January 2014 due to the lag time associated with collecting and analyzing the Hollings MEP client survey data six months after the services are delivered. These targets were based on an FY 2012 client target of 32,500.

Comments on Changes to Targets: N/A					
Relevant Program Change(s): $+25.0 Million	**Title:** Hollings Manufacturing Extension Partnership				**Exhibit 13 Page no:** NIST - 208
Validation and Verification					
Data Source	Frequency	Data Storage	Internal Control Procedures	Data Limitations	Actions to be Taken
The client impact survey is administered by a private firm, Fors Marsh Group, located in Arlington, Va.	The survey is conducted four times per year, and clients are selected based on when they completed the first project with a MEP Center in the previous year.	Survey data is sent directly to MEP for analysis. MEP reviews and stores survey data received from Fors Marsh Group.	Internal controls include verification and significant review of the client responses by MEP staff. Criteria are in place for identifying outliers in the data. Centers verify the outlier and if necessary, the data are revised based on the Center review.	As with similar survey instruments, sources of uncertainty include variation in interpretation of specific questions; in the estimation techniques used in response to specific questions; in the quality of industry data; missing values; and other common survey problems.	None

NIST Agency Priority Goals

NIST does not have any Agency Priority Goals for FY 2013.

Other NIST Information

Management Reviews

At the agency level, NIST has developed and is continuing to improve its Balanced Score Card (BSC) which is reported directly to the Secretary of Commerce every quarter. The metrics defined in the NIST BSC are the responsibility of the top level management and therefore are directly incorporated in their individual performance plans. In support of the top level management, next tier managers along with their employees are designated particular responsibilities in their performance plans that come together to achieve and improve the desire metrics. With respect to strategic human capital plans, specific metrics are included in the NIST BSC to advance these objectives. These metrics include goals related to veteran hiring, alternate dispute resolution mechanisms, hiring and recruitment time, and helping post-doctoral associates find their next step in their career path at NIST or in industry. Post-doctoral associates represent an effective pathway for technology transfer to industry. Future metrics on the NIST BSC will include metrics that monitor the quality and the adaptability of the NIST human capital.

Cross-Agency Collaborations

NIST is working closely with a number of other agencies to further its objective of providing the measurement tools and standards to strengthen manufacturing, enable innovation, and increase efficiency. Key examples include:

- ***Advanced manufacturing*** – Working closely with the Office of Science and Technology Policy (OSTP), the National Economic Council, DOD, the National Science Foundation (NSF), the Department of Energy (DOE), and the National Aeronautics and Space Administration, NIST has launched the Advanced Manufacturing National Program Office in order to: (1) convene and foster regional public-private partnerships; and (2) create a whole-of-government response to the needs of advanced manufacturing.
- ***Materials Genome Initiative*** – NIST is working closely with OSTP, NSF, DOD, DOE and others to coordinate efforts under this multiagency effort.
- **Nanotechnology** –NIST is heavily engaged with the National Nanotechnology Initiative and is contributing to all five of the Nanotechnology Signature Initiatives.
- **Public Safety Communications** – NIST is working with the National Telecommunications and Information Administration, NSF, the Department of Justice, and others to address the R&D needs for a next-generation public safety communications network.
- ***Biosciences*** – NIST has been working with the Food and Drug Administration to define areas where NIST measurement capabilities can be applied to help further their regulatory mission.

Through the MEP, NIST also works closely with a number of other agencies in support of its objective of improving the competitiveness of small and medium-sized firms in manufacturing and service industries. Examples include:

- ***E3: Economy, Energy, and Environment*** – MEP is collaborating with DOE, the Environmental Protection Agency, the Department of Labor, the Small Business Administration, and the U.S. Department of Agriculture on E3, a coordinated federal and local technical assistance initiative that is helping manufacturers across the nation adapt and thrive in a new business era focused on sustainability.
- ***ExporTech:*** Deployed nationally as a collaboration between MEP, U.S. Export Assistance Centers, and other partners including District Export Councils, State Trade Offices, Ex-Im Bank and SBA, ExporTech helps companies enter or expand in global markets.
- ***Supplier Scouting:*** In partnership with the Department of Transportation, DOE, DOD, and other NIST programs, MEP has been using its extensive network of manufacturers and suppliers to help American companies meet the requirements of the Buy America and Buy American standards.

Program Evaluations

The National Research Council (NRC) provides expert assessments of the NIST Laboratory programs. The NRC assessments assure decision-makers within the Federal government that NIST maintains the highest standards of effort, performance, and relevance. The assessments also help NIST respond to recommendations and advice as provided to NIST by its advisory body, the Visiting Committee on Advanced Technology. In addition, the process of bringing expert NRC panelists to the NIST campus creates an opportunity for NIST scientists to obtain direct feedback and to foster professional relationships with experts in their field. The final NRC Assessment Reports for NIST since FY 2007 are available at: http://www.nist.gov/director/nrc/index.cfm .

For FY 2013 and beyond, NIST has proposed that the NRC return to conducting technical assessments of selected NIST laboratories for their scientific impact, beginning with the Center for Neutron Research (NCNR). The NRC Panel will be asked to assess the NCNR on at least three criteria, i.e. the technical merit of the current laboratory program; the adequacy of the NCNR budget, facilities, equipment, and human resources; and the degree to which the programs achieve their desired impact.

In addition, the National Academy of Sciences (NAS) will issue a report in June 2013 on its review of "21st Century Manufacturing: The Role of the Manufacturing Extension Partnership of the National Institute of Standards." The objectives of this evaluation which began in FY 2011 are to generate a better understanding of the operation, achievements, and challenges of the MEP program and provide recommendations to improve program operations and impact.

Data Validation and Verification

The FY 2012 PAR includes in the Secretary's Statement, an assessment of the reliability and completeness of the Department's performance data,

National Technical Information Service

NTIS provides the American public with permanent and ready access to scientific, technical, and business research through the acquisition, organization, and preservation of data added to its permanent collection. NTIS collects, classifies, coordinates, integrates, records, and catalogs scientific and technical information from whatever sources, foreign and domestic, that may stimulate innovation and discovery and then disseminates that information to the public. In an effort to provide the American public with increased access to the vast collection of government information, NTIS utilizes advanced e-commerce channels, including providing downloads of any item in its collection that is in electronic format for a single low fee or at no charge if under five pages. NTIS also helps other Federal agencies interact with and better serve the information needs of their own constituents by providing information management services.

Cross-Agency Priority Goals: NTIS is not a leader or a participant of any Cross-Agency Priority Goals

DoC Strategic Themes, Goal and Objective: Corresponding NTIS

DoC Theme: Science and Information

DoC Strategic Goal: Generate and communicate new, cutting-edge scientific understanding of technical, economic, social, and environmental systems.

Performance Objective 13: Increase scientific knowledge and provide information to stakeholders to support economic growth and to improve innovation, technology, and public safety.

NTIS operates a central clearinghouse of scientific and technical information that is useful to U.S. business and industry. Without appropriated funds, NTIS collects scientific and technical information; catalogs, abstracts, indexes, and permanently archives the information; disseminates products in the forms and formats most useful to its customers; develops electronic and other new media to disseminate information; and provides information processing services to other Federal agencies. NTIS' funding comes from (1) the sale of technical reports and subscription services to business and industry, schools and universities, state and local government offices, and the public at large; and (2) services to Federal agencies that help them communicate more effectively with their employees and constituents. NTIS promotes the development and application of science and technology by providing technologically advanced global e-commerce channels for dissemination of its specialized information to business, industry, government, and the public. The NTIS bibliographic database is available for searching via the NTIS website and search engines free of charge. Users can download full text documents for free or for a nominal fee depending on document length and can purchase the same documents in a

variety of physical media formats. Subscriptions are available to NTIS technical reports through the NTIS National Technical Reports Library and private sector database lease partners.

NTIS Priorities / Management Challenges

NTIS: Strategic Priorities for FY 2014

NTIS' priority is to contribute successfully to the Department of Commerce's strategic goal of generating and communicating new, cutting-edge scientific, technical, economic, social and environmental systems. To that end, NTIS is committed to increasing the number of updated items it makes available, increasing the number of information products disseminated annually and enhancing customer satisfaction.

NTIS Targets and Performance Summary

NTIS Performance Objective 13: Increase scientific knowledge and provide information to stakeholders to support economic growth and to improve innovation, technology, and public safety.						
Measure 1A: Number of Updated Items Available (Annual)	**FY 2009 Actual**	**FY 2010 Actual**	**FY 2011 Actual**	**FY 2012 Actual**	**FY 2013 Target**	**FY 2014 Target**
	893,138	969,473	836,579	987,871	892,500	910,350
Description: The number of items available for sale to the public from NTIS includes scientific, technical, and engineering information products added to the permanent collection, as well as items made available through online electronic subscriptions.						
Comments on Changes to Targets: The FY 2014 Target reflects continued increases in expected activity.						
Relevant Program Change(s): N/A	**Title:** N/A				**Exhibit 13 Page no:** N/A	

Validation and Verification					
Data Source	**Frequency**	**Data Storage**	**Internal Control Procedures**	**Data Limitations**	**Actions to be Taken**
NTIS operates and maintains internal systems for collecting acquisition statistics.	Data is available daily. Reports are produced monthly.	All data is stored within NTIS systems.	NTIS' accounting and budget offices analyze and report performance data to management. Data verification is provided through regular internal independent auditor reporting.	Output Only	None

Measure 1B: Number of Information Products Disseminated (Annual)	FY 2009 Actual	FY 2010 Actual	FY 2011 Actual	FY 2012 Actual	FY 2013 Target	FY 2014 Target
	49,430,840	50,333,206	48,958,993	54,592,481	50,875,560	51,893,071

Description: This measure represents information disseminated and includes compact discs, diskettes, tapes, online subscriptions, electronic document downloads, Web site pages, as well as traditional paper and microfiche products.

Comments on Changes to Targets: The FY 2012, FY 2013, and FY 2014 targets have been updated to reflect results of the deployment of the Next Generation 2.0 website released in FY 2010 – FY 2011. The targets have been updated using FY 2011 actuals as the new baseline.

Relevant Program Change(s): N/A	Title: N/A	Exhibit 13 Page no: N/A

Validation and Verification

Data Source	Frequency	Data Storage	Internal Control Procedures	Data Limitations	Actions to be Taken
A modified commercial order processing system and a standard Web analysis software package used by industry.	Internal management activity reports are produced daily, summaries are produced monthly.	All data is stored within NTIS systems.	NTIS' accounting and budget offices analyze and report performance data to management. Data verification is provided through regular internal independent auditor reporting.	Output Only	None

Measure 1C: Customer Satisfaction	FY 2009 Actual	FY 2010 Actual	FY 2011 Actual	FY 2012 Actual	FY 2013 Target	FY 2014 Target
	98%	98%	99.5%	98.4%	95% - 98%	95% - 98%

Description: This measure represents the percentage of NTIS customers that are satisfied with the quality of their order, the ease of order placement, and the timely fulfillment of that order. NTIS's continual efforts to maintain and possibly improve this very high rate of customer satisfaction are essential to the success of NTIS's performance and mission to collect and disseminate scientific and business-related information.

Comments on Changes to Targets: N/A

Relevant Program Change(s): N/A	Title: N/A	Exhibit 13 Page no: N/A

Validation and Verification

Data Source	Frequency	Data Storage	Internal Control Procedures	Data Limitations	Actions to be Taken
A modified commercial order processing system.	Internal management activity reports are produced daily, summaries are produced monthly.	All information is stored within NTIS systems.	NTIS accounting and budget offices analyze and report performance data to management. Data verification is provided through regular internal and independent auditor reporting.	None	None

NIST/NTIS Resource Requirements Table *

NIST Resource Requirements (obligations in M)

	FY 2009 Actual	FY 2010 Actual	FY 2011 Actual	FY 2012 Actual	FY 2013 Estimate	FY 2014 Base	Increase/ Decrease	FY 2014 Request
Performance Objective 3: Stimulate high growth business formation and entrepreneurship, through investing in high-risk high-reward technologies and by removing impediments to accelerate technology commercialization.								
TIP (ITS)	$50.2	$77.2	$74.2	$8.4	3.3	-	-	-
AMTech (ITS)	-	-	-	-	-	-	$21.4	$21.4
FTE	72	80	76	25	5	-	4	4
Performance Objective 5: Provide measurement tools and standards to strengthen manufacturing, enable innovation, and increase efficiency.								
Labs (STRS & majority of Reimbursable)	576.1	607.6	606.5	656.1	691.9	641.3	120.9	762.2
User Facilities (STRS)	74.5	72.9	74.2	83.0	90.1	80.3	6.0	86.3
SCMMR (CRF)	161.7	169.8	91.0	35.6	92.3	55.8	4.2	60.0
Recovery Act funds	125.1	475.6	4.4	7.0	1.4	-	-	-
FTE	2,739	2,840	2,861	2,859	3,046	3,046	160	3,206
Performance Objective 8: Improve the competitiveness of small and medium-sized firms in manufacturing and service industries.								
MEP (ITS Approp)	112.6	126.8	129.3	132.6	140.6	131.3	23.8	155.1
FTE	70.0	79.0	84.0	89.0	90.0	90.0	1.0	91.0

NIST Total Original Funds	975.1	1,054.3	975.2	915.7	1,018.2	908.7	176.3	1,085.0
NIST Total, Recovery Act Funds	125.1	475.6	4.4	7.0	1.4	-	-	-
Total NIST	1,100.2	1,529.9	979.6	922.7	1,019.6	908.7	176.3	1,085.0
FTE	2,881	2,999	3,021	2,973	3,141	3,136	165	3,301

NTIS Resource Requirements (obligations in M)

	FY 2009 Actual	FY 2010 Actual	FY 2011 Actual	FY 2012 Actual	FY 2013 Estimate	FY 2014 Base	Increase/ Decrease	FY 2014 Request
Performance Objective 13: Increase scientific knowledge and provide information to stakeholders to support economic growth and to improve innovation, technology, and public safety.								
NTIS	31.9	46.0	48.9	66.3	66.0	66.5	-	66.5
FTE	119	121	114	104	150	150	-	150

Grand Total (NIST & NTIS)	FY 2009 Actual	FY 2010 Actual	FY 2011 Actual	FY 2012 Enacted / Actual	FY 2013 Estimate	FY 2014 Base	Increase/ Decrease	FY 2014 Request
Original Funding								
Direct	803.5	894.8	806.5	744.0	827.2	757.2	176.3	933.5
Reimbursable	203.6	205.4	217.4	238.0	257.0	218.0	-	218.0
Total	1,007.1	1,100.2	1,023.9	982.0	1,084.2	975.2	176.3	1,151.5
Recovery Act Funding								
Direct	122.8	464.2	4.4	7.0	1.4	-	-	-
Reimbursable	2.3	11.4	-	-	-	-	-	-
Total	125.1	475.6	4.4	7.0	1.4	-	-	-
Total Funding								
Direct	926.3	1,359.0	810.9	751.0	828.6	757.2	176.3	933.5
Reimbursable	205.9	216.8	217.4	238.0	257.0	218.0	-	218.0
Total	1,132.2	1,575.8	1,028.3	989.0	1,085.6	975.2	176.3	1,151.5
Original FTE	2,982	3,014	3,124	3,067	3,291	3,286	165	3,451
Recovery Act FTE	18	106	11	10	-	-	-	-
Total FTE	3,000	3,120	3,135	3,077	3,291	3,286	165	3,451

*Dollars reflect obligations for all fund sources and excludes $1,000M National Network for Manufacturing Innovation (mandatory appropriation).

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Scientific and Technical
Research and Services

Exhibit 5

Department of Commerce
National Institute of Standards and Technology
Scientific and Technical Research and Services
SUMMARY OF RESOURCE REQUIREMENTS
(Dollar amounts in thousands)

	Positions	FTE	Budget Authority	Direct Obligations	Appro-priation
2013 CR (annualized)	2,203	2,202	$579,721	$599,160	$570,471
less: Unobligated balance from prior year	0	0	0	(18,439)	0
less: Transfers from DoJ	0	0	(6,500)	(6,500)	0
less: Transfer from EAC	0	0	(2,750)	(2,750)	0
2014 Adjustments to base:					
plus: Restoration of 2013 deobligation offset	0	0	1,000	0	1,000
less: DoC IT Reinvestment	0	0	(3,777)	(3,777)	(3,777)
plus: Uncontrollable cost changes	0	0	8,162	8,162	8,162
less: Amount absorbed	0	0	(3,749)	(3,749)	(3,749)
less: Estimated recoveries, 2014	0	0	(1,000)	0	(1,000)
2014 Base Request	2,203	2,202	571,107	572,107	571,107
Administrative savings (amount reinvested)			[14,975]	[713]	
plus: 2014 Program changes	218	160	121,138	121,138	122,638
plus: Transfer from DoJ			3,000	3,000	0
plus: Transfer from EAC			2,750	2,750	0
2014 Estimate	2,421	2,362	697,995	698,995	693,745

		2012 Actual		2013 CR (annualized)		2014 Base		2014 Estimate		Increase/ (Decrease) Over 2014 Base	
Comparison by program/sub-program:		Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount
Measurement science, services, and programs											
Laboratory programs	Pos./Approp	2,089	$517,969	2,089	$521,139	2,089	$521,678	2,278	$616,770	189	$95,092
	FTE/Obl.	1,936	529,511	2,088	536,868	2,088	522,538	2,228	618,880	140	96,342
Corporate services	Pos./Approp	37	18,547	37	18,661	37	18,734	37	18,734	0	0
	FTE/Obl.	35	18,559	37	19,381	37	18,837	37	18,837	0	0
Standards coordination and special programs	Pos./Approp	77	30,484	77	30,671	77	30,695	106	58,241	29	27,546
	FTE/Obl.	71	26,989	77	42,911	77	30,732	97	61,278	20	30,546
TOTALS	Pos./Approp	2,203	567,000	2,203	570,471	2,203	571,107	2,421	693,745	218	122,638
	FTE/Obl.	2,042	575,059	2,202	599,160	2,202	572,107	2,362	698,995	160	126,888

Comparison by program/sub-program:	2012 Actual		2013 CR (annualized)		2014 Base		2014 Estimate		Increase/ (Decrease) Over 2014 Base	
	Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount
Adjustments for:										
Recoveries		(4,622)		(1,000)		(1,000)		(1,000)		0
Unobligated balance, start of year		(15,924)		(18,439)		0		0		0
Unobligated balance, end of year		18,439		0		0		0		0
Unobligated balance, expired account		3		0		0		0		0
Unobligated balance transfer to ITS for TIP shutdown/BPEP transition		1,600		0						
Budget Authority		574,555		579,721		571,107		697,995		126,888
Financing from transfers:										
Transfers to other accounts		1,695		0		0		1,500		1,500
Transfers from DoJ to OLES		(6,500)		(6,500)		0		(3,000)		(3,000)
Transfer from Election Assistance Commission		(2,750)		(2,750)		0		(2,750)		(2,750)
Appropriation		567,000		570,471		571,107		693,745		122,638

Exhibit 7

Department of Commerce
National Institute of Standards and Technology
Scientific and Technical Research and Services
SUMMARY OF FINANCING
(Dollar amounts in thousands)

	2012 Actual	2013 CR (annualized)	2014 Base	2014 Estimate	Increase/ (Decrease) Over 2014 Base
Total Obligations	$575,059 [1/]	$599,160 [1/]	$572,107	$698,995	$126,888
Offsetting collections from:					
Federal funds	0	0	0	0	0
Non-Federal sources	0	0	0	0	0
Total offsetting collections	0	0	0	0	0
Adjustments for:					
Recoveries and refunds	(4,622)	(1,000)	(1,000)	(1,000)	0
Unobligated balance, start of year	(15,924) [2/]	(18,439) [2/]	0	0	0
Unobligated balance, end of year	18,439	0	0	0	0
Unobligated balance, expired	3	0	0	0	0
Unobligated balance transfer to ITS	1,600	0	0	0	0
Budget Authority	574,555	579,721	571,107	697,995	126,888
Financing:					
Transfer to other accounts	1,695	0	0	1,500	1,500
Transfer from other accounts	(9,250) [3/]	(9,250) [3/]	0	(5,750) [3/]	(5,750)
Appropriation	567,000	570,471	571,107	693,745	122,638

[1/] Including $6,974K in FY 2012 and $1,414 in FY 2013 from ARRA HHS transfer, which is no year.

[2/] Including $8,382K in FY 2012 and $1,414 in FY 2013 from ARRA HHS transfer, which is no year.

[3/] $2,750K from EAC and $6,500K from DoJ in FY 2012 and FY 2013; and planned $2,750K from EAC and $3,000K from DoJ in FY 2014.

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Adjustments
to Base

Exhibit 9

Department of Commerce
National Institute of Standards and Technology
Scientific and Technical Research and Services
JUSTIFICATION OF ADJUSTMENTS TO BASE
(Dollar amounts in thousands)

	FTE	Amount
Adjustments:		
Restoration of FY 2013 deobligation offset	0	1,000

In FY 2013, NIST's STRS budget authority was reduced by $1,000,000 based on an estimated level of prior year deobligations. This adjustment would restore the reduction in FY 2014.

Department of Commerce IT Reinvestment	0	(3,777)

NIST's share of the Department of Commerce Information Technology Reinvestment reflects a reduction of $3,777,000.

Subtotal, Adjustments	0	(2,777)
Financing:		
Recoveries of prior year deobligations	0	(1,000)

NIST's FY 2014 STRS budget authority is reduced by the estimated level of prior year deobligations in FY 2014.

Other Changes:

Annualization of 2013 pay raise	0	326

A pay raise of .5 percent is assumed to be effective January 1, 2013.

Total cost in FY 2014 of 2013 pay raise	$1,304,000
Less amount requested in FY 2013	(978,000)
Less amount absorbed in FY 2013	0
Amount requested in 2014 to provide full-year cost of 2013 pay raise	326,000

2014 Pay increase and related costs	0	2,133

A general pay raise of 1 percent is assumed to be effective January 1, 2014.

Total cost in FY 2014 of pay increase	$2,084,000
Less amount absorbed in FY 2014	0
Amount requested for FY 2014 pay increase	2,084,000
Payment to Departmental Management Working Capital Fund	49,000
Total adjustment for FY 2014 pay increase	2,133,000

Personnel benefits		$1,982
Civil Service Retirement System (CSRS)	($258)	
Federal Employees' Retirement System (FERS)	834	
Thrift Savings Plan (TSP)	228	
Federal Insurance Contribution Act (FICA) - OASDI	474	
Health Insurance	547	
Employees' Compensation Fund	157	

Civil Service Retirement System (-$258,000) – The number of employees covered by the Civil Service Retirement System (CSRS) continues to drop as positions become vacant and are filled by employees who are covered by the Federal Employees' Retirement System (FERS). The estimated percentage of payroll for employees covered by CSRS will decrease from 8.7 percent in FY 2013 to 7.0 percent in FY 2014. The contribution rate will remain at 7.0 percent in FY 2014.

Payroll subject to retirement systems ($216,567,996)	
Cost of CSRS contributions in FY 2014 ($216,567,996 x .070 x .07)	$1,061,183
Cost of CSRS contributions in FY 2013 ($216,567,996 x .087 x .07)	1,318,899
Total adjustment to base	(257,716)

Federal Employees' Retirement System ($834,000) – The number of employees covered by FERS continues to rise as employees covered by CSRS leave and are replaced by employees covered by FERS. The estimated percentage of payroll for employees covered by FERS will increase from 91.3 percent in FY 2013 to 93.0 percent in FY 2014. The contribution rate increased from 11.7 percent for FY 2013 to 11.9 percent in FY 2014.

Payroll subject to retirement systems ($216,567,996)	
Basic benefit cost in FY 2014 ($216,567,996 x .930 x .119)	$23,967,580
Basic benefit cost in FY 2013 ($216,567,996 x .913 x .117)	23,134,010
Total adjustment to base	833,570

Thrift Savings Plan ($228,000) – The cost of agency contributions to the TSP will also rise as FERS participation increases. The contribution rate will increase from 4.54 to 4.57 percent in FY 2014.

Thrift plan cost in FY 2014 ($216,567,996 x .930 x .0457)	$9,204,356
Thrift plan cost in FY 2013 ($216,567,996 x .913 x .0454)	8,976,787
Total adjustment to base	227,569

Federal Insurance Contributions Act (FICA) - OASDI ($474,000) – As the percentage of payroll covered by FERS rises, the cost of OASDI contributions will increase. In FY 2014, the maximum salary subject to OASDI tax will increase from $113,100 in FY 2013 to $119,100 in FY 2014. The OASDI tax rate for employers remains at 6.2 percent in FY 2014.

FERS payroll subject to FICA tax in 2014 ($216,567,996 x .930 x .903 x .062)	$11,276,042
FERS payroll subject to FICA tax in 2013 ($216,567,996 x .913 x .882 x .062)	10,812,480
Increase (FY 2013-FY 2014)	463,562
OTP payroll subject to FICA tax in FY 2014 ($5,050,004 x .930 x .903 x .062)	262,938
OTP payroll subject to FICA tax in FY 2013 ($5,050,004 x .913 x .882 x .062)	252,129
Increase (FY 2013-FY 2014)	10,809
Total adjustment to base	474,371

Health insurance ($547,000) – Effective January 2012, NIST's contribution to Federal employees' health insurance premiums increased by 3.6 percent. Applied against the FY 2013 estimate of $15,189,000 the additional amount required is $546,804.

Employees' Compensation Fund ($157,000) – The Employees' Compensation Fund bill for the year ending June 30, 2012 is $156,858 higher than for the year ending June 30, 2011.

Travel and transportation of persons 0 1

The General Services Administration (GSA) has increased the mileage rate from 51 cents to 55 cents, a 7.8 percent increase in FY 2014. This percentage was applied to the FY 2013 estimate of $7,000 to arrive at an increase of $546.

Rental Payments to GSA 0 2

GSA rates are projected to increase 1.6 percent in FY 2014. This percentage was applied to the FY 2013 estimate of $100,000 to arrive at an increase of $1,600.

Communications, utilities, and miscellaneous charges 0 (1,867)

Postage.....	2
HCHB Electricity decrease	(1)
HCHB Water/Sewer increase	1
Electricity rate decrease.....	(1,037)
Natural Gas rate decrease.....	(832)

Effective January 22, 2012, the Governors of the Postal Service implemented a rate increase for shipping services. The overall price change is 4.6%. When applied to the FY 2013 postage estimate of $49,000, this results in an increase of $2,254.

The average decrease for HCHB PEPCO electricity is projected to be 18%. This percentage was applied to the 2013 electricity estimate of $3,000 for a decrease of $540.

The average increase for HCHB DCWASA is projected to be 66%. This percentage was applied to the 2013 DCWASA estimate of $1,000 for an increase of $660.

The electricity ATB amount was derived using a year to year comparison of the cost per kilowatt hour. In analyzing the 12 months ended February 2012 and 2011, the per kilowatt hour rate decreased 10.3 percent (from .111 to .100) for Gaithersburg, Maryland; increased 20.1 percent (from .355 to .426) for Kauai, Hawaii; remained constant at .071 for Boulder, Colorado; and increased 1.0 percent (from .089 to .090) for Ft. Collins, Colorado for a net decrease of $1,037,000.

The natural gas ATB amount was derived using a year to year comparison of the average cost per therm. In analyzing the 12 months ended February 2012 and 2011, the per therm rate decreased 13.3 percent (from .891 to .772) and decreased 11.3 percent (from 1.720 to 1.526) for Gaithersburg and Boulder respectively resulting in a decrease of $832,000.

Other Services		0	2,581
Working Capital Fund (Departmental Management)	2,400		
Commerce Business Systems (CBS)	179		
National Archives and Records Administration (NARA) storage costs	2		

Working Capital Fund (Departmental Management) ($2,401,000) – An additional $2,401,000 is required to fund cost increases in the Departmental Working Capital Fund (includes $2,281,000 for DoC's WCF/A&R IT Reinvestment).

Commerce Business Systems (CBS) ($179,000) – An increase of $179,000 is required in FY 2014 consistent with the CBS Capital Asset Plan.

National Archives and Records Administration (NARA) storage costs ($2,000) - NARA estimates reflect an increase of $2,000 in FY 2014 for records storage and maintenance costs.

Supplies and Materials		0	174
Scientific journal subscriptions	$174		

Scientific journal subscriptions ($174,000) - This adjustment to base addresses the FY 2011 to FY 2012 inflationary increase in costs for NIST's subscriptions journals which exceed the inflationary increases provided through the regular general pricing level deflator. The application of the 7.6 percent deflator results in an increase of $174,116 when applied to the FY 2013 estimate of $2,291,000.

General pricing level adjustment		0	2,830

This request applies the OMB economic assumption of 1.7 percent for FY 2014 where the prices that the government pays are established through the market system. Factors are applied to sub-object classes that result in the following adjustments to base: transportation of things $14,926; rental payments to others $30,600 communications, utilities, and miscellaneous charges $50,796; printing and reproduction $4,539; other services $1,429,875; supplies and materials $501,211; and equipment $797,011.

Subtotal, Other changes	0	8,162
Amount absorbed	0	(3,749)
Total adjustments to base	0	636

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STRS

APPROPRIATION ACCOUNT: Scientific and Technical Research and Services (STRS)

The STRS account contains the Measurement Science, Services, and Programs, which contains three budget sub-programs: Laboratory Programs, Corporate Services, and Standards Coordination and Special Programs. These three sub-programs, as well as initiatives proposed within each sub-program, are described in further detail in this section of the budget.

The 2014 President's Budget recognizes the important role of NIST programs to advancing innovation by requesting $693.7 million for the Scientific and Technical Research and Services (STRS) appropriation. Within the $693.7 million request, current Administration priority areas targeted for budget increases include Advanced Manufacturing, Cybersecurity, Healthcare IT, Disaster Resilience, Forensics, Advanced Communications, and NIST Centers of Excellence in measurement science and new technology areas.

SIGNIFICANT ADJUSTMENTS-TO-BASE (ATBs):

NIST STRS will absorb some inflationary costs within its base to fund adjustments to current programs. These costs include a 2014 Federal Pay Raise and inflationary increases for non-labor activities. STRS ATBs in FY 2014 total $4.385 million, of which $3.749 million will be absorbed.

BUDGET PROGRAM: Measurement Science, Services, and Programs

Measurement Science, Services, and Programs Overview

The NIST Measurement Science, Services, and Programs work at the frontiers of measurement science to ensure that the U.S. system of measurements is firmly grounded on a sound scientific and technical foundation. NIST promotes the use of measurements based on the international system of units (SI). The measurement science research at NIST is useful to all science and engineering disciplines. The NIST Laboratories directly support U.S. innovation and industrial competitiveness by developing new measurement instruments and facilities to address critical barriers to innovation; disseminating validated measurement methods and protocols; providing reference data, reference materials, and calibration services to ensure that industry-performed measurements are traceable to NIST standards; and developing testing protocols and supporting laboratory accreditation programs. NIST works actively with other metrology institutes from around the world to ensure that the global marketplace is supported with sound measurements and standards.

The NIST Laboratories also support the development of written standards and specifications that define technical and performance requirements for goods and services. These standards—also known as documentary standards—are often developed collaboratively with the private sector through an open, consensus-based process. NIST scientists and engineers lend their expertise to these efforts in order to promote standards that are based on sound science and to ensure that the standards are supported by effective measurements and testing for conformity to the standards.

Primary areas being researched with the program's base resources include the following:

- maintaining and disseminating national measurement standards;
- developing new measurement technologies and ways to tie needed measurements to fundamental national standards;
- developing, maintaining, and improving existing measurement science, services, references, and standards; and
- pursuing basic and applied research in measurement areas within NIST's mission.

The work performed by the NIST Laboratories affects many aspects of daily life in the U.S. Examples include:

- **Manufacturing** -- NIST programs in Advanced Manufacturing are developing the tools to enable new more competitive ways to manufacture current generation products and that support the manufacture of new products that are emerging from advanced technologies.
- **Cybersecurity** -- NIST programs focused on information technology and cybersecurity are enabling the adoption of a robust and secure cyber infrastructure that will increase productivity and foster continued innovation.
- **Interoperability** -- Critical emerging technologies such as the Smart Grid and national health care information systems have the potential to transform our society and revitalize the U.S. economy. NIST programs are helping to accelerate the development of standards needed to ensure that the many interconnected components in these systems can fully function and exchange information seamlessly across systems.

Laboratory Programs

Department of Commerce
National Institute of Standards and Technology
Scientific and Technical Research and Services
PROGRAM AND PERFORMANCE: DIRECT OBLIGATIONS
(Dollar amounts in thousands)

Program: Measurement science, services, and programs
Sub-program: Laboratory programs

Line Item		2012 Actual Personnel	2012 Actual Amount	2013 CR (annualized) Personnel	2013 CR (annualized) Amount	2014 Base Personnel	2014 Base Amount	2014 Estimate Personnel	2014 Estimate Amount	Increase/ (Decrease) over 2014 Base Personnel	Increase/ (Decrease) over 2014 Base Amount
Strategic and emerging	Pos./Approp	18	$9,496	18	$9,531	18	$9,598	18	$9,598	0	0
research initiative fund	FTE/Obl.	16	10,815	17	10,487	17	9,598	17	9,598	0	0
National measurement and	Pos./Approp	1,704	420,908	1,704	423,497	1,704	423,959	1,879	513,368	175	$89,409
standards laboratories	FTE/Obl.	1,582	433,075	1,710	435,016	1,710	424,607	1,839	515,266	129	90,659
User facilities	Pos./Approp	264	74,557	264	74,954	264	74,937	278	80,920	14	5,983
	FTE/Obl.	243	74,014	258	77,523	258	75,135	269	81,118	11	5,983
Postdoctoral research	Pos./Approp	103	13,008	103	13,157	103	13,184	103	12,884	0	(300)
associateship program	FTE/Obl.	95	11,607	103	13,842	103	13,198	103	12,898	0	(300)
Total	Pos./Approp	2,089	517,969	2,089	521,139	2,089	521,678	2,278	616,770	189	95,092
	FTE/Obl.	1,936	529,511	2,088	536,868	2,088	522,538	2,228	618,880	140	96,342

BUDGET SUB-PROGRAM: Laboratory Programs

BASE JUSTIFICATION:

Laboratory Programs Overview

The objectives of the Laboratory Programs are to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology that drive technological change. NIST's Laboratories play a unique role in the Nation's scientific, industrial, and business communities. NIST anchors the national measurement and standards system that is the language of research and commerce. Maintaining the national standards of measurement is a role that the U.S. Constitution assigns to the Federal government to ensure fairness in the marketplace. NIST's presence and leadership in the Nation's measurement and standards system enables companies, researchers, government agencies, and universities to work with each other more easily, improving the Nation's economic security and quality of life.

NIST resources are devoted to meeting today's economic and societal challenges and to laying the foundation for future success. NIST activities help address a broad range of critical challenges for the Nation. Current Administration priority areas targeted for budget increases include Advanced Manufacturing, Cybersecurity, Healthcare IT, Disaster Resilience, Forensics, Advanced Communications, and NIST Centers of Excellence in measurement science and new technology areas. NIST also supports enacted legislation such as the America COMPETES Act, which outlines major roles for NIST in promoting national competitiveness and innovation, and the National Technology Transfer Advancement Act (NTTAA), which designates NIST as the coordinator for all Federal agencies using documentary standards.

The individual descriptions of the activities under NIST's Laboratory Programs are described below.

1. NIST Center for Neutron Research (NCNR)

Program Description:

The NCNR safely and reliably operates a national user facility providing neutron-based measurement capabilities to U.S. researchers from industry, academia, other NIST laboratories, and other government agencies in support of materials research, neutron imaging, chemical analysis, neutron standards, dosimetry, and radiation metrology. Neutrons – uncharged particles from the nucleus of atoms – have unique properties that make them ideal probes of the structure and motion of materials at the scale of atoms and molecules in a material. The NCNR provides an intense source of neutron beams that are used to probe the molecular and atomic structures and dynamics of a wide range of materials. The facility also boasts a unique, large-volume, liquid hydrogen cold source, which produces the highest intensity of "cold" (or low-energy) neutron beams in the country. Cold neutrons are used to probe the underlying structures and slow dynamics in advanced materials such as plastics, magnetic films, chemical catalysts, biological materials, and composites. With such state-of-the-art measurement capabilities unavailable elsewhere in North America, the NCNR plays an essential role in broad sectors of nano-science and technology. In a wide range of applications, neutron beam measurement techniques are on a par with the x-ray or microscope in their ability to probe materials that are the focus of study in today's most important research areas, including materials, biotechnology, and nanotechnology. The NCNR operates as a national user facility that provides merit-based access to all qualified researchers. The NCNR also supports critical NIST research in materials research, chemistry, physics, nanoscale science, and other related fields. Use of the NCNR facilities for proprietary research is possible on a full-cost recovery basis. As a result, researchers from industry, academia,

and other Federal agencies depend on NCNR's unique research capabilities to work on cutting edge science. The capabilities of the NCNR are further leveraged through a variety of cost-sharing partnerships with other agencies, industries, and universities to expand specific measurement capabilities, and to broaden the access to unique neutron instrumentation. The NCNR is significantly expanding its collaboration with the Nation's industrial and academic researchers with new instrumentation and analysis methods for macromolecular structure and dynamics, elemental trace analysis, determination of magnetic nano-structures, neutron imaging, and neutron spectroscopy.

Examples of Accomplishments:

Research and Facility Performance:

- National Research Facility/Neutrons: The NCNR has operated with high availability for decades and provides, on average, 260 days of reactor operation annually to support scientific research. During FY 2012, nearly 2,000 researchers directly benefited from access to NCNR capabilities, which accounted for over one-half of all neutron research done in the United States. These researchers also represent 149 U.S. universities, 33 corporations, and 40 U.S. government organizations and laboratories.

- High Impact Research: Research performed at the NCNR resulted in 324 publications in FY 2012. With a significant fraction of these papers published in prominent journals, the NCNR ranks as one of the highest impact neutron facilities in the world.

Priority Objectives for FY 2014:

By FY 2014 the NCNR will have completed all of the infrastructure construction and will have commissioned new instrumentation that was enabled by work performed during the recent outage to complete construction. This has allowed NIST to provide new neutron measurement capabilities to the U.S. research community. Examples of research the expanded NCNR will support include:

- Energy Efficiency and Alternative Energy: Studying nanomaterials for the structure and behavior of new materials at the nano-scale, making it possible to improve process technologies and develop new materials applications in areas ranging from lighter weight advanced materials for the auto industry to new nanocomposites for polymer-based solar cells to new materials and approaches for the efficient storage of energy.

- Fuel Cell Design: Imaging the interior of complex devices and materials non-destructively to "see" how they function under various operating conditions. NCNR neutron imaging has made it possible to look through the steel casings of operating fuel cells and watch the flow and movement of water molecules as the cell functions, leading to better designs and performance.

- Drug and Vaccine Development: Improving the study of the structure and motions of very large biological molecules such as proteins. Neutrons can see detailed protein structure such as bending or folding which helps identify the protein's function. The insights gained could lead to the development of new drug therapies, new anti-toxins, and improved vaccines.

- Environment: Studying chemical interactions with porous or other complex structured materials. The unparalleled penetration and imaging power of neutrons is being used to develop new, more efficient, industrial catalysts and better ways to remove toxins from the

environment, as well as to achieve a better understanding of complex biological systems at the cellular level.

- Advanced Computer Technology: Studying advanced new materials that can be used to advance computer technology beyond the integrated circuit. As the size of transistors reaches fundamental limits, further advances in the computation power of computer chips will require new materials that can exploit other electronic properties, such as electronic spin, to carry information in the device.

- Materials Performance: Probing the internal stresses in materials such as pipelines, turbine blades, railroad rails, and shock absorbers, which are essential to understanding and improving the performance of products used in industry, transportation, and national defense.

- Data Storage: Increasing the density of stored information. The advance of information technology requires a concomitant increase in the density of stored information. This required the development of new nanostructured magnetic materials. Neutrons allow researchers to develop a detailed understanding of the magnetism to develop these new data storage systems.

2. Center for Nanoscale Science and Technology (CNST)

Program Description:

In the few years since its inception, the CNST has become a major national resource for nanoscale science and the development of nanotechnology, and the only national nanocenter with a focus on commerce. Unique in its mission to provide the measurement infrastructure that underlies all progress in this critically important 21st century technology, the CNST serves the U.S. industrial and scientific research communities by providing a venue for highly collaborative, multidisciplinary research and direct access to state-of-the-art nanoscale measurement and fabrication tools. The continued development of nanotechnology is key to firmly establishing U.S. leadership in such diverse fields as energy, manufacturing, information technology, electronics, health, and biotechnology. For example, in the case of energy, nanoscale phenomena lie at the heart of a great many energy production, storage, and transmission processes. Research in CNST's NanoLab aimed at optimizing the nanoscale structure of photovoltaic or thermoelectric devices can therefore have a profound impact by enhancing the conversion of the sun's energy to electricity. Such research demands a multidisciplinary approach and the development and ready availability of advanced tools, which manipulate and measure the properties of structures - where size can be counted in atoms. The CNST has been purposely built to satisfy these demands and offer many unique measurement capabilities in an open, collaborative, multi-disciplinary research environment. This environment is where the innovative research takes place that advances the state-of-the-art of measurement and fabrication ("fab"). A critical component of the CNST, the NanoFab, is available through a simple, merit-based application process. Users can economically utilize expensive state-of-the-commercial-art fabrication tools, measurement tools, and processes. Proprietary research can be performed on a full cost recovery basis. Having now completed its initial ramp up in staff, equipment, facilities, and processes, the CNST continues to expand its strategic relationships and collaborations with industrial and academic partners. In addition, in FY 2012 the CNST began an annual program to recapitalize and update its equipment and instrumentation and thereby maintain the cutting edge research environment required to meet the needs of CNST's stakeholders. In FY 2012 the NanoFab updated key elements of its nanofabrication capability in thin film deposition, nanoscale-lithography, and metrology, including capabilities for x-ray diffraction and ellipsometry. In FY 2013 the NanoFab recapitalization effort continues with significant enhancements in

electron beam lithography technology, wet chemical processing tools, and advanced metrology tools capable of keeping pace with the ever increasing requirements for improved accuracy and resolution.

Examples of Accomplishments:

CNST research focuses on industry and government priorities, as demonstrated by these recent examples:

- National Research Facility: In the few years since its inception, both the capabilities and the associated impact of the CNST have grown rapidly. In fiscal year 2012 alone, over 1,600 researchers representing over 350 institutions from 39 states and the District of Columbia participated in projects at the CNST. CNST projects resulted in 160 publications and patents in FY 2012, and helped more than 120 companies meet their measurement and fabrication needs.

- Nanoscale Fabrication: The CNST developed models and experimental methodologies that enable the sources of line-edge roughness to be identified in advanced photoresists and diblock copolymers that represent, respectively, the current state-of-the-art and the future direction of lithography in semiconductor manufacturing. Control of line-edge roughness is essential for maintaining progress in the semiconductor industry. This research included collaborators from CNSE Albany, Lawrence Berkeley National Laboratory, and the University of Maryland.

- Energy Conversion, Storage, and Transport: The CNST developed a new metrology for nanostructured oxides used for photoelectrochemical water splitting correlating multiple techniques, including energy dispersive X-ray spectroscopy (EDS), electrochemical impedance spectroscopy, electronic conductivity, and secondary ion mass spectroscopy to determine the dopant density. Results suggest a new route for achieving higher water splitting efficiencies.

- Energy Conversion, Storage, and Transport: The CNST developed a new method for fabrication of high current density field emitter arrays based on nanoporous silicon carbide. The emitters are monolithic structures whose fabrication does not require high temperature gas phase synthesis. Stable, continuous electron emission has been demonstrated that far exceeds that of existing technologies. This technology leading to field emitters that are reliable and operate at high current density would enable significant advances in several fields, including medical diagnostics.

- Future Electronics: CNST researchers used the CNST-developed, unique world-class low temperature scanning tunneling microscope to make key measurements of the electronic and electromechanical properties of graphene, the basis of new carbon-based electronics that is being hotly pursued by the electronics industry as a replacement for silicon in the ever-increasing pursuit of faster, smaller and more energy-efficient electronic devices. The CNST research included collaborators from the University of Maryland, Columbia University, Princeton University, SUNY Albany, the University of Texas at Austin, Georgia Institute of Technology, Seoul National University, the University of Regensburg, and others.

Priority Objectives for FY 2014:

- Nanoscale Material Characterization: Extend the capabilities of single-molecule fluorescence microscopy to the imaging of nanostructures at the 10 nm length scale in soft materials, such as diblock copolymers and photoresists, enabling the optimization of materials and processes in fields as diverse as integrated circuit fabrication and advanced composite manufacturing.

- Metrologies for Nanoparticle Production: Develop robust metrology techniques that use advanced optical and nanofluidic methods to enable quality control measurements of nanoparticle size, size distribution, shape, and shape distribution in production environments to assist U.S. industry in the volume production of nanoparticles for applications ranging from drug delivery to oil-well sensing. This effort will complement existing efforts related to nanoparticle environmental health and safety.

- New Microscopies for Nanoscale Characterization and Fabrication: Continue development of innovative ion beam sources that provide unique performance in brightness, species selection, and energy spread, enabling new imaging modalities and better nanomachining for such key industrial applications as integrated circuit editing and failure analysis. Actively pursue technology transfer of CNST-developed technology, leading to high tech start-ups and the associated increased employment opportunities in an area where the U.S. can lead the world.

- Solar Energy/Photovoltaics (PV): Develop measurements for functional and structural characterization of existing and emerging thin-film photovoltaic materials and devices to achieve three-dimensional, high resolution maps on the nanoscale. In collaboration with major U.S. companies, relate these property maps with high-throughput measurements to enable new manufacturing metrology required to fully optimize thin-film PV technology.

- Solar Energy/Solar Fuels: Develop methods for measuring water oxidation activity of photoelectrochemical (PEC) nanocatalysts with ultra-high sensitivity and establish the rate limiting steps for promising materials in support of developing PEC materials with improved performance. Develop measurements based on electron paramagnetic resonance spectroscopy to probe, in situ, the catalyst oxidation state, coordination environment, and reaction chemistry for integrating light harvesting with solar fuels production.

- New Generation of Nanotechnologists: Help educate a new generation of nanotechnologists by providing hundreds of young scientists and engineers with the ability to use some of the world's most advanced instrumentation to address the challenge of measuring the subtle phenomena of nature that occur only on the nanometer scale. Through two-year-long postdoctoral appointments and visiting fellowships available to scientists from academia, industry, and government laboratories, CNST will provide in depth, post-graduate training in nanotechnology for more than 50 researchers.

3. Physical Measurement Laboratory (PML)

Program Description:

The PML develops and disseminates the national standards of length, mass, force and shock, acceleration, time and frequency, electricity, temperature, humidity, pressure and vacuum, liquid and gas flow, and electromagnetic, optical, microwave, acoustic, ultrasonic, and ionizing radiation. Its activities range from fundamental measurement research to the provision of measurement services, standards, and data.

PML applies its measurement capabilities to problems of national significance through collaborations with industry, universities, professional and standards setting organizations, and other government agencies of government. It supports the research community in such areas as communication, defense, electronics, energy, environment, health, lighting, manufacturing, microelectronics, radiation, remote sensing, space, and transportation. PML establishes spectroscopic methods and standards for infrared, visible, ultraviolet, x-ray, and gamma-ray radiation; investigates the structure and dynamics of

atoms, molecules, and biomolecules; develops the electrical, thermal, dimensional, mechanical, and physical metrology for measuring the properties of precision measurement devices and exploratory semiconductor, quantum electronic, nanoelectronic, bioelectronic, biooptical, optoelectronic, and quantum information devices and systems; and examines the thermophysical and interfacial properties of streams of flowing fluids, fluid mixtures, and solids. It develops and disseminates national standards by means of calibrations, measurement quality assurance, standard reference materials, technology transfer, education/training, and a comprehensive weights and measurement program to promote uniformity and accuracy at the international, Federal, state, and local levels. It generates, evaluates, and compiles atomic, molecular, optical, ionizing radiation, electronic, and electromagnetic data in response to national needs; measures and improves accuracy of the fundamental physical constants; and develops and operates major radiation sources for measurement science and metrology.

NIST's base activities within PML support a broad range of scientific, technological, commercial, and consumer needs.

- Time and Frequency: NIST maintains the Nation's standards for time and frequency measurement, an increasingly important field that supports advanced communications, electronic systems, power grids, and high-speed commerce. NIST focuses on developing the highest accuracy standards and methods of disseminating time and frequency, e.g., through the Internet, radio broadcasts, and satellites. The Internet service alone provides official time to the public over 12 billion times daily.

- Medical Radiation and Imaging Technology: NIST calibrations underlie the safety and efficacy of diagnostic procedures (such as mammography) and therapeutic procedures (such as for cancer treatment). Well in excess of 22 million therapeutic radiation procedures and nearly 40 million x-ray mammograms annually are traced to NIST standards. NIST researchers have a robust program in a broad range of medical imaging technologies.

- Electrical and Electronics Metrology: Electronics are highly dependent on measurements enabled by NIST programs. NIST supports the electronics industry in many ways in its drive to develop ever smaller and more functional semiconductor products. The accuracy of every electricity revenue meter in the U.S. relies on standards provided by NIST. NIST is currently developing new techniques to support increasing complex, smaller, and more integrated devices, where feature sizes continue to be reduced and the role of defects and imperfections become increasingly important. In addition, NIST is developing techniques for to support state variables other than charge for future electronic logic.

- Optoelectronics and Optical Technology: The optical products industry is a $100 billion sector, requiring accurate and trusted standards in areas such as lighting, communications, photography, color and appearance, spectroscopy, and imaging. Work at NIST is important for environmental monitoring instruments used to measure temperature, atmospheric composition, and other things important in large-scale climate studies.

- Mechanical and Dimensional Metrology: NIST leads the development of new measurement standards to support U.S. manufacturing and harmonize the U.S. with international standards, removing impediments to U.S. competitiveness. NIST activities in this area promote lower costs for U.S. manufacturers, assure quality and interchangeability of parts, and achieve acoustical standards for the safety of workers in noisy environments.

- Fluid Dynamics: NIST maintains, improves, and disseminates the national measurement standards for gas flow, liquid flow, air speed, pressure, temperature, and humidity. Such measurements

underlie process chemistry and manufacturing, equitable commerce in natural gas and liquid fuels, wind turbine performance, aircraft altimeter accuracy, and atmospheric monitoring.

- Public Health and Safety: NIST expertise in radiation detection and measurement supports critical needs of first responders, homeland security surveillance, medical sterility, and nuclear energy. Optical measurement systems support needs in highway and aviation safety, missile defense, and medical diagnosis. NIST aids the law-enforcement community with performance standards for body armor and bullet forensics.

- Weights and Measures: NIST promotes uniformity in U.S. weights and measures laws, regulations, and standards to achieve equity between buyers and sellers in the marketplace nationwide and internationally. This enhances consumer confidence, enables U.S. businesses to compete fairly at home and abroad, and strengthens the U.S. economy. NIST works with state and local officials and business, industry, and consumer groups, to achieve these goals.

- Advanced Training and Technology Transfer: Through NIST's joint institutes with the University of Colorado (JILA) and the University of Maryland (Joint Quantum Institute), NIST helps train graduate students and postdoctoral fellows in advanced science and technology, who support research and innovation in industry, academia, and government laboratories. Many NIST-supported trainees have gone on to found high-technology companies, creating new jobs and products for the U.S. economy.

Examples of Accomplishments:

- Public Safety: NIST played a central role in the establishment of new testing and evaluation standards for radiation and nuclear detectors, which have been adopted by 22 Federal agencies. The standards cover a range of devices from personal-detection equipment to hand-held radionuclide identifiers for field use and portal monitors for vehicles and cargo containers. The standards provide assurance to the agencies that their radiation detectors are reliable and fit for the purpose for which they are being used.

- Medical Imaging Technology: NIST developed a miniature, atom-based magnetic sensor that can measure human brain activity. Experiments verified the sensor's potential for biomedical applications such as studying mental processes and advancing the understanding of neurological diseases. The sensor, about the size of a sugar cube, contains a low-power laser and micro-optics that, together with rubidium vapor in a sealed cell, can measure a magnetic field 50 million times weaker than that of the Earth.

- Quantum Information and Communication: NIST made practical advances in the nascent field of quantum computing, demonstrating the first "universal" programmable quantum processor, which could one day be coupled together to perform practical computations, and the first quantum "dimmer switch," which could eventually store and transport information in future quantum computers. NIST also produced the world's most efficient single photon detector, which is able to count individual particles of light traveling through fiber optic cables with roughly 99 percent efficiency—a tool needed to ensure the accuracy of quantum computations and the integrity of secure quantum communications.

Priority Objectives for FY 2014:

- Advanced Communications: Using ultrafast electro-optic measurement technology, NIST will improve the ability to measure complicated signals at new and higher bandwidths. This will help wireless and fiber optic communications achieve high bandwidth data transfers, enabling wireless Internet access and optical transport at these potential high data rates.

- Large-Scale Dimensional Metrology: Develop a new multilateration technique using laser trackers to provide world-class measurement accuracy on large, complex 3-D structures, such as airplanes. Applications include construction and advanced manufacturing.

- Better Microscopy for Nanomanufacturing: Develop innovative approaches to solving vibration and drift problems in production line, scanned particle beam microscopy by utilizing super-fast image capture and a NIST-developed alignment program to improve image sharpness.

- Medical Imaging Technology: Design and calibrate "phantoms" to better calibrate PET-CT scanners, and use them to monitor scanner performance during a clinical trial. This will be the first clinical trial that uses a calibrated phantom standard to assist in evaluating the instrumental effects on clinical data. Additionally, continue development and validation of a phantom to calibrate magnetic resonance imaging (MRI) scanners. Together, these will improve the accuracy of medical diagnostic imaging, lead to more effective treatments, and speed the discovery and validation of new drugs and therapies.

- Electronics Technology: Develop the measurement science infrastructure that will enable emerging "Beyond-CMOS" nanoelectronic information processing technologies, including those based upon new computational state variables, to more rapidly enter into the marketplace.

- Optical Technology: We will develop and benchmark a deployable instrument based on differential absorption LIDAR (Light Detection And Ranging) for accurately measuring greenhouse gas emissions from natural and anthropogenic sources. Combined with measurements of greenhouse gas sinks, these data will inform local, national, and international mitigation efforts.

- Public Health and Safety: We will develop and deploy specialized radiation detectors in a public transit application. We will operate the detectors in underground locations for an extended period of time to monitor the variability in the ambient radiation background. These data will assist commercial manufacturers of radiation detectors develop products that are effective and suitable for the application.

- Measurement Science: Develop "NIST on a chip" technology, exploiting NIST's pioneering research in chip-scale atomic clocks and magnetometers, for a broad range of measurements, including time, length, electrical quantities, acceleration, and temperature. This research will provide the public with extremely accurate measurement capability in small, convenient devices. These devices will be incorporated into innovative products and directly benefit manufacturers.

- Measurement Services: Strengthen NIST's programs in the delivery of calibration services by furthering the development of the mise-en-pratique for the electronic kilogram. This will allow an international redefinition of the kilogram, to be based on fundament constants of nature, and improve the method of delivering services. Develop new, dynamic measurement techniques in

both force and length metrology to support real-time measurements for advanced manufacturing.

4. Material Measurement Laboratory (MML)

Program Description:

The MML serves as the national reference laboratory for measurements in the material, biological, and chemical sciences through activities ranging from fundamental and applied research on the composition, structure, and properties of industrial, biological, and environmental materials and processes, to the development and dissemination of certified reference materials, critically evaluated data, and other programs to enable assurance of measurement quality.

MML serves a very broad range of industry sectors ranging from transportation to biotechnology by conducting research, and providing its output in the form of measurement services and measurement quality assurance tools to address problems of national importance such as: greenhouse gas emissions measurements; renewable energy; the Nation's aging infrastructure; environmental quality; food safety and nutrition; forensics and homeland security; healthcare measurements; and manufacturing ranging from advanced materials to photovoltaics to biologic drugs.

Specifically, MML conducts research in:

- Materials Science and Engineering to provide the measurement science, standards, technology, and data required to support the Nation's need to design, develop, manufacture, and use materials. In partnership with U.S. industry, other government agencies and other scientific institutions, we develop and disseminate measurement methods, theories, models, tools, critical data, reference materials, reference data, standards, and science underpinning the Nation's materials science and engineering enterprise. These activities foster innovation and confidence in measurements needed to advance technology and facilitate manufacturing in industrial sectors such as energy, electronics, transportation and the environment.

- Materials Measurement Science to provide the measurement science, measurement standards, and measurement technology required to enable world-leading characterization of materials in support of the Nation's needs for the determination of the composition, structure, and properties of materials. In partnership with U.S. industry, government agencies and other stakeholders, we develop state-of-the-art instrumentation, methods, models and software to accurately and precisely measure materials over a range of length and time scales. We provide benchmarking and validation of emerging materials analysis methods, and disseminate reference materials, standards and scientific data to foster innovation and advance a wide range of technologies, such as those for public safety, forensics, homeland security and nanomanufacturing.

- Biosystems and Biomaterials to address the Nation's needs for measurement science, standards, data, methods and technology in the quantification of complex biological systems, materials and processes, from the nano- to the macro-scale. In partnership with U.S. industry, other government agencies and other scientific institutions, we develop and disseminate infrastructure supporting quantitative biology and biomaterial measurements with the intent of fostering innovation and confidence for stakeholders in biomedicine and healthcare, manufacturing, food safety, environmental health, and national security. We enable the U.S. to maximize the return on our national investment in the bioscience enterprise through interdisciplinary research drawing from expertise in the physical, information, and biological sciences.

- Biomolecular Measurement to provide the measurement science, standards, technology, and data required to support the Nation's needs in determining the composition, structure, quantity, and function of biomolecules. In partnership with U.S. industry, government agencies, and scientific institutions, we perform fundamental and applied research on the measurement of macromolecules such as proteins and nucleic acids, as well as peptides, glycans, metabolites, lipids, and natural products. We provide measurement science, reference materials, reference data, and technologies to foster innovation and confidence in measurements needed to advance biotechnology, DNA forensics, biomedical and bioscience research, and health care.

- Chemical Sciences to provide the measurement science, standards, technology, data and chemical informatics required to support the Nation's needs in the determination of chemical composition and chemical structure of gases, organic, and inorganic species and in the measurement of a wide variety of chemical properties and processes, including chemical reactivity and mechanisms, and thermochemical properties. In partnership with U.S. industry, government agencies, and academic scientific institutions, we perform fundamental and applied research to advance and create state-of-the-art chemical measurement capabilities, theory and computational methods for quantitative measurements, and sensing of solids, liquids, gases, plasmas, transient species, and multicomponent matrices. We also formulate and disseminate reference materials and measurement standards, and critically evaluate reference data. These activities support the chemical science, technology, and engineering enterprise with the intent of fostering innovation and confidence in measurements and technologies used in a wide range of applications, including chemical analysis, environmental and climate assessment, clinical health assessment, food and nutritional assessment, sensing, manufacturing, and energy transformation.

- Applied Chemicals and Materials to provide the measurement science, standards, technology, instrumentation, models and data required to support the Nation's needs for design, production, and assessment of chemical and material products. In partnership with U.S. industry, other government agencies and other scientific institutions, we provide thermophysical and mechanical properties; analysis of reliability and performance of materials and structures; and information systems for chemical and materials engineering, with the intent of fostering innovation and confidence in the Nation's physical and energy infrastructures, enabling advances in chemical manufacturing and in electronics, and promoting sustainability.

MML is also responsible for coordinating the NIST-wide Standard Reference Materials (SRMs) and Standard Reference Data (SRDs) programs. NIST SRMs, SRD and calibrations are key technology transfer mechanisms that enable U.S. industry to achieve traceability of their measurements to NIST's fundamental standards and best-in the-world measurements, and to the International System of units. This traceability enables industry to more easily address international comparability and compliance, which is necessary for the US to export its products worldwide.

Examples of Accomplishments:

Accomplishments (and continuing activities) include research and measurement service delivery focus on industry and government priorities, as described below:

- Advanced Materials: Provided the underpinning measurement science, standards and leading-edge measurement tools needed to establish quantitative processing-structure-property relationships of advanced materials, in ways that enable U.S. industry and other government agencies to discover, develop and optimize advanced materials and to harness their properties for technology innovations. Advanced materials include ceramics, metals, polymers, semiconductors, composites, fluids, and some biomaterials, in bulk, particulate, and multilayer forms, that have new

or improved properties; MML provides the tools and standards for accurate measurements of material composition, structure, and properties for sustainable and safe manufacture, use and recycling of products that contain advanced materials.

- Biomedical and Health: Increased the accuracy, comparability, and efficacy of measurements used in medical diagnostics and advanced therapeutics in ways that enabled reduced U.S. healthcare costs and improve quality of life through more informed medical decision-making. For more than 25 years NIST has maintained standards for electrolytes, organic biomarkers (such as cholesterol, creatinine and glucose), drugs of abuse and toxic metals. NIST provides needed measurements and standards to support: the measurement of health status markers in serum, urine, and tissue; the development of innovative biologic medicines such as protein therapeutics, cell-based regenerative products, and vaccines; the development of advanced dental materials, tissue engineering scaffolds, nanoparticle-based therapies for cancer, and safe and reliable implanted medical devices.

- Electronics: Quantified the composition, structure, properties and dimensions of current and emerging electronic materials and devices, and assessed electronics fabrication routes in ways that enabled development and manufacture of advanced electronics by U.S. industry. This work enables industrial development and commercialization of next-generation semiconductor devices, magnetic materials for low-noise sensors and next generation computer logic, and flexible organic electronic devices; as well as tests and standards to ensure the safe and reliable long-term use of these products.

- Energy: Supported the development, production and reliability of materials and devices related to advanced energy sources, renewable energy, energy storage and energy-harvesting, as well as the safe and effective use of petroleum, in ways that enabled the Nation to adopt new energy technologies and to ensure energy security. MML measurement methods, reference materials and data are essential for a cleaner fossil fuel economy, and support the development, manufacture and quality control of biofuels, next generation photovoltaics, advanced batteries and heat-harvesting thermoelectric devices.

- Environment and Climate: Verified assessments of soil, air, and water, as well as environmental threats, and supported environmental remediation strategies, in ways that enabled our Nation to protect its environmental resources and develop science-based environmental policy. MML measurement methods, certified reference materials, reference data, and measurement quality assurance programs are central to environmental contaminant measurement and monitoring programs, provide needed improvements to the reliability and comparability of measurements and assessments of environmental quality and climate; In addition, MML has developed an advanced specimen banking program that enables retrospective analyses and determination of trends of contaminants in the environment and animals.

- Food Safety and Nutrition: Underpinned measurements of the composition of food and water in ways that enabled the Nation to prevent contaminated food and water from entering supply streams, ensured the reliability of nutrition information on product labels, and that enabled consumers to make well-informed dietary choices. MML reference materials enable food manufacturers and distributors to accurately assess the nutritional content of their products, and MML expertise in chemical analysis supports new methods to detect contamination.

- Manufacturing: Supported the industrial production of finished goods from raw chemicals, raw materials and biological sources, and facilitated the design of materials for manufactured products, in ways that promote innovation, U.S. industrial competitiveness, and job creation. MML research and standards products provide essential support to a large number of U.S. manufacturing sectors, including automotive, electronics, materials and chemicals production, and biopharmaceuticals.

- Physical Infrastructure: Provided measurement science and test methods, including non-destructive evaluation techniques, needed to assess the health of aging physical infrastructure components and materials, to predict their lifetime and failure, and to gauge their performance under extreme environmental conditions, in ways that enabled the Nation to prioritize infrastructure remediation, and to manufacture more resilient infrastructure components. These include reference materials and standards for assessing material strength and hardness, standards for fuel pipeline safety, methods to assess the performance of plastic pipes for water and gas, and methods to test and predict the heath of critical connections and join-ends in bridges and buildings.

- Safety, Security, and Forensics: Advanced threat detection, improve the accuracy of forensics measurements and helped ensure the reliability of protective technologies and materials, in ways that foster homeland security, the safety of public servants, and effective law enforcement. These include advanced instrumentation and reference materials that enable the accurate and reliable detection of chemical, biological, radiological, nuclear and explosive threats; standards and reference materials that support DNA-based human identity testing for forensics and biometrics; and measurement methods that ensure the reliability of soft body armor.

Priority Objectives for FY 2014:

Advanced materials: To enable innovation, manufacture, use and recycling of high priority advanced materials in a range of industry sectors, MML will develop and disseminate:

- instruments, measurement methods, and standards to determine the composition and structure of advanced materials with the unprecedented resolution and accuracy needed by industry to advance the development of products that contain such materials; for example, semiconductors, engineered nanomaterials, and catalysts. These measurement tools include microscopy and spectroscopic methods to image materials at the atomic and molecular scales, and a suite of NIST-developed synchrotron spectroscopy instrumentation to be installed at the world's premiere synchrotron user facility, NSLS-II (Brookhaven National Laboratory)

- instruments, measurement methods, standards and validated data to determine the properties of advanced materials for myriad industries. For example, reference materials to calibrate instruments for nanoscale measurements, including reference flexural cantilever arrays for force measurements in scanning probe microscopes, which are ubiquitous in industrial laboratories, and length-dispersed carbon nanotube reference materials to assess potential environmental, health, and safety (EHS) risks and to enable their use in nanomanufacturing of CNT-enabled products

- databases of critically evaluated crystal structure, diffusion rates, interatomic potentials, and phase equilibrium diagrams needed by industry to design, develop, and process advanced materials

- transferable instruments, validated protocols and assays, standards, and validated data to determine the physico-chemical and toxicological properties of engineered nanomaterials and nanotechnology-enabled products, essential to assess and manage EHS risks, with a focus on

industry-relevant advanced materials such as carbon-based nanomaterials and nanoparticles of titanium dioxide, silver, and silicon dioxide. A specific thrust area is the detection, quantification, and characterization of silver nanoparticles in textiles and CNTs in polymer-based composites

- a new industry consortium, nSoft, which will help a wide range of industry partners leverage advanced neutron-based measurement methods needed to accelerate the development and commercialization of new "soft materials", including polymers, colloidal materials, complex fluid formulations, petroleum based products, consumer products, and pharmaceuticals.

Biomedical and Health: MML will develop and disseminate reference methods, Standard Reference Materials, and measurement quality assurance programs to increase the accuracy and comparability of healthcare assessments and to advance biomedical technologies, including:

- protocols and reference materials for blood protein health status marker detection (such as those used for detection of heart attack, kidney function, and prostate cancer)

- DNA and RNA measurement methods and standards that support whole genome sequencing, early detection and diagnosis of disease such as cancer, and genetics-based diagnostics for detection of chromosomal disorders such as Huntington's Disease and Fragile X Syndrome

- measurement protocols, reference data, and reference materials to support the development, manufacturing and regulatory approval of innovative biopharmaceuticals such as protein therapeutics

- novel measurement methods and protocols development for mapping cell response and composition

- documentary standards and best-practice protocols for measuring key attributes of stem cells linked to their safety and efficacy as requested by the cell therapy industry and the FDA

- measurements and data needed to ensure the reliability of implanted medical devices, including means to predict runaway wear, a leading cause of failure in metal hip replacements, and non-destructive in-line means to detect faulty capacitors and leads in active medical devices like pacemakers

- measurement protocols and reference materials for improving the design and reliability of new dental materials, such as mercury-free polymer composite filling materials.

Electronics: In support of the U.S. semi-conductor and electronics industry and the users of advanced electronic materials in a number of industries, MML will develop and disseminate:

- measurement methods and instrumentation needed to accelerate the commercialization of devices based on emerging electronic technologies, including organic flexible electronics and magnetic based logic, by enabling industry to determine the source of materials performance variations that hinder reliable manufacture of innovative products such as flexible displays and ultra-energy efficient computer components

- measurement methods, instruments and reference materials needed by the U.S. semiconductor industry to produce the nanoscale structures, and to employ the novel materials, inherent to the manufacture of next-generation microelectronic devices. These include dimensional metrologies to

ensure the quality of manufactured structures and films, enable the use of self-assembly approaches, and 3D chemical imaging and depth profiling techniques to gauge the reliability of emerging materials deposition and doping routes for manufacturing multi-layered devices and interconnects

- measurements and models to determine the mechanical integrity and predict the lifetime and reliability of device components including those in implantable medical devices

- measurement science underpinning ultrasensitive magnetic sensor technologies for healthcare and military applications, and measurement techniques that support the manufacture of reliable microelectromechanical systems by mapping strain and stress in devices at the nanoscale.

Energy: To keep abreast of current measurement needs of U.S. industry as they design, manufacture, and deploy renewable energy resources, MML will develop and disseminate:

- measurement methods, documentary standards, and reference materials to accelerate the commercialization of solar devices made from thin-film semiconductors, nanostructured materials, and organic photovoltaics. These include measurement tools requested by the budding U.S. solar industry to benchmark material performance, optimize processing and design, monitor manufacturing processes, and determine failure mechanisms that shorten lifetime

- measurement methods, data, and reference materials that enable our Nation to develop and use alternative and renewable fuels. These include needed fundamental physical property data and the production of data and reference materials needed for the reliable manufacturing and quality control of biofuels such as ethanol and biodiesel, alternative aviation and motor fuels, and pinene and terpene based fuels

- measurement methods and reference materials to accelerate the industrial development of energy harvesting and energy storage devices. These include instrumentation and reference materials needed by the U.S. automotive industry to test the performance of thermoelectric devices that recover waste-heat, and measurements that will help industry to commercialize better batteries and fuel cells

- measurement protocols and critical data for testing composite wind turbine blades under bending, shear and tension, to ensure that new materials and integration methods are sufficiently robust to avoid failure during operation.

Environment and Climate: MML will develop and disseminate:

- measurement methods, data, chemical informatics tools, and reference materials to allow precise measurements of key greenhouse gases, including carbon dioxide, methane, and reactive species. This will include two reference materials for calibrating atmospheric levels of CFCs as well as very accurate measurements of optical properties of methane

- reference materials and data needed to support the Deep Water Horizon Oil spill damage assessment and remediation efforts, including means to better monitor oil residues in marine sediments and animal tissues

- reference materials, data, and measurement methods to enable sound scientific assessment of the state of aquatic and soil environments when impacted by contaminants attributed to chemical

releases from industrial activities, including hydrocarbons in marine environments, and heavy metals, such as hexavalent chromium, in soil

- measurement methods, data, and reference materials to allow precise measurements of the optical properties of environmental aerosols, such as so-called black and brown carbon species, that will enable substantially better models for predicting atmospheric warming phenomenon

- measurement methods for assessing the release of engineered nanoparticles from nanotechnology enhanced products

- measurement methods and data necessary to design and evaluate candidate sorbent materials for industrial scale carbon capture and sequestration systems

- reference data and thermophysical property values to evaluate the effectiveness and safety of more environmentally benign refrigeration fluids.

Food Safety and Nutrition: In this area, reference measurement methods and reference materials or data will be developed and disseminated for underpinning measurements made for determining:

- folate species, vitamin B12, vitamin B6, and vitamin D metabolites to support human nutrition assessment studies being conducted by the CDC and NIH

- accurate levels of iodine and other key nutrients in baby foods, breakfast cereals and table salt, in partnership with the NIH Office of Dietary Supplements

- identity and properties of bacterial foodborne pathogens by coupling emerging genomic methods with mass spectrometry techniques.

Manufacturing: Enabled by new funding provided in FY 2012 appropriations and the reprioritizing of current resources, MML will grow priority measurement science and standards programs that will enhance the competitiveness of U.S. manufacturers. Priority program development will include:

- Biomanufacturing: The MML program in biomanufacturing will develop measurement methods, protocols, and standards for improved measurement of biologic products. Biotechnology drugs, currently dominated by protein therapeutics, are the fastest-growing class of pharmaceuticals and one of the fastest growing categories of health care spending. One of the major factors for the high price of these products is the inability of the current state-of-the-art in measurement technology to define these complex protein products with sufficient precision and accuracy. MML will work closely with industry, the FDA, and other standards organizations with the goal of developing a new measurement science and tools for improved physical/chemical characterization of biologic products. Improved measurement infrastructure will enable greater manufacturing flexibility, the development of biosimilars and new innovative products, and ultimately, safer, more effective biologic medicines.

- Materials Genome Initiative (MGI): MML expertise in materials measurements and modeling is an essential component to this interagency effort aimed at accelerating industrial innovation by significantly reducing the time from discovery to commercialization for new materials. The MGI will integrate modeling and simulation tools with experimental tools and digital data/informatics in ways that enable rapid prediction and optimization of materials properties. To support this revolutionary approach, MML, in collaboration with NIST's Information Technology Laboratory, will continue to

develop the key infrastructure to enable data and models to be exchanged between researchers and integrated in real time, and provide the critical quality metrics (validation, verification, sensitivity, and uncertainty quantification) for these data and models to allow realization of advanced, new materials. To achieve these ends, NIST will continue to assess and implement the best technical modalities for materials data exchange, develop digital repositories of materials data and models, and work with its stakeholders to establish additional repositories, using shared, consensus-based, materials metadata standards.

- NanoEnvironmental Health & Safety for Nanomanufacturing: In partnership with Industry and other agencies, MML will develop measurement methods, standards, and validated data needed to support EHS assessments of nanomaterials in nanotechnology-enabled products and the release of nanomaterials from such products during manufacturing. These measurement tools will enable safe implementation of U.S. innovations in nanomanufacturing and provide the basis for science-based regulation of nanomaterials and nanotechnology-enabled products.

- In-line Measurements for Manufacturing with Advanced Materials: In partnership with industry, MML will develop measurement tools capable of monitoring advanced high-volume manufacturing processes used to produce technologies such as flexible electronics and organic photovoltaics. The work will focus on techniques for monitoring processes such as interface formation, film formation, deposition distribution and structure formation at the speeds needed for high-volume manufacturing, and often with nanometer-level resolution.

- Advanced Materials for Sustainable Vehicles and Structures: In partnership with the Nation's leading vehicle manufacturers, The NIST Center for Automotive Light-Weighting will deploy data, measurement protocols and models that enable the automotive industry to rapidly design and produce vehicle components from advanced light-weight alloys, which promise to radically improve fuel efficiency. In addition, MML will pioneer: 1) fundamental measurements to accelerate the manufacture of high-power magnets and electronics, often used in hybrid cars, that reduce or eliminate the use of critical rare earth metals, 2) development of measurement protocols and standard reference materials that improve the quality and performance of renewable plastics and composites fabricated from bio-based feedstocks to be used in vehicles and other structures.

Physical Infrastructure: MML will focus its measurement science base in areas critical to maintenance and assessment of our Nation's physical infrastructure. MML will develop, validate, and disseminate:

- measurement techniques that will establish the safety of gusset plate connections in fracture-critical bridges, and that support the establishment of standards for non-destructive bridge condition assessments, in collaboration with the FHWA Turner-Fairbank Research Center

- measurements and computational models of connections in bridges to predict their resilience to extreme conditions like fire and impact, and detect hidden flaws due to corrosion

- test methods and standards to qualify steels used in fuel pipelines, and measurements that foster the repurposing of pipelines for alternative fuels like hydrogen, and needed by the DOT and DOE to determine the safety rating of these materials for hydrogen distribution

- develop measurements to foster robust water infrastructure, including means to evaluate next generation plastic water pipelines used in households and nuclear plant cooling and test the mechanical integrity of water filtration membranes.

Safety, Security, and Forensics: In this area, MML will develop and deploy:

- measurement methods, reference materials, and data to ensure that the Nation has reliable and effective detection capabilities for Chemical, Biological, Explosive, and Nuclear threat materials, including new test protocols for the efficient sampling of contraband residues requested by the Transportation Security Administration, and control and calibration systems for assessing the performance of biothreat assays

- reference materials and methods of DNA profiling for consistent genetic typing within the forensics and biometrics communities, including new tests to evaluate prototype rapid DNA typing equipment

- a new laser based protocol for evaluating the performance of soft body armor materials at high strain rates.

5. Engineering Laboratory (EL)

Program Description:

EL provides the measurement science and standards needed for the technology-intensive manufacturing, construction, and cyber-physical infrastructure communities. EL carries out mission functions in fire prevention and control; national earthquake hazards reduction; national windstorm impact reduction; national construction safety teams; building materials and structures; engineering and manufacturing materials, products, processes, equipment, technical data, and standards; green manufacturing and construction; manufacturing enterprise integration; smart grid devices and systems; collaborative manufacturing research pilot grants; and manufacturing fellowships. EL also carries out other engineering research and services to support mission functions as may be necessary, including systems integration and engineering; intelligent systems and control; robotics and automation; cyber-physical systems; sustainability and energy efficiency; economic analysis and life cycle assessment; productivity measurement; and safety, resilience, and environmental performance.

EL's measurement science research and services include the development of performance metrics, measurement and testing methods, predictive modeling and simulation tools, knowledge modeling, protocols, technical data, and reference materials and artifacts; the conduct of inter-comparison studies and calibrations; the evaluation of technologies, systems, and practices, including uncertainty analysis; and the development of the technical basis for standards, codes, and practices—in many instances via testbeds, consortia, standards and codes development organizations, and/or other partnerships with industry and academia.

The impacts of EL's mission programs are focused on three strategic goals in areas of critical national priority: Disaster-Resilient Buildings, Infrastructure, and Communities; Sustainable and Energy-Efficient Manufacturing, Materials, and Infrastructure; and Smart Manufacturing, Construction, and Cyber-Physical Systems. EL achieves these end-use impacts by serving as an authoritative source of (1) critical solution-enabling measurement science, and (2) critical technical contributions underpinning emerging standards, codes, and regulations that are used by the U.S. manufacturing, construction, and infrastructure industries to strengthen leadership in domestic and international markets. The programs described below support EL's strategic goals; they all develop and deploy advances in measurement science with the specific objectives listed.

- Smart Manufacturing, Construction, and Cyber-Physical Systems

  - Smart Manufacturing Processes and Equipment: To enable rapid, agile and cost-effective production of innovative, complex products through advanced manufacturing processes and equipment.

  - Next-Generation Robotics and Automation: To safely increase the versatility, autonomy, and rapid re-tasking of intelligent robots and automation technologies for smart manufacturing, construction, and cyber-physical systems applications.

  - Smart Manufacturing and Construction Control Systems: To enable real-time monitoring, control, and performance optimization of smart manufacturing and construction systems at the factory or site.

  - Systems Integration for Manufacturing and Construction Applications: To enable integration of engineering information systems used in complex manufacturing and construction networks to improve product and process performance.

  - Smart Grid: To enable integration of interoperable and secure real-time sensing, control, communications, information and power technologies to increase the efficiency, reliability and sustainability of the Nation's electric grid.

- Sustainable and Energy-Efficient Manufacturing, Materials, and Infrastructure

  - Sustainable Manufacturing: To enable sustainable production of complex manufactured products through efficient utilization of energy and materials resources.

  - Sustainable, High-Performance Infrastructure Materials: To enable sustainable use of materials in manufacturing and construction, including cementitious, polymeric, and composite materials.

  - Net-Zero Energy, High-Performance Buildings: To move the Nation toward net-zero energy, high-performance buildings while maintaining a healthy indoor environment.

  - Embedded Intelligence in Buildings: To improve building operations to achieve energy efficiency, occupant comfort, and safety through the use of intelligent building systems.

- Disaster-Resilient Buildings, Infrastructure, and Communities

  - Fire Risk Reduction in Communities: To improve the resilience of communities and structures to unwanted fires through innovative fire protection and response technologies and tactics.

  - Fire Risk Reduction in Buildings: To increase the safety of building occupants and the performance of structures and their contents by enabling innovative, cost-effective fire protection technologies.

  - Earthquake Risk Reduction in Buildings and Infrastructure: To resist earthquake effects, improve safety, and enhance resilience of buildings, infrastructure, and communities.

- Structural Performance Under Multi-hazards: To enhance the resilience of buildings and infrastructure to natural and manmade hazards.

Examples of Accomplishments:

- Smart Manufacturing, Construction, and Cyber-Physical Systems

  - Smart Manufacturing Processes and Equipment: NIST technical contributions and standards leadership resulted in the first ever international standard specifying test procedures to measure and evaluate the performance of contacting probe systems integrated with numerically controlled machine tools (ISO 230-10:2011). This standard helps manufacturers implement on-machine measurement of machined parts to improve quality monitoring and control.

  - Next Generation Robotics and Automation: A significant revision of the ANSI B56.5 safety standard for automated guided industrial vehicles was released to update the safety requirements for their design, operation, and maintenance based on critical NIST contributions. The safety standard now incorporates the latest advances in the areas of non-contact sensing, obstacle detection, and vehicle control which will be incorporated into new automated vehicles and users will benefit from reduced accidents and injuries.

  - Smart Manufacturing and Construction Control Systems: Developed a new standard for security requirements for industrial control systems (ISA 99.03.03) that will promote integration of security into the design process—rather than as an after-thought—for future industrial control systems, thus resulting in greater security for manufacturing and critical infrastructure controls.

  - Systems Integration for Manufacturing and Construction Applications: Developed three-dimensional manufacturing information specifications that have been adopted by ISO, and included in new international standards for manufacturing systems integration, and in engineering data quality tests to reduce manufacturing errors. These new standards and tests enable exchange of manufacturing information using lower cost engineering applications that are more affordable for small and medium sized U.S. manufacturers.

  - Smart Grid: Published NIST Framework and Roadmap for Smart Grid Interoperability (Release 2.0), a revised version of the NIST Framework and Roadmap for Smart Grid Interoperability. This document includes updates on the Smart Grid architectural framework, priorities for standardization, standards identified for implementation, the Smart Grid Interoperability Panel (SGIP), Priority Action Plans (PAPs), cybersecurity, testing and certification, and international Smart Grid standards.

- Sustainable and Energy-Efficient Manufacturing, Materials, and Infrastructure

  - Sustainable Manufacturing: Launched a new sub-committee E60.13 on Sustainable Manufacturing under American Society of Testing and Materials (ASTM) Committee E60 on Sustainability. Introduced into the consensus standardization process the following draft ASTM standards 1) New Guide for The Evaluation of Manufacturing Processes for Sustainable Improvement and 2) New Guide for Sustainability Improvement of Manufacturing Processes. Developed a research tool for harmonizing and visualizing the terms and concepts. This was demonstrated to the industry partners and ASTM will evaluate this tool for use across various technical committees.

- Sustainable, High-performance Infrastructural Materials: Introduced into the standardization process, a draft standard on concrete rheometer calibration protocol, which makes use of a combination of new NIST standard reference materials and computational models. This standard will give the concrete industry the measurement science-based tools needed to optimize concrete mix design for ease of placement and to make more wide-spread and effective use of new materials like self-consolidating concrete.

- Net-Zero Energy, High-Performance Buildings: Completed the design, construction, and instrumentation of the Net-Zero Energy Residential Test Facility. This facility will initially be used to demonstrate a home similar in size, aesthetics, and features to those in the surrounding community can generate as much energy as it consumes on an annual basis. The facility will subsequently be used to as a test bed to improve methods of test and performance metrics for residential energy efficient technologies. Developed a commissioning tool for residential and light commercial air-conditioning and heat pump systems to guide the installer in setting proper refrigerant charge both in the cooling and heating modes as well as verify the overall health of the system. Verifying proper installation will significantly reduce the estimated 95 percent of systems that fail a health check and operate at less than 80 percent of their as-designed efficiency.

- Disaster-Resilient Buildings, Infrastructure, and Communities

  - Fire Risk Reduction in Communities: Completed characterization of how ventilation tactics can affect the growth and spread of fire within structures. Guidelines on the effects of fire ventilation will enable the development of science-based guidelines and standards to improve the safety and effectiveness of fire ground operations.

  - Fire Risk Reduction in Buildings: Completed development of, and introduced into the consensus standardization process, a test method for estimating the toxic potency of smoke from burning building and furnishing products (chairs, electrical cables, etc.). Smoke inhalation kills more people than burn injuries, and knowing how long it takes for a fire to become life-threatening enables cost-effective design of fire control systems and evacuation systems for buildings.

  - Structural Performance Under Multi-hazards: Published guidelines, developed in collaboration with industry, for vulnerability assessment of new and existing buildings for disproportionate collapse potential. The vulnerability assessment will identify building weaknesses and recommend mitigation strategies to reduce such weaknesses, incorporating both rapid and comprehensive evaluation procedures.

Priority Objectives for FY 2014:

- Smart Manufacturing Processes and Equipment: Develop measurement and test methods to characterize the properties of additive manufacturing metal powders, and fabricated part materials to enable product quality assurance. The new methods will be proposed to ASTM F42 committee, and will create a path for wider acceptance of additive manufacturing technology for critical aerospace and defense applications.

- Next-Generation Robotics and Automation: Develop a knowledge representation to support robotic kitting and packaging operations in manufacturing. The knowledge representation will provide the

technical basis for standards that enable more rapid deployment and re-tasking of robotic systems in these applications, resulting in more agile and productive assembly and packaging processes.

- Smart Manufacturing and Construction Control Systems: Develop a virtual manufacturing testbed and use it to conduct tests for assembly line optimization. This testing will validate standards for real-time production data collection used to measure quality and optimize timing and resource allocation for assembly processes, leading to increased quality, throughput and productivity.

- Smart Grid: Complete a report on the NIST smart grid interoperability framework, covering accomplishments in development of standards for the smart grid, progress in deployment, and remaining challenges in measurement science supporting smart grid interoperability and cyber-security. The work covered in the report will provide the standards framework necessary to modernize the U.S. electric power delivery system which will increase the reliability, efficiency and security of the electric delivery system and also to help build the infrastructure that will facilitate clean energy sources to American homes and businesses.

- Sustainable Manufacturing: Develop methodologies for determining energy and material information models for critical manufacturing processes (e.g., casting, injection molding) to compute their sustainability metrics (e.g., embedded energy, material efficiency). These models, and the associated computational tools, will enable manufacturers to optimize their production processes with respect to energy consumption and material usage.

- Sustainable, High-Performance Infrastructure Materials: Deliver a validated solution for accurately predicting the service life of an industrially important engineered polymer, composed of three components: a validated computer program, a set of integrated consensus industry standards, and commercially viable instrumentation. This will provide manufacturers and end-users with the critical capability to design materials for a given application and desired service life.

- Systems Integration for Manufacturing and Construction Applications: Develop systems engineering standards to enable interoperability of modeling and simulation data for manufacturing systems. Deployment of new interoperability standards by industry will make manufacturers more competitive by enabling them to model and predict the performance of increasingly complex products and processes with greater efficiency and lower uncertainty.

- Net-Zero Energy, High-Performance Buildings: Provide the ability to perform coupled energy, airflow and contaminant transport analyses via an integration of the NIST airflow and indoor air quality software CONTAM and the energy analysis software EnergyPlus. This new tool will enable building designers to improve building energy efficiency and concurrently maintain or improve indoor environmental conditions vital to the health, comfort, and productivity of building occupants.

- Embedded Intelligence in Buildings: Complete a laboratory capability for investigating and testing the performance of distributed intelligent agents that optimize the operation of commercial building heating, ventilating, and air-conditioning systems.

- Fire Risk Reduction in Buildings: Establish a technical basis for efficient stairwell design based on observational data. Efficient stairwell design will ensure adequate capacity to enable safe evacuation during building emergencies.

- Fire Risk Reduction in Communities: Develop standard test methods for evaluating the thermal performance of radios used by fire fighters. Performance-based testing of critical personal protective equipment such as radios will ensure that fire fighters can depend on critical equipment

to work under actual firefighting conditions, leading to improved safety for fire fighters and building occupants.

- Earthquake Risk Reduction in Buildings and Infrastructure: Develop new building code provisions and analytical modeling tools that provide refined performance-based reinforced concrete shear wall design procedures, based on analysis and research associated with observed building responses in 2010 Maule, Chile, earthquake.

6. Information Technology Laboratory (ITL)

Program Description:

ITL enables the future of the Nation's measurement and standards infrastructure for information technology by accelerating the development and deployment of information and communication systems that are interoperable, secure, reliable, and usable; advancing measurement science through innovations in mathematics, statistics, and computer science; and conducting research to develop the measurements and standards infrastructure for emerging information technologies and applications. We accomplish these goals through collaborative partnerships with our customers and stakeholders in industry, government, academia, and consortia. Based on input from these customers and stakeholders, we have focused our research and development agenda on these broad program areas.

- Cloud Computing: Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. NIST's role in cloud computing is to promote the effective and secure use of the technology by providing technical guidance and promoting standards that enable cloud users to benefit from increased efficiency for cost savings and enhanced capabilities for applications such as Big Data and mobile computing.

- Measurement Science for Complex Information Systems: Complex Systems are composed of large interrelated, interacting entities which taken together, exhibit a macroscopic behavior which is not predictable by examination of the individual entities. The Complex Systems Program seeks to understand the fundamental science of these systems and develop rigorous descriptions (analytic, statistical, or semantic) that could enable prediction and control of their behavior. Initially focused on the Internet, Grid Computing, and Cloud Computing, this Program facilitates predictability and reliability in these areas and other complex systems such as biotechnology, nanotechnology, semiconductors, and complex engineering.

- Cybersecurity Automation: NIST develops the underlying essential standards to enable automating cybersecurity vulnerability discovery, configuration management, and security metrics. These standards allow for the design of machine readable cybersecurity policies that can be automatically disseminated, enforced, audited and remediated by commercial tools in near real time as well as tool based, standardized cybersecurity vulnerability management at enterprise scale. The program is focused on extending the standards to areas of cybersecurity where automation is needed to identify threats and accelerate vulnerability remediation. The program provides a standardized base for commercial tools and organizations to fully implement a threat-vulnerability-asset based cybersecurity continuous monitoring program.

- Health Information Technology: NIST's laboratories are contributing to the healthcare industry by providing its standards, measurement science and testing expertise. NIST collaborates with The

HHS Office of the National Coordinator, major standards development organizations, professional societies and the public sector in fostering interoperable, secure, reliable, and usable standards-based solutions for the exchange of health information. ITL focuses on ensuring key health information standards are complete and testable and, providing the necessary conformance tests, interoperability tools and techniques where appropriate. These activities, when integrated into standards, software and certification processes, will raise the quality of the clinical outcomes, lower cost of Health IT implementation, and foster adoption of Health IT.

- Identity Management Systems: Identity management systems are responsible for the creation, use, and termination of electronic identities that are routinely used to access logical and physical resources, and have become a ubiquitous part of our national infrastructure. In this area, NIST is pursuing the development of common models and metrics for identity management, critical standards, and interoperability of electronic identities. These efforts will improve the quality, usability, and consistency of identity management systems while protecting privacy.

- National Cybersecurity Center of Excellence: The U.S. Department of Commerce, through NIST, has established a public-private partnership to operate the National Cybersecurity Center of Excellence (NCCOE) in cooperation with the State of Maryland. By working collaboratively with the Information Technology industry and business sectors, the NCCoE fosters development and rapid adoption of comprehensive cybersecurity platforms that support automated and trustworthy government and industry business operations and e-commerce.

- National Initiative for Cybersecurity Education: The goal of the National Initiative for Cybersecurity Education (NICE) is to establish an operational, sustainable and continually improving cybersecurity education program for the Nation to use sound cybersecurity practices that will enhance the Nation's security. NICE is a national campaign designed to improve the cybersecurity behavior, skills, and knowledge of every segment of the population, enabling a safer cyberspace. NIST is the interagency lead for coordination of the NICE initiative. The NICE initiative, involving more than 20 Federal departments and agencies, ensures coordination, cooperation, focus, public engagement, technology transfer and sustainability for cybersecurity education and training. NICE is comprised of four Components: National Cybersecurity Awareness, led by the Department of Homeland Security; Formal Cybersecurity Education, led by the Department of Education and the National Science Foundation (NSF); Cybersecurity Workforce Structure led by the Department of Homeland Security (DHS) and supported by the Office of Personnel Management (OPM); and Cybersecurity Workforce Training and Professional Development, led by the Department of Defense (DoD), the Office of the Director of National Intelligence (ODNI), and DHS.

- National Strategy for Trusted Identities in Cyberspace: The National Strategy for Trusted Identities in Cyberspace (NSTIC) is an initiative established in direct response to the recommendations of the White House Cyberspace Policy Review that will raise the level of trust associated with the identities of individuals, organizations, services, and devices involved in online transactions. The National Program Office (NPO) for the National Strategy for Trusted Identities in Cyberspace has established a privately led Identity Ecosystem Steering Group (IDESG) to develop standards, policies and accreditation processes necessary to implement NSTIC and develop, in collaboration with stakeholders, a standards roadmap for credential issuers, relying parties and service providers. The NPO has also awarded pilots through the NSTIC Grant Program to advance the NSTIC vision, objectives and guiding principles, demonstrate innovative frameworks that can provide a foundation for the Identity Ecosystem, and tackle barriers that have to date, impeded the Identity Ecosystem from being fully realized. The NPO will continue to work within the Identity Ecosystem Steering Group on development of a framework for the Identity Ecosystem called for in the NSTIC, as well as award additional pilots to advance implementation of the NSTIC. The NPO

works closely with the Executive Office of the President (EOP), the Federal CIO Council, the Cybersecurity Interagency Policy Committee (IPC), and other identified governing bodies to obtain appropriate guidance, expertise, and issue resolution. NIST has a leading role in the Department of Commerce's cybersecurity and privacy initiatives, which contribute to the potential for ecommerce to foster innovation, bolster U.S. industrial competitiveness, and enhance our economic prosperity and security.

- Next Generation Internet Technologies: Today's Internet architecture was designed in 40 years ago when no one could envision the network growing beyond 255 networks. Today, the Internet interconnects 2 billion people, 500,000 independent networks and is responsible for $8 trillion of electronic commerce per year. While it is impressive that the original architecture has been stretched to support today's demands, there is serious doubt that it can be made to scale to the demands of the next decade, in which we expect orders of magnitude increases in the number of attached devices and resulting traffic. The academic community has begun to investigate various "clean slate" designs for fundamentally new architectures and protocols for core Internet services, including: Internet routing and addressing, software defined networks, scalable traffic management, information-centric networking and scalable distributed trust infrastructures. Given the business/mission critical stature of the Internet today, there is a vast chasm between academic designs and commercially viable Internet-scale technologies. Through this effort NIST helps bridge this gap by developing and employing advanced test and measurement techniques to characterize critical design requirements for next generation Internet architectures and to work with industry to evaluate and improve their emerging protocols designs.

- Quantum Information: Quantum science and engineering has the potential to revolutionize 21st century technology in much the same way that lasers, electronics, and computing did in the 20th century. As part of the larger NIST Quantum Information Program, ITL aims to understand the potential for quantum-based technology to transform computing and communications, and to develop the measurement and standards infrastructure necessary to exploit this potential. The principal goals are:

    - to understand the potential (both opportunities and risks) for quantum information to revolutionize information science
    - to develop theory, methods, architectures and algorithms to enable engineering and testing of quantum computing components and systems
    - to demonstrate and test communication components, systems and protocols for the quantum era.

- Smart Grid: By linking information technologies with the electric power grid, the Smart Grid promises many benefits, including increased energy efficiency, reduced carbon emissions, and improved power reliability. As outlined in the Energy Independence and Security Act of 2007 (Public Law 110-140, often referred to as EISA), NIST has been given "primary responsibility to coordinate development of a framework that includes protocols and model standards for information management to achieve interoperability of Smart Grid devices and systems." NIST works nationally and internationally with industry, other government agencies, academia, and other stakeholders on cybersecurity, and communication requirements, performance metrics, measurement methods, and standards. ITL leads NIST Smart Grid activity in cybersecurity and the use of wireless and power line communication infrastructures. ITL provides smart grid users and stakeholders with guidance and tools to help them make informed decisions about smart grid information infrastructures.

- Virtual Measurement Systems: The Virtual Measurement Systems Program focuses on a metrology infrastructure for scientific computation. Scientific computing is used throughout NIST to assist in the achievement of the institutional mission to provide world class measurement capabilities to U. S. industry. In addition, scientific computing is increasingly used to inform policy and decision-making at all levels of industry and government. A metrology infrastructure is essential to stabilize the use of scientific computing in both capacities. Elements of this infrastructure being developed under the VMS Program include: analysis and dissemination of numerical benchmark problems, uncertainty characterization and propagation, and traceability for computational models. Success in these program goals will result in predictive computing with quantified reliability. In turn, this will provide a solid foundation for the use of scientific computing as a measurement and decision-making tool.

- Voting Systems Standards and Research: The 2002 Help America Vote Act gave NIST a key role in helping to realize nationwide improvements in voting systems for domestic and overseas voters. To assist the Election Assistance Commission with the development of voluntary voting system guidelines, HAVA established the Technical Guidelines Development Committee (TGDC) and directed NIST to chair the TGDC and provide necessary technical support and research to support the development of voting system standards. NIST activities include research into:

  - security of computers, computer networks, and computer data storage used in voting systems;
  - methods to detect and prevent fraud
  - protection of voter privacy
  - assessment of the role of human factors in the design and application of voting systems, including assistive technologies for individuals with disabilities (including blindness) and varying levels of literacy.

- Wireless Interoperability: The Wireless Interoperability program focuses on measurement science - in the form of methods, metrics and models – for wireless interoperability and innovation. Today, a growing range of wireless technologies serve to connect billions of people and devices around the world. These devices and technologies are being used in ever more complex settings at higher demand levels and for innovative applications that stretch their original design. Innovation in usability, interoperability, scalability and the efficient use of finite temporal, spectral, and spatial resources is needed to meet the challenges posed by this rapid growth. This program provides the effective metrics and measurement tools required to enable innovation in a multi-vendor, multi-technology environment and ensure reliability and resilience in mission-critical applications such as public safety and smart grid communications. The assessment capabilities developed by this program will be used to identify performance gaps and foster the development of new protocols and technologies that improve the scalability, reliability and interoperability of next generation wireless systems.

Examples of Accomplishments:

- Cloud Computing: NIST successfully adjudicated the 200 public comments it received in response to the draft Special Publication 500-293 "USG Cloud Computing Technology Roadmap," which was released in November 2011, and published the updated Roadmap in November 2012. NIST continues to make progress in addressing the high priority interoperability, security, and portability requirements defined in the roadmap. The roadmap priorities are those which must be met for USG agencies to accelerate deployment of Cloud Computing. Key accomplishments include: work with the private sector to leverage the NIST Cloud Computing Reference Architecture to develop international standards and categorize commercial cloud services to make it easier for cloud

consumers to compare product offerings; development and implementation of a third party private sector conformity assessment system approach to make it easier for USG agencies to procure secure cloud services; and completion of the draft special publication 500-296 "Challenging Security Requirements for US Government Cloud Computing Adoption." This work was completed through the NIST hosted public working groups and collaboration web site, in partnership with academia, industry, standards organizations, government, and the international community. NIST brought the Cloud Computing and Big Data communities together at a forum with over 600 participants from academia, industry, and government to set out first steps in realizing the potential for progress at the intersection of these exciting technologies.

- Measurement Science for Complex Information Systems: Networked computer systems often exhibit degraded performance caused by erroneous programming or malicious attacks which result in computing resources becoming unavailable for future service ("resource leakage"). In extreme cases this can lead to complete system failure. The advent of cloud computing provides additional opportunities to amplify such vulnerabilities, potentially affecting a significant number of computer users. Using simulation, we have demonstrated that cloud computing systems based on open-source code could be subjected to a simple malicious attack capable of degrading the availability of its virtual machines. We also identified and studied a strategy to detect and mitigate this vulnerability.

- Cybersecurity Automation: The Cybersecurity Automation Program standardized metadata and provided metrics more than 1,500 new Cybersecurity Vulnerabilities. It provided all cybersecurity vulnerability reference data in standardized format which are used by U.S. Government, industry, academia and multiple foreign governments in the NIST National Vulnerability Database (NVD). We have completed SCAP v1.2 that includes significant enhancements to the SCAP Validation Testing, ensuring that products seeking validation meet a wide range of robust requirements. NIST published an extensive body of publications and reference materials which allow for automated, metrics-based, near real time and continuous monitoring and management of cybersecurity risk and began working with formal standards bodies to ensure worldwide acceptance of the SCAP protocols and metadata.

- Health Information Technology: Enabled integration of clinical environments and semantic interoperability of medical devices through research and development of complete and unambiguous standards, test tools, and information models; provided leadership to this effort through enhanced collaborations with public and private stakeholders, such as: FDA; TATRC; IEEE; IHE; HL7; Continua; Kaiser Permanente; Carnegie Mellon; Mass General Hospital.

- Identity Management Systems: NIST completed its technical review of Federal Information Processing Standard (FIPS) 201 update that includes support for derived credentials and clarified issues related to registration and credential issuing processes.

- National Cybersecurity Center of Excellence: NIST executed a Joint Project Agreement with the State of Maryland and Montgomery County, Maryland to establish the National Cybersecurity Center of Excellence, based at a facility shared by NIST and the State of Maryland, to engage the commercial, academic, and Federal, state, and local government sectors to: foster transfer and broad adoption of cybersecurity capabilities and practices from the laboratory to practical, affordable, and useful business use cases and applications across the full range of commercial and government sectors; research and develop new principles and mechanisms underlying security standards, metrics, and technologies; promote the emergence of a private sector-led ecosystem for trusted identities in cyberspace; establish a comprehensive library of practical and effective

standards, guidelines, metrics, and best practices for secure and privacy preserving information technologies; develop and test methods for composing, discovering, monitoring, and measuring the mechanisms, configurations, and practices that affect the security posture of systems and enterprises; and communicate cybersecurity principles and technologies to cyber systems developers, providers, and user. NIST established long term partnership agreements with industry and established two use cases in security: health information technology and protection of intellectual property in manufacturing environment. NIST examined options for cybersecurity research and engineering development processes in support of the NCCoE.

- National Initiative for Cybersecurity Education: In FY 2013, the National Initiative for Cybersecurity Education (NICE) Strategic Plan, "Building a Digital Nation" was finalized. Additionally, NIST issued draft NICE component-specific implementation plans. NIST organized and hosted the third annual NICE Workshop, "Shaping the Future of Cybersecurity Education - Connecting the Dots on Cyberspace," early in FY 2013. This workshop served as a forum for the community to reflect on current collaborations in cybersecurity education projects, trends and initiatives that will provide pathways to future solutions. As part of its outreach role, members of the NIST NICE Leadership Team (NNLT) attended events, symposia, forums, competitions, educational outreach meetings, and workshops across the country.

- National Strategy for Trusted Identities in Cyberspace: Fulfilling its role as the lead agency to implement the National Strategy for Trusted Identities in Cyberspace (NSTIC), NIST established the NSTIC National Program Office (NPO) in FY 2012 and established the privately-led Identity Ecosystem Steering Group to foster private sector leadership in the development and use of strong electronic identity management for the Nation. In FY 2013, the NPO worked in close partnership with the Steering Group to develop Version 1 of the Identity Ecosystem Framework – a key set of technical standards, policies, operating rules and accreditation processes to govern the Ecosystem and stimulate the marketplace of identity solutions. NIST also continued the NSTIC Pilots Grant Program, which in FY 2012 and 2013 awarded more than $18 million across industry, academia, state and local governments and non-governmental organizations to advance the NSTIC vision of an Identity Ecosystem that is secure and resilient; privacy-enhancing and voluntary; interoperable; and cost effective and easy to use.

- Next Generation Internet Architectures: NIST staff, working in collaboration with the Internet Research Task Force (IRTF), contributed modeling and analysis results and design guidance to the research and development of new routing and addressing architectures for the Internet. This effort resulted in the selection, by the IRTF Routing Research Group, of a single recommended architecture for future research and development.

- Quantum Information: If built, quantum computers will be able to efficiently solve certain classes of problems that are too difficult to solve on classical computers. Among those problems is factoring, whose difficulty provides the security behind the public key crypto-systems which enable electronic commerce. Thus, understanding the full range of problems amenable to efficient solution by quantum computers is of considerable importance. One important question is whether there is a realizable computational model even more powerful than quantum computers. One class of systems on which to base such speculation are quantum fields, which form the basis for the standard model of particle physics. This year ITL scientists, in collaboration with researchers at the University of Pittsburgh and Caltech, have shown that a certain class of quantum field theories can be efficiently simulated on quantum computers. Besides shedding light on the questions of the true computational power of the universe itself, such a fast quantum algorithm will be useful in gaining new fundamental scientific knowledge by simulating processes from nuclear, particle, astronomical, and condensed-matter physics.

- Smart Grid: NIST has co-led the Smart Grid Interoperability Panel (SGIP) Priority Action Plan 18 group and the development and publication of a best practices document describing the migration path between the Zigbee Smart Energy Profile 1.X and 2.0. NIST led the development of a revision of the "Guidelines for assessing wireless standards for Smart Grid Applications, V1.0", NISTIR7761, and released metrics and tools for quantitatively assessing the performance of wireless communications in context of select smart grid usage scenarios. The SGIP's Cybersecurity Working Group (CSWG) and NIST partnered with DOE and NERC on the recently published Electricity Sector Cybersecurity Risk Management Process document, which utilizes the risk management approach defined in NIST SP 800-39. During this reporting period, the CSWG Standards sub-group completed a cybersecurity review of 39 identified standards against the NISTIR 7628 high-level security requirements. In addition, the CSWG Privacy sub-group recently developed recommended privacy protection practices for non-utility third parties.

- Virtual Measurement Systems: NIST created software to automatically identify tumor location in lung CT scans. This work was based on the Cancer Imaging Archive (TCIA), a publically available FDA database consisting of over a thousand CT scans intended for facilitating the assessment of lung nodule size estimation methodologies, the development of image analysis software, and other applications. The use of these scans by the medical and research communities would be greatly facilitated by the availability of reference nodule (phantom) location data that could be input into methods that require them. Preliminary results with an initial software version and thin-slice datasets indicate that the NIST algorithm accurately locates over 93% of the nodules as identified by subject matter experts, with a low false positive rate (3.5%).

- Voting Systems Standards and Research: NIST continued to develop key research findings related to both HAVA and the Uniformed and Overseas Citizens Absentee Voting Act (UOCAVA). This research includes: Information systems security for UOCAVA-supporting systems; assessment of risk of current UOCAVA (mail) voting systems, and accessibility and usability for voting systems. NIST created an initial risk assessment methodology for current absentee remote voting systems. NIST also led the development of the first of a planned suite of standards for common data format for electronic exchange of voting system data: IEEE P1622 Standard for Electronic Distribution of Blank Ballots for Voting Systems.

- Wireless Interoperability: ITL developed an effective approach to modeling the public safety broadband network at multiple scales and obtained initial results on the network coverage and capacity of a nationwide public safety network spanning the entire United States. The performance trends and trade-offs highlighted by this work provided the technical underpinnings for the signed legislation (HR 3630, the "Middle Class Tax Relief and Job Creation Act of 2012") that allocates 20 MHz of spectrum in the D-Block (700 MHz) to public safety communications.

Priority Objectives for FY 2014:

Cloud Computing: NIST will continue work on the high priority interoperability, security and portability requirements identified in the USG Cloud Computing Technology Roadmap to accelerate USG adoption of cloud computing. This includes developing metrics that facilitate performance assessment and enable adopters to develop effective service level agreements, maturation of the draft security reference architecture for cloud computing through community input, and provide input to international standards efforts to promote interoperability and ensure US providers can be competitive in a global a cloud services marketplace. NIST will promote community-based efforts to explore the synergy that lies at the intersection of cloud computing and applications including Big Data and mobile computing. Big Data refers to vast, complex, and high-speed digital data generated by industry, government, academia and others around the world. Big data has tremendous potential to open doors to discovery, innovation,

and entrepreneurship that are inaccessible at conventional data scales. However, there are significant challenges that prevent information and knowledge from being extracted from this data deluge. NIST's role is help address these challenges by collaborating with industry, other agencies, and academia to accelerate development of the infrastructure (standards, measurements, methodologies, and best practices) necessary so that information and knowledge can be extracted from Big Data and thereby facilitate innovation and competitiveness.

- Measurement Science for Complex Information Systems: NIST will continue to develop metrics that enable the characterization of key structural and dynamical properties of abstract networks and their relation to the reliability and security of information systems. Computational modeling, simulation, and validation strategies for efficient estimation will also be developed and applied to the assessment of critical infrastructure such as the Internet, cloud computing, and the power grid.

- Cybersecurity Automation: NIST will apply cryptographic techniques to ensure the authenticity and integrity of the security automation reference data provided to government, industry and academia.

- Health Information Technology: To promote interoperability and adoption of Health IT by applying NIST expertise in standards development, harmonization, and testing; security; usability; and, certification processes. In particular, to enable broader applications of electronic health records and health IT: through telehealth and mobile devices; in other venues including the home and alternative places of care (e.g., nursing homes); and, by incorporating emerging technologies such as clinical decision support and wireless medical wearable sensors.

- Identity Management Systems: NIST will continue the development of common models and metrics for identity management, critical standards, and interoperability of electronic identities to improve the quality, usability, and consistency of identity management systems while protecting privacy. The focus of the effort will increasingly shift to remote authentication services provided by cloud-based services and to embedded user credential of new computing platforms such as mobile devices.

- National Cybersecurity Center of Excellence: NIST will expand its development of multi-institutional, collaborative research facilities and programs that member institutions cannot develop or conduct alone; continue installation of a modern research facility that promotes frequent and direct interaction among scientists, students, fellows, and practitioners including sharing of material resources and work-in-progress; and further develop and implement comprehensive cybersecurity principles and platforms that support automated and fully trusted government and industry business operations and e-commerce.

- National Initiative for Cybersecurity Education: NIST will continue to provide collaboration and coordination for the NICE component areas. The NNLT will facilitate bi-weekly coordination meetings for component leads, host an annual public/private sector NICE workshop, and maintain the NICE website to disseminate cybersecurity education/workforce information. The NNLT will also continue to participate in public-private partnership events, symposia, forums, competitions, educational outreach meetings, and workshops to promote cybersecurity education, and support initiatives promoting greater national awareness and a stronger cybersecurity workforce.

- National Strategy for Trusted Identities in Cyberspace: NIST will continue to facilitate implementation of the NSTIC. NIST's primary focus will be supporting the work of the privately-led Identity Ecosystem Steering Group, which is charged with crafting policies and standards for the Identity Ecosystem. In FY 2014, NIST will work with Steering Group to transition it from a NIST-funded organization to one that is independent and self-sustaining. In addition, NIST will be funding

additional NSTIC pilot projects. These activities will accelerate the development and adoption (by individuals and industry) of secure, efficient, easy-to-use, and interoperable identity solutions to access online services in a manner that promotes confidence, privacy, choice, and innovation. Finally, NIST will work with agencies to accelerate Federal adoption of accredited commercial identity solutions, enabling individuals and organizations to complete online transactions with confidence, trusting the identities of each other and the identities within the infrastructure.

- Next Generation Internet Technologies: NIST will develop advanced test and measurement techniques to characterize and improve promising "clean slate" designs for fundamentally new architectures and protocols for core Internet services, including: new routing and addressing paradigms, information centric networking architectures and software defined networks.

- Quantum Information: NIST will develop the theoretical basis for measurement technology to assess the improvements in processing power obtainable through the use of quantum resources. We will apply these techniques to the (a) evaluation of candidate physical realizations of quantum computers, and (b) the assessment of algorithms that may provide the basis for future quantum-resistant public key cryptography.

- Smart Grid: NIST will continue to develop and disseminate methods and guidelines for assessing the suitability of network communication technologies and architectures and their use for Smart Grid applications. This will be accomplished by developing and using system-level performance metrics and simulation models to accurately characterize the interactions between the power systems and the underlying communications infrastructures, identifying gaps in the communication systems and facilitating the development of standard technologies for filling them. NIST will perform research to identify the most common platforms used in the Smart Grid and in cyber-physical systems (CPS) in order to extend the security content automation protocol (SCAP). Additionally, NIST will explore the application of lightweight, low-power cryptography for processing platforms that are applicable for the Smart Grid and perform research on identity vetting and authentication for CPS and the Smart Grid.

- Virtual Measurement Systems: NIST will research and develop metrology constructs – standard reference computations, uncertainty quantification, and traceability – for scientific computation and computer-assisted measurement technologies. Applications will include quantitative simulation and validation of medical imaging technologies such as magnetic resonance imaging (MRI) and computational simulation of materials processes. A new application area is image manipulation and enhancement in forensic analysis of latent fingerprint images. Results in this application area will contribute to a systematic and scientific basis for fingerprint image enhancement, as well as serve as a test case for the development of comparable analyses for other image-based methods in forensic sciences. Overall, the results from this program will contribute to the goal of predictive computing with quantified reliability.

- Voting Systems Standards and Research: NIST will continue to accelerate the development and adoption of advanced voting technologies through research and development of standards and test methods in security, reliability, usability, accessibility, and privacy of voting systems. We will develop a risk management framework and approaches for common data format in support of voting standards for remote overseas and military voting. We will continue to work with IEEE on a suite of standards for common data format for exchange of voting system data for voter registration databases, election night results, and auditing. We will conduct research on methods for achieving auditability of voting systems, without the use of paper, which can support both security and accessibility requirements so that high-level, technology-independent requirements can be

developed. This will result in more trustworthy voting systems for Federal, state, and local elections in the U.S. We will continue research on software assurance and testing to support the voting standards guidelines, as well as research on usability and accessibility of different types of voting systems and their security. Finally, we will begin an evaluation of the potential for the use of emerging technologies such as smart phones and pads as elements of a secure, accessible voting system.

- Wireless Interoperability: NIST will develop measurement science tools to expedite the development and deployment of new communication protocols in support of scalable, reliable, secure, interoperable wireless communications. In addition, NIST will develop a modeling framework consisting of performance metrics and measurement methods necessary to enable the development and evaluation of efficient and dynamic spectrum management techniques and the use of frequency bands that are not used today.

7. Strategic and Emerging Research Initiative (SERI)

Program Description:

The Strategic and Emerging Research Initiatives (SERI) program provides the NIST Director with the programmatic flexibility to seed the development of new competencies that enable NIST to contribute to the solution of future national needs and goals by investing in high-risk, high-payoff innovative research. SERI supports the Department of Commerce and NIST's mission of promoting U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology that drive technological change.

The primary activities being conducted with the program's base resources are the development of new competencies necessary to develop and maintain knowledge related to measurement techniques that solve problems in areas of national need that NIST has identified. The SERI program gives NIST the flexibility to quickly develop capabilities to solve new measurement problems for emerging national needs. Examples of past national need areas that had related measurement and standards competencies addressed through SERI include Smart Grid, physical infrastructure, advanced manufacturing, and reduction of greenhouse gas (GHG) emissions. SERI allows NIST to develop these measurement and standards competencies more quickly, which enables emerging problems to be addressed much more efficiently and effectively, leading to even greater economic benefits.

Current Objectives and Examples of Accomplishments:

Forensics Metrology

SERI funding is being utilized to increase NIST competence in a range of forensic science specialties. Public trust in the justice system relies on the validity and certainty of evidence presented to the courts. Increasingly that evidence is gathered and analyzed with innovative forensic technologies and any time a new technology is developed, accurate measurements, standards, and uncertainty estimates are needed to ensure that the technology works as intended. In 2009 a committee of the National Research Council (NRC) made a number of important recommendations for strengthening the public's trust in forensic science findings, included was strong support for improved measurement and validation methodologies, development of additional forensic standards, and dissemination of best practices to strengthen the precision and reliability of forensic science analyses. Despite its long

experience in the field, the bulk of NIST's efforts have been on narrowly targeted projects funded by other agencies, from fingerprint technologies to DNA testing to computer forensics. With SERI funding, NIST strategically selected five specific areas in which to develop new competencies:

- Rapid High Sensitivity DNA Extraction Using DRAGEN (Direct Rapid Analysis Generating Extracted Nucleotides)
- Nuclear Forensic Reference Materials (RM) for Attribution of Urban Nuclear Terrorism
- Establish a "National Ballistics Evidence Search Engine (NBESE) based on 3D topography measurements on correlation cells
- Metrics for Manipulation and Enhancement of Forensic Images
- Production of Seized Drug Analysis Standards through Inkjet Printing Technology.

Redefinition of the Kilogram

SERI funding is being utilized by NIST to support the international efforts to prepare for a future redefinition of the unit of mass - the kilogram - the last remaining International System of Units (SI) basic unit defined by an artifact. NIST initiated two efforts to redefine the kilogram with an invariant of nature, the Watt-Balance Project and the Avogadro Project. The Watt-Balance Project measures the force required to balance a 1 kg mass artifact against the pull of Earth's gravity by monitoring the voltage and current (hence the name "watt") involved in doing so. The Avogadro Project involves the determination of Planck's constant, requiring "counting" the number of atoms (via unit cell volume of a crystal) in each of two highly pure 1 kg single-crystal enriched silicon spheres about 94 mm in diameter to define their molar mass. The result provides a determination of the Avogadro constant, which in turn can be used to obtain Planck's constant using the well-known values of other constants. Specifically, SERI funding has accomplished the following:

- Setup of the multicollector inductively coupled plasma mass spectrometer (MC-ICPMS) for the Avogadro Project
- Performing repeated molar mass measurements using optimized design to evaluate reproducibility and ensure it meets the goal of the project
- Recalibrated components of the previous watt balance to enable the redefinition
- Initiated the development of a new, robust watt balance capable of routine mass dissemination after the redefinition.

National Strategy for Trusted Identities in Cyberspace (NSTIC)

SERI funding was utilized in FY 2011 to initiate the NIST effort in support of NSTIC, which President Obama signed in April 2011. This strategy charts a course for the public and private sectors to collaborate to raise the level of trust associated with identities of individuals, organizations, networks, services, and devices in online transactions. The Strategy's vision is a future in which "Individuals and organizations utilize secure, efficient, easy-to-use, and interoperable identity solutions to access online services in a manner that promotes confidence, privacy, choice, and innovation." SERI funding enabled the initiation of the NIST effort and building of a platform to maximize initiative funding received for FY 2012. Specifically, SERI funding accomplished the following:

- Laid the groundwork for the NSTIC National Program Office that will lead the implementation of NSTIC and coordinate activities with the private sector stakeholders
- Worked with industry, academia, advocates, non-profits and governments to develop a comprehensive view of the problem space and inform the NSTIC vision, objectives, and guiding principles

- Issued grants to advance the NSTIC vision, objectives, and guiding principles. In FY 2012 NIST awarded more than $9M for pilot projects to five U.S. organizations. In January 2013 NIST released the FFO for the second round of pilots.

Climate Research/GHG Monitoring

SERI funding was utilized to develop competence across NIST in development and validation of novel methodologies and procedures for remote monitoring and measurement of greenhouse gas emissions. This competence forms the basis of a recently-funded effort in which NIST will:

- Provide the measurement science basis for accurate and comparable quantitative measurements of Green house gas emissions
- Ensure measurement capabilities for accurate and reliable assessment of current GHG baselines, verification of GHG emissions, and quantification of GHG sinks that absorb GHGs through quantitative measurements
- Enable development of international measurement standards to ensure the accuracy of global assessments of GHG emissions.

Biomanufacturing

SERI funding was utilized to jump start NIST's ability to address inefficiencies and stimulate innovation in healthcare by addressing challenges associated with the development and manufacture of biologic drugs. NIST used SERI funding to develop competence in the measurement needs and techniques in biomanufacturing and to procure instruments used to characterize proteins/biologic drugs. NIST will use these competencies and accomplish the NIST role in the development of a suite of fundamental measurement science, reference standards and reference data to enable more accurate and confident characterization of key attributes of protein drugs that are directly linked to their safety and efficacy. Specifically, these competencies form the basis of a recently-funded effort in which NIST will focus on three measurement challenge areas related to 1) the characterization of protein therapeutics and their manufacture; 2) protein stability: protein structure; and 3) protein cell variability. These tools will facilitate the development of the Biomanufacturing industry and offer the possibility of lower cost biosimilars, thereby allowing U.S. citizens affordable access to these innovative and life-saving biopharmaceutical medicines.

8. Innovations in Measurement Science (IMS)

Program Description:

The Innovations in Measurement Science (IMS) Program provides funds to explore high-risk, leading-edge research concepts that anticipate future measurement and standards needs of industry and science. These funds are a principal mechanism for initiating the new programs and research directions necessary for NIST to keep pace with and respond quickly to the increasingly complex nature, and the shorter time frame, of technology development.

Since its inception in 1979, the IMS Program has: 1) funded over 100 research projects that have evolved into core activities within the NIST Laboratories, 2) formed the cutting edge of NIST's research programs, and 3) attracted some of the Nation's top scientific talent to NIST. Four NIST Nobel Prize winners in Physics (Dr. William Phillips, 1997; Dr. Eric Cornell, 2001; Dr. Jan Hall, 2005; and Dr. David Wineland, 2012) each conducted projects that were funded by the IMS Program. Other program achievements include the development of a cold-neutron small-angle scattering facility, a bold concept

that ultimately led to the NIST Center for Neutron Research (NCNR), now a premier research program that attracts almost 2,300 affiliated researchers annually from industry, government, and academia.

One current research effort funded through the IMS program is addressing fundamental problems with the essential links between electrical and mechanical units from the International System of Units (SI). The calculable capacitor, a device that realizes the capacitance unit (farad) from the meter, was originally created 40 years ago after many years of research and has been used ever since. With the availability of new technologies, such as modern lasers and digital electronics, it is now possible to build the next generation of calculable capacitors with improved reliability, accessibility, and accuracy. In this project, NIST will use femtosecond laser frequency comb technology to create a new calculable capacitor that would, for the first time, realize an SI electrical unit based directly on an atomic clock. NIST's goal is for its new calculable capacitor to have measurement uncertainties roughly a factor of two lower than those of other calculable capacitors currently being developed around the world.

9. Postdoctoral Research Associateship Program

Program Description:

NIST supports a nationally competitive Postdoctoral Research Associateship Program which is administered in cooperation with the National Research Council (NRC). The NIST NRC postdoctoral program recruits outstanding research scientists and engineers to work on NIST research projects, strengthens communications with university research, and provides a valuable mechanism for the transfer of research results from NIST to the scientific and engineering communities.

The NIST NRC postdoctoral program is an important part of NIST's efforts to support industry through advancing measurement, standards, and technology, and represents a highly cost-effective means of technology transfer to and from NIST of the latest measurement sciences and technologies. Incoming associates bring the most recent advances in university research to NIST, while actively contributing to NIST projects. The program increases technology transfer from NIST to industry, academia, and other government agencies, contributing to the employment pool of highly-qualified scientists and engineers for these sectors. NIST's mission to support U.S. industry with measurements, standards and technology depends on a constant infusion of new ideas and expertise to address the rapidly advancing needs of a technology-driven economy. Skilled and motivated people are the most effective source of technology and knowledge transfer. The highly competitive NIST NRC postdoctoral program ensures a continuing infusion of postdoctoral associates who bring to NIST the benefits of the latest academic research.

Examples of Accomplishments:

NIST NRC postdoctoral associates carry out state-of-the-art research which supports industry through advancing measurements, standards, and technology throughout the core programs of NIST. Each of the projects advances measurement and standards research areas in some way, but a few examples of areas of research by recent postdoctoral associates include such projects as:

- Investigation of aerosols using photointiation in a flow cell reactor;
- Development of a technique for nanofiber synthesis for bone regeneration;
- Design of a micro-fabricated wafer system for microchip devices;

- Characterization of platinum-based catalysts related to stress measurements of thin films;
- Precision frequency measurements and optical control of ultracold strontium gases toward improving atomic clocks; and
- Design of a nanowire gas sensor for use as a portable detector for security or industrial monitoring purposes.

Priority Objectives for FY 2014:

The priority objectives for FY 2014 for the NIST NRC postdoctoral program are to continue to recruit the best applicants for the program and to make best use of the available resources to bring on as many highly-qualified postdoctoral associates as possible. The additional base funding for the postdoctoral program from the FY 2012 initiatives will give NIST greater flexibility to respond to new industry measurement needs. NIST scientists and engineers, acting as mentors/advisers for the program, are constantly refining and proposing new research areas in which to interest applicants. The program is a very flexible and responsive way to focus new NIST activities to address critical national priorities including those in energy, environment, information technology security, and physical infrastructure. A comprehensive two-year assessment of the program was completed in 2012 and the information from this independent assessment will be used in improving the focus NIST's efforts to ensure a continuing infusion of motivated postdoctoral associates into the NIST measurement science laboratories, ensuring mutually-beneficial technology and knowledge transfer between NIST and the postdoctoral associates. Across all NIST laboratories, the program strongly supports the goals of the NIST Three Year Programmatic Plan. The postdoctoral program addresses NIST priorities to meet critical national needs, strengthening and focusing NIST's laboratories and research to ensure U.S. leadership in measurement science and standards in these areas.

PROGRAM CHANGES:

1. Advanced Manufacturing: Enabling an Advanced Manufacturing Measurement Infrastructure for Industry (Base Funding: $90.8 million and 98 FTE; Program Change: + $50 million and +67 FTE).

NIST requests an increase of $50 million and 67 FTE for a total of $ 140.8 million to enable the development of an advanced manufacturing infrastructure that will support the needs of American manufacturers.

Proposed Actions: Enable an Advanced Manufacturing Infrastructure

The Nation's long-term competitiveness relies heavily on global leadership in advanced manufacturing capabilities. Revitalizing the Nation's manufacturing industries and helping to ensure that they will continue to be engines of innovation and job creation in the future is essential for U.S. competitiveness in an increasingly global economy. NIST will develop and deploy unique tools to support U.S. advanced manufacturing through its laboratory research programs. To continue to compete in manufacturing, the U.S. must develop and adopt advanced, high-value manufacturing techniques - from modeling and simulation methods that accelerate the deployment of advanced materials, to the availability of chip-scale precision measurements, to methods and tools to enable smart manufacturing enterprises. This investment for NIST resources is essential for rejuvenating U.S. manufacturing by the

development of measurements and standards that are part of an advanced manufacturing infrastructure.

Action 1: Measurement science and data infrastructure for emerging materials

This request provides the resources to support NIST's key role in the Materials Genome Initiative[1], an interagency effort to dramatically influence the pace for bringing new materials to market. Through considerable interactions with industry and academia, NIST will develop and deploy an advanced materials data infrastructure, including data assessment and validation as well as data standards and modeling and simulation tools. These efforts will ensure the interoperability and accessibility of materials data across many length scales to help US manufacturers achieve "materials by design" for tomorrow's high-tech products in industrial sectors including aerospace, automotive, energy, and defense.

Action 2: Support manufacturing in emerging technology areas

From using biological systems as inspiration for improved design and engineering to integrating nanoscale materials and processes into manufacturing plants, the Nation's economy and quality of life have much to gain from innovations in emerging technology areas. Advances in synthetic biology are likely to create a new manufacturing paradigm using cells as foundries to create new products including fuels, pharmaceuticals, specialty chemicals, and advanced materials. Measurement science developed at NIST will also support the emerging markets and regulatory framework for protein drugs and the generic copies of these drugs, referred to as biosimilars. At the nanometer scale (a sheet of paper is about 100,000 nanometers thick), new material properties and structures can enable new manufacturing processes and products for applications that include electronics, energy, and national defense. NIST programs are needed to ensure that nanomanufacturing techniques yield the desired performance at scale and economically viable cost. NIST's nanotechnology-related environmental health and safety (nanoEHS) program is also critically needed to support the scientific basis for risk assessment of nanomaterials.

Action 3: Precision measurement to support manufacturers

Precise manufacturing metrology enables high-quality, high-throughput production, increasing the competitiveness of US manufacturers. Current methods for calibrating machinery and assessing quality can introduce cost and time delays to manufacturing processes. NIST is requesting these funds to develop measurement science to directly integrate self-calibrating technologies that are based on quantum measurements into equipment and products to provide continuous quality control and assurance, freeing customers from complex measurement traceability chains and lengthy calibration procedures. Virtually all manufacturing processes could be improved with onboard self-calibration technologies, such as airliners with continual, high-precision measurements of electrical quantities, pressure, and temperature to improve efficiency and safety; almost any major product or process employing precision physical measurements could benefit from built-in intrinsic quantum-based calibration technology.

Action 4: Measurement science and standards for Smart Manufacturing

The next generation of smart manufacturing processing and equipment will need to be optimized to enable cost-effective and agile manufacturing of high-tech products and systems. This introduces intelligent manufacturing concepts such as automation and smart operating systems that support

[1] http://www.whitehouse.gov/mgi

distributed sensing, computing, communications, and control technologies in order to monitor, control, and optimize performance. A 2011 workshop organized by NIST in partnership with DARPA, NSF, and NASA on the topic of "extreme manufacturing" identified some major industrial drivers, such as the increasing pace of technological change; increasingly rapid product and process innovation; shorter time to market; continual push for higher quality, better performing customized products; and the need to increase productivity while at the same time reducing costs[2]. Smart manufacturing systems need to be implemented that are adaptive and agile, collaborating easily with other system components to optimize the performance of the entire system. To support these needs, NIST will develop the measurements and standards for a secure, smart quality measurement system focusing on automated in-process quality monitoring and control for factory-level production systems. Next-generation robotics and automation as well as adaptive "on-demand" technologies such as additive manufacturing are essential for enabling these smart systems. This request provides funds to support testbeds that integrate a systems architecture framework and open standards platforms for facilitating predictive modeling and simulation for automated control and performance optimization.

Statement of Need and Economic Benefits:

NIST requests these resources to support the competitive advantage that U.S. manufacturers are poised to hold, as a result of U.S. excellence in areas such as biotechnology, nanotechnology, materials science, cybersecurity, and precision measurement. Manufacturing plays an essential role in the U.S. economy and is innately tied to our capacity to innovate. In 2011, the U.S. manufacturing sector generated $1.8T in GDP (12.2% of the total U.S. GDP) and is responsible for jobs, exports, and national security; furthermore, manufacturing has a tremendous economic multiplier effect: $1 spent in manufacturing generates $1.35 in additional economic activity[3].

The future of U.S. manufacturing will rely on innovative, complex, high value-added products manufactured with sophisticated materials and processes. A 2012 study by the Institute for Defense Analysis, *Emerging Global Trends in Advanced Manufacturing*[4], identified a number of areas such as synthetic biology and smart manufacturing where measurement science and standards are needed to accelerate and support technology developments and manufacturability. The markets for emerging materials are impressive: the 2010 U.S. revenues from biotech drugs and industrial biotechnology (e.g., fuels, materials, chemicals, and industrial enzymes) were approximately $190 billion[5] and estimates of the total nanotechnology market in 2020 are as high as $3 trillion[6]. Building on NIST measurement excellence, the new capability to deliver on-chip precision measurements will provide a disruptive technology to American manufacturers and a competitive advantage. Smart manufacturing advancements will help manufacturers overcome many barriers that currently inhibit their ability to operate as efficiently as possible. These barriers include the inability of manufacturers to rapidly - and safely - integrate automated production equipment and systems; the lack of fundamental understanding about underlying production processes and systems across the product lifecycle; and the difficulty in assemblying enterprise networks of manufacturing services that utilize the full potential of small and medium sized manufacturers. The Smart Manufacturing Leadership Coalition has identified a number of

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[2] See http://www.nist.gov/el/extrememanu.cfm and *Summary of the NIST Extreme Manufacturing Workshop*, Report prepared by IDA Science and Technology Policy Institute, March 29, 2011.

[3] As cited in the 2013 NSTC report *National Network for Manufacturing Innovation: A Preliminary Design* http://manufacturing.gov/docs/NNMI_prelim_design.pdf

[4] http://www.wilsoncenter.org/sites/default/files/Emerging_Global_Trends_in_Advanced_Manufacturing.pdf

[5] Biodesic 2011 Bioeconomy Update http://www.biodesic.com/library/Biodesic_2011_Bioeconomy_Update.pdf (cited in 2012 White House National Bioeconomy Blueprint)

[6] WTEC Panel Report on Nanotechnology Research Directions for Societal Needs in 2020; Eds. Mihail C. Roco, Chad A. Mirkin, and Mark C. Hersam (WTEC 2010).

potential benefits of smart manufacturing, including reduced time to market, higher export markets and a competitive edge to those companies implementing smart manufacturing processes[7]. Modeling and simulation tools will provide an underpinning for each of these advanced manufacturing areas, ultimately providing manufacturers with the ability to predict desired product and engineering system attributes.

Stakeholders for this NIST research include American manufacturers up and down the supply chain as well as consumers. The importance of advanced manufacturing, in general, and the components described in this initiative, specifically, have been recognized by leading industry and Federal advisory groups, including the President's Council of Advisors on Science and Technology, the NIST Visiting Committee of Advisors on Technology, the Institute for Defense Analysis and the National Academies[8].

Base Resource Assessment:

In the areas of advanced manufacturing, NIST invested a total of $90.8 million in base STRS funds in FY 2012.

This initiative builds upon many program areas across NIST in measurement science and standards development. Research at the NIST Laboratories develops and delivers measurement science tools that support advanced manufacturing technologies, including materials modeling and simulation, nanomanufacturing, biomanufacturing, smart manufacturing, robotics, and other enabling technologies. A recent assessment of the NIST manufacturing-related programs conducted by the National Research Council[9] found that NIST program teams are "highly qualified and comparable to the best in the world." Measurement science and standards services developed at NIST provide the basic and applied research underpinnings to support advances in manufacturing. NIST provides the enabling interoperability standards and tools to allow manufacturers and researchers to lower costs and accelerate innovation. Unique, cutting edge user facilities (i.e., the NIST Center for Neutron Research and the Center for Nanoscale Science and Technology) support innovation in materials development and deployment, nanotechnology discovery and fabrication, and other emerging technology areas.

NIST's expertise in measurement science will be critical to the growth and sustainability of many US manufacturing industries, including the burgeoning synthetic biology industry. NIST has a number of programs in support of the bioeconomy, for example protein characterization and high-throughput sequencing research efforts, which were highlighted in the White House *National Bioeconomy Blueprint* released in April 2012[10]. NIST laboratory programs are developing innovative, cost-effective, rapid methods needed to understand the properties of biomaterials, nanostructures, and device arrays as they are processed at high speed. Furthermore, NIST efforts in nanotechnology-related environmental, health and safety (nanoEHS) are coordinated with other Federal agencies through the National Nanotechnology Initiative. The nanoEHS program produces reference materials, standards, and good laboratory practice publications that are helping manufacturers ensure safe workplace environments and that provide the scientific underpinning for regulatory decision makers. NIST is

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[7] Implementing 21st Century Smart Manufacturing, SMLC https://smart-process-manufacturing.ucla.edu/about/news/Smart%20Manufacturing%206_24_11.pdf

[8] For example, July 2012 PCAST report *Capturing Domestic Competitive Advantage in Advanced Manufacturing* http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast_amp_steering_committee_report_final_july_27_2012.pdf, 2011 Annual Report (VCAT) http://www.nist.gov/director/vcat/upload/FINAL-2011-VCAT-Report.pdf

[9] *A Review of the Manufacturing-Related Programs at the National Institute of Standards and Technology, FY 2012*, available at www.nap.edu.

[10] http://www.whitehouse.gov/sites/default/files/microsites/ostp/national_bioeconomy_blueprint_april_2012.pdf

centrally positioned in the interagency Materials Genome Initiative, which has the goal of significantly reducing the time from discovery to commercial deployment of new materials through modeling and simulation.

Providing precision measurements, a new program in NIST chip-scale technologies would extend NIST's dramatic initial success with devices such as ultraminiature atomic clocks, magnetometers and other devices to a broad range of measurements: electrical quantities, temperature, time, magnetic fields, motion, acceleration, force, gravity, and many other physical measurements. These on-chip reference measurements will enhance the competitiveness of US manufacturing by improving the quality and reliability of manufacturing processes. To accomplish these objectives, this program will leverage NIST's world-leading strengths in quantum-based measurements and in the science and technology of microfabrication, as well as NIST's experience convening university and industry partners.

Finally, NIST has deep expertise in a number of domains that support a smart manufacturing enterprise. The base program is developing the underpinning measurement science, performance metrics, and reference artifacts for metal-based additive manufacturing and robots working in close proximity to humans. The NIST capacity in smart manufacturing is uniquely positioned to support the development of rigorous procedures and standards to support manufacturers and industries and has a demonstrated commitment to convening and working with partners in industry and academia in an unbiased manner. Further, NIST has a legacy of information technology expertise, for example in the area of cybersecurity, which may be applicable to the smart manufacturing program.

Schedule & Milestones:

Action 1: Measurement science and data infrastructure for emerging materials

- Develop methods and standards to assess data quality (e.g., of models, simulations, and materials data) and identify data sharing standards and metadata criteria for implementation in a national materials data infrastructure (FY2014-2016).
- Provide "materials by design" testbeds at NIST containing tools and techniques for the representation and interoperability of materials data (experimental and simulation) across many length scales (FY2014-2018).

Action 2: Supporting manufacturing in emerging technology areas

- Develop standards to support synthetic biology by enabling quality assessment of DNA and comparability and confidence in biological measurements for gene expression, proteomics, and other critical areas. (FY2014-FY2017).
- Community driven development of data and metadata standards to improve genetic designs (FY2014-FY2018).
- Develop and deploy methods for monitoring bioreactor manufacturing systems, especially cell health and feedstock performance measurements (FY2015-FY2018).
- Develop and disseminate in-line metrology tools for nanomaterial synthesis and nanocomposite fabrication (FY2014-FY2017).

- Provide validated data and models pertaining to the release of nanomaterials throughout the lifecycle, including manufacturing, use, and disposal of nanotechnology-enabled products to support nanoEHS (FY2015-2018).

Action 3: Precision metrology to support manufacturers

- Demonstration of cold-atom microsystems for precision metrology of time, frequency, length, magnetic fields, and other quantities with improved performance relative to current room temperature microsystems (FY2014-2015).
- High-frequency optomechanical systems for absolute temperature, high sensitivity force, short-term stable frequency, and acceleration at chip-scale dimensions (FY2014-2018).
- Microscale femtosecond laser frequency comb systems, for absolute frequency and length references, and as a core enabling technology linking the extreme precision of frequency combs to mechanical, electrical, temperature, pressure, and other quantities (FY2014-2016).
- Develop methods for coupling force, acceleration, and temperature standards to atom-based quantum measurements (FY2015-2017).
- Precision electrical and electronic measurements integrated with chip-scale atom-based measurements, including quantum-based electronic waveform synthesizers; integrated voltage, current, and resistance standards; and high performance microwave and radio frequency signal generators (FY2015-2018).
- On-chip sensor networks for continuous monitoring of resistance, pressure, temperature and humidity and volatile chemical species. (FY2017-2019).

Action 4: Measurement science and standards for Smart Manufacturing

- Interoperability standards and measurement tools based on secure integrated systems architectures to evaluate and support reference architecture development for factory-wide wireless, real-time control networks. (FY2014-2017).
- Standard test methods and performance metrics to evaluate and predict the quality of control networks and integration of robotics, automation, and machine tools in factory floor environments. (FY2014-2018).
- Measurement tools and standards for metal-based additive manufacturing to enable rapid design-to-product transformation (FY2014-2016).
- Development of a testbed for a service-oriented manufacturing architecture and integration infrastructure for high quality adaptive control networks and production systems. (FY2015-2018).

Deliverables:

Action 1: Measurement science and data infrastructure for emerging materials

- Measurement methods that are tightly integrated with multi-scale models for simulating materials growth, structure, optical and electronic properties, and device performance for "materials by design" in industrial application areas such as automotive lightweighting and semiconductor electronics.

- Repositories of modeling and simulation results, standard reference problems and critically evaluated datasets and associated models for use by the materials design community within the Materials Genome Initiative framework.
- Creation and dissemination of tools to integrate multi-scale, multi-disciplinary models and simulations with material properties of reference data to enable US manufacturers to use predictive "materials by design" approaches in advanced materials development.

Action 2: Supporting manufacturing of emerging technology areas

- Development of reliable cell line identification techniques to provide unambiguous identification of the cell strain used to generate protein therapeutic drugs.
- Development of Reference Materials that mimic the range, size disparity, and optical properties of protein particles and establishment of methods quantitatively measuring the size and concentration of protein particulates that can hamper the efficacy of biologic drugs.
- Development and broad dissemination of nanomaterial measurement and characterization protocols, standard reference materials and reference materials for nanomaterials certified for relevant physical and chemical parameters (e.g., positive toxicity controls, nanomaterials in complex media).

Action 3: Precision metrology to support manufacturers

- Chip-scale technologies for precision measurements of electrical quantities, temperature, force, motion, acceleration, gravity, and other quantities.
- Partnerships with university and industry researchers to develop new ultraminiature measurement technologies.
- New ways of integrating multiple precision measurement technologies on a single small, robust, low-cost measurement platform.
- Improved technology transfer from NIST to industry for the production, distribution and implementation of in-place precision measurement technologies.

Action 4: Measurement science and standards for Smart Manufacturing

- Quality measurement systems for smart manufacturing based on secure integrated systems architectures at many levels, i.e., the manufacturing cell level, factory level, and the enterprise/production network level.
- Model-based systems integration and assurance tools for adaptive production systems, including methods to model production network performance real-time in the presence of uncertainties.
- Metrics and tools for quality assurance of secure, dynamic production networks utilizing disruptive technology platforms (e.g., robotics and additive manufacturing) and distributed data for performance, diagnostics, and prognostics, and associated testbeds.

Performance Goals and Measurement Data:

Performance Goal: Number of validated data sets/published methods for nanoparticle characterization	FY 2013 Target	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target	FY 2018 Target
With increase	0	5	10	15	20	25
Without increase	0	3	6	9	9	9
Description: Number of validated data sets and/or methods published for nanoparticle characterization as part of the NIST nanoEHS program in support of risk assessment of nanomaterials.						

Performance Goal: Publications pertaining to advanced manufacturing	**FY 2013 Actual**	**FY 2014 Target**	**FY 2015 Target**	**FY 2016 Target**	**FY 2017 Target**	**FY 2018 Target**
With Increase		3	5	10	15	20
Without Increase	1	2	2	2	2	2
Description: Number of new related publications in the form of standards, frameworks, guidelines, interagency reports, consumer outreach, and gap analyses.						

Performance Goal: New chip-scale technologies demonstrated 2018 Target Performance Goal: Pilots	**FY 2013 Actual**	**FY 2014 Target**	**FY 2015 Target**	**FY 2016 Target**	**FY 2017 Target**	**FY 2018 Target**
With Increase	0	3	5	7	9	11
Without Increase	0	1	1	1	1	1
Description: Number of new chip-scale technologies demonstrated, to support NIST precision measurements, including measurements of electrical quantities, temperature, force, motion, acceleration, gravity, and combinations thereof.						

PROGRAM CHANGE PERSONNEL DETAIL
(Dollar amounts in thousands)

Program: Measurement Science, Services, and Programs
Sub-program: Laboratory Programs
Program Change: Advanced Manufacturing

Title:	Location	Grade	Number of Positions	Annual Salary	Total Salaries
Materials scientist	Gaithersburg	ZP IV	2	$ 105,737	$ 211,474
Biophysicist	Gaithersburg	ZP V	1	124,377	124,377
Chief, precision measurement coordinator	Gaithersburg	ZP V	1	124,377	124,377
Computer scientist	Gaithersburg	ZP V	1	124,377	124,377
Electronics engineer	Gaithersburg	ZP V	1	124,377	124,377
Mass spectrometrist	Gaithersburg	ZP V	1	124,377	124,377
Mathematician	Gaithersburg	ZP V	1	124,377	124,377
Mechanical engineer	Gaithersburg	ZP V	1	124,377	124,377
Physicist	Gaithersburg	ZP V	1	124,377	124,377
Project manager	Gaithersburg	ZP V	1	124,377	124,377
Research chemist	Gaithersburg	ZP V	3	124,377	373,130
Research physicist	Gaithersburg	ZP V	2	124,377	248,754
Systems engineer	Gaithersburg	ZP V	1	124,377	124,377
Analytical chemist	Gaithersburg	ZP IV	1	105,737	105,737
Analytical mass spectrometrist	Gaithersburg	ZP IV	1	105,737	105,737
Applied geneticist	Gaithersburg	ZP IV	1	105,737	105,737
Bioanalytical chemist	Gaithersburg	ZP IV	1	105,737	105,737
Bioinformaticist	Gaithersburg	ZP IV	1	105,737	105,737
Biomedical engineer	Gaithersburg	ZP IV	1	105,737	105,737
Bioprocess engineer	Gaithersburg	ZP IV	1	105,737	105,737
Cell biologist	Gaithersburg	ZP IV	1	105,737	105,737
Chemical engineer	Gaithersburg	ZP IV	1	105,737	105,737
Chemist	Gaithersburg	ZP IV	1	105,737	105,737
Computer scientist	Gaithersburg	ZP IV	3	105,737	317,211
Electonics engineer	Gaithersburg	ZP IV	2	105,737	211,474
Electrical engineer	Gaithersburg	ZP IV	1	105,737	105,737
Environmental engineer	Gaithersburg	ZP IV	1	105,737	105,737
Fire research engineer	Gaithersburg	ZP IV	1	105,737	105,737
Grants adminstrator	Gaithersburg	ZA IV	1	105,737	105,737
Immunologist	Gaithersburg	ZP IV	1	105,737	105,737
IT specialist	Gaithersburg	ZP IV	1	105,737	105,737
Materials engineer	Gaithersburg	ZP IV	1	105,737	105,737
Materials informatics	Gaithersburg	ZP IV	1	105,737	105,737
Mathematician	Gaithersburg	ZP IV	2	105,737	211,474
Mechanical engineer	Gaithersburg	ZP IV	3	105,737	317,211

Title:	Location	Grade	Number of Positions	Annual Salary	Total Salaries
Molecular biologist	Gaithersburg	ZP IV	1	105,737	105,737
Neutron biophysicist	Gaithersburg	ZP IV	1	105,737	105,737
Physical scientist	Gaithersburg	ZP IV	7	105,737	740,159
Physicist	Gaithersburg	ZP IV	1	105,737	105,737
Physicist	Boulder	ZP IV	2	105,737	211,474
Protein biochemist	Gaithersburg	ZP IV	1	105,737	105,737
Protein nmr spectrometrist	Gaithersburg	ZP IV	1	105,737	105,737
Research chemist	Gaithersburg	ZP IV	1	105,737	105,737
Research chemist	Boulder	ZP IV	2	105,737	211,474
Research physicist	Gaithersburg	ZP IV	1	105,737	105,737
Research statistician	Gaithersburg	ZP IV	1	105,737	105,737
Administrative support	Gaithersburg	ZA III	2	75,246	150,493
Administrative support	Boulder	ZA III	1	75,246	75,246
Analytical chemist	Gaithersburg	ZP III	1	75,246	75,246
Network specialist	Gaithersburg	ZP III	1	75,246	75,246
Physical scientist	Boulder	ZP III	2	75,246	150,493
Physicist	Boulder	ZP III	2	75,246	150,493
Research chemist	Gaithersburg	ZP III	2	75,246	150,493
Electrical technician	Gaithersburg	ZT III	1	57,141	57,141
Electrical technician	Boulder	ZT III	1	57,141	57,141
Electronics technician	Gaithersburg	ZT III	1	57,141	57,141
Engineering technician	Gaithersburg	ZT III	1	57,141	57,141
Administrative/technical support	Gaithersburg	ZA II	8	51,888	415,105
Control systems engineer	Gaithersburg	ZP II	1	51,888	51,888
Administrative office sssistant	Gaithersburg	ZS III	3	38,173	114,519
Total			91		8,684,555
Less Lapse		25 %	(24)		(2,171,139)
Total full-time permanent (FTE)			67		6,513,416
2014 Pay Adjustment (1%)					65,135
Total					6,578,551

Personnel Data	Number
Full-Time Equivalent Employment:	
Full-time permanent	67
Other than full-time permanent	0
Total	67
Authorized Positions:	
Full-time permanent	91
Other than full-time permanent	0
Total	91

PROGRAM CHANGE DETAIL BY OBJECT CLASS
(Dollar amounts in thousands)

Program: Measurement Science, Services, and Programs
Sub-program: Laboratory Programs
Program Change: Advanced Manufacturing

	Object Class	2014 Increase
11	Personnel compensation	
11.1	Full-time permanent	$6,578
11.3	Other than full-time permanent	0
11.5	Other personnel compensation	0
11.8	Special personnel services payments	0
11.9	Total personnel compensation	6,578
12	Civilian personnel benefits	2,046
13	Benefits for former personnel	0
21	Travel and transportation of persons	522
22	Transportation of things	134
23.1	Rental payments to GSA	0
23.2	Rental Payments to others	0
23.3	Communications, utilities and miscellaneous charges	5,558
24	Printing and reproduction	65
25.1	Advisory and assistance services	0
25.2	Other services	6,922
25.3	Purchases of goods & services from Gov't accounts	2,550
25.4	Operation and maintenance of facilities	0
25.5	Research and development contracts	8,300
25.6	Medical care	0
25.7	Operation and maintenance of equipment	720
25.8	Subsistence and support of persons	0
26	Supplies and materials	2,790
31	Equipment	4,231
32	Lands and structures	0
33	Investments and loans	0
41	Grants, subsidies and contributions	8,084
42	Insurance claims and indemnities	0
43	Interest and dividends	0
44	Refunds	0
99	Direct obligations	48,500
	Transfer to the Working Capital Fund	1,500
	Total obligations	50,000

2. Cybersecurity R&D and Standards: Ensuring a Secure and Robust Cyber Infrastructure (Base Funding: $45 million and 95 FTE; Program Change: + $15 million and +25 FTE).

NIST requests an increase of $15 million to improve the security and interoperability of our Nation's cyberspace infrastructure, accelerate the development and adoption of cybersecurity standards in support of Administration priorities, and support the leading edge work of the National Cybersecurity Center of Excellence (NCCoE).

Proposed Actions: Advances in Cyberspace Infrastructure and Assurance ($15 million)

Action 1: Cybersecurity Research and Development ($8 million)

This Administration has declared the cyber infrastructure a strategic asset, and the President has established a set of high-priority recommendations in the Cyberspace Policy Review and the Executive Order on Improving Critical Infrastructure Cybersecurity. NIST has a leading role in the Department of Commerce's cybersecurity and privacy initiatives that support realizing the potential for e-commerce to foster innovation, bolster U.S. industrial competitiveness, and enhance our economic prosperity and security. In addition to supporting the President's recommendations, this initiative supports the Secretary's Priorities under Innovation and Intellectual Property: "Creating an Environment for Future Growth" (Innovation and Entrepreneurship). Specifically, identity fraud and lack of consumer confidence in the security of business transactions in cyberspace could become a barrier to entrepreneurship, growth of innovation and development of high-growth businesses.

The request continues and expands existing efforts to improve the cybersecurity assurance posture of current and future information technologies and improving the trustworthiness of IT components such as claimed identities, data, hardware, and software for networks and devices. The requested funding is needed to achieve the objectives of the Administration's cybersecurity agenda. NIST will apply its security research and standards expertise and proven ability for industry collaboration to enable organizations to improve the efficiency and effectiveness of their cybersecurity trusted credential practices, thereby improving the security and interoperability of our Nation's cyberspace infrastructure.

Additional resources will accelerate cybersecurity research and development work in areas such as:

- **Action 1.1: Security for the Federal Mobile Environments**: Mobile devices, such as smart phones and tablets, typically need to support multiple security objectives: confidentiality, integrity, and availability. To achieve these objectives, mobile devices should be secured against a variety of threats. Like any new technology, smart phones present new capabilities, but also a number of new security challenges. Moreover, as the pace of the technology advancements continues to increase, our current Information Assurance standards and processes must be updated and new technologies developed to allow the continued use of Commercial Off-The-Shelf (COTS) products, to meet their missions without sacrificing privacy and security, allowing government users to access the latest technologies. Overall, securing the Federal mobile workforces will be about more than just the end device. It is the user, the device, third parties providing applications and services, the connection, the carriers and infrastructure and the back end organization.
- **Action 1.2: Techniques for Measuring and Managing Security:** U.S. industry and government need interoperable, scalable, automated techniques to monitor, measure, manage and communicate security status in real-time for a spectrum of systems ranging from end point

devices such as mobile devices to networks to clouds. For example, the U.S. government operates millions of computing devices and each device generates, stores, and processes information vital to U.S. interests. At the same time, these devices and underlying infrastructure are under constant threat of cyber attack. Recent activities, such as continuous monitoring are designed to transform the fundamental underpinning to cybersecurity, allowing for insight into the configuration and security status of devices across the infrastructure. However, the diversity of computing devices and systems as well as the range of information that is being analyzed will pose implementation challenges. This requires robust engagement with industry to develop tools and techniques that will provide essential, near real-time security status-related information. Moreover, cloud and mobile computing have dramatically increased the complexity of the security challenge, and future innovations will introduce new challenges. With cloud computing, user data and processing can be dynamically relocated at any time; similarly, mobile devices are constantly on the move and vulnerable to theft, loss, and destruction. Classic concepts of perimeter security and current security implementations need new capabilities so risk and uncertainty do not inhibit the business promises of cloud, mobile technologies and other emerging technologies.

Action 2: Cybersecurity Standards ($2 million)

The availability of cybersecurity standards and associated conformity assessment schemes that can serve as a basis for the security and resiliency of all U.S. information systems is foundational to protecting the critical U.S. information and communication infrastructure. International cybersecurity standards, developed by the consensus of a variety of stakeholders including critical infrastructure owners and operators, provide a basis for planning and deployment of sound security solutions and building trust among those creating and using those solutions throughout the country. These standards provide a common language to communicate security requirements and ways of implementing them that are common and accepted, as well as enabling organization reporting of security framework compliance. Effective participation in cybersecurity standards development organizations, such as the International Organization for Standardization (ISO), Internet Engineering Task Force (IETF), Organization for the Advancement of Structured Information Standards (OASIS) and the World Wide Web Consortium (W3C), to name a few, is necessary to promote the inclusion of technical solutions that do not discriminate against U.S.-based technology internationally, acquire advance information about future content of standards that can be used to shape U.S. industry products, and ensure that the frameworks designed to enhance the security to U.S. critical infrastructure, can take full advantage of interoperability and consensus best practices.

The National Technology Transfer and Advancement Act (NTTAA) and OMB Circular A-119 directs Federal agencies use of private sector standards and conformity assessment practices. The objective is for Federal agencies to adopt private sector standards, wherever possible, in lieu of creating proprietary, non-consensus standards. The Act and Circular enable NIST to act as a convener bringing together Federal agencies, as well as State and local government, with the private sector to achieve greater reliance on voluntary standards and decreased dependence on in-house standards. This also enables NIST to have a unique view of Federal agencies adoption of standards and creates regular and meaningful opportunities to collaborate with government and industry partners in the development and promulgation of those standards.

NIST's role in the standardization of cybersecurity technologies is exercised by the deep technical expertise held by NIST personnel. NIST cybersecurity experts engage with a variety of National and international standards bodies including the American Standards Committee (ASC) X9 (financial industry standards), the International Organization for Standardization (ISO), the Institute of Electrical and Electronics Engineers (IEEE), the Internet Engineering Task Force (IETF), and the Trusted

Computing Group (TCG). By way of example, NIST's participation in these organizations has assisted in the development of fundamental Internet standards such as IPv6 and DNSSec in the IETF. In ISO, NIST contributed to the issuance of ISO/IEC 19790, Security Requirements for Cryptographic Modules, and ISO/IEC 24759, Test Requirements for Cryptographic Modules. These efforts have led to consistent testing of cryptographic modules across the global community, enhancing the security and reliability of encryption tools and techniques.

Assignment of full time personnel to standards bodies would help accelerate the standardization and adoption other U.S. information and critical infrastructure technology. Some activities where increased personnel would be valuable:

- The *Executive Order on Improving Critical Infrastructure Cybersecurity* (issued 2/13/2013) requires the Department of Commerce/NIST to lead the development of a framework of cybersecurity practices to reduce cyber risks to critical infrastructure. A core component of this framework is the identification of cybersecurity voluntary consensus standards that can be adopted by critical infrastructure owners and operators. From the Executive Order Section 7(b): "The Cybersecurity Framework shall focus on identifying cross-sector security standards and guidelines applicable to critical infrastructure. The Cybersecurity Framework will also identify areas for improvement that should be addressed through future collaboration with particular sectors and standards-developing organizations. To enable technical innovation and account for organizational differences, the Cybersecurity Framework will provide guidance that is technology neutral and that enables critical infrastructure sectors to benefit from a competitive market for products and services that meet the standards, methodologies, procedures, and processes developed to address cyber risks."
- Engage in standards activities in support of the *National Strategy for Information Sharing and Safeguarding.*
- In close collaboration with government and industry partners, NIST is actively pursuing the standardization of U.S. government specifications such as the Security Content Automation Protocol (SCAP), which is an underlying component for continuous monitoring activities in support of evolving FISMA requirements, as referenced in OMB Memorandum M-12-20, "FY 2012 Reporting Instructions for the Federal Information Security Management Act and Agency Privacy Management." While this engagement has garnered positive results, the assignment of a full FTE to promoting and managing this effort will have near term and significant benefits by accelerating the approval and adoption of these and other critical technical specifications, leading to the availability of interoperable security tools and technologies that can meet the rapidly evolving security challenges facing U.S. information and critical infrastructure systems.
- The Managed Incident Lightweight Response (MILE) Working Group within the IETF is focused on the development and promulgation of standards to create efficient and effective incident handling and information sharing. Enabling NIST personnel to participate regularly in this group will accelerate the evolution and development of these important standards and ensure their relevance and efficacy for critical infrastructure components.
- The Malware Working Group within the IEEE has the focus "to establish more intelligent ways of sharing malware samples and the information associated with them in a way that makes the computer security industry more effective." Increased engagement in this group will lead to the acceleration in the development of the needed taxonomies, methods, and mitigations necessary to combat the prevalence of malware in computer networks.

These represent just a few areas where increasing NIST expert participation would have direct impact on the Nation's cybersecurity capabilities. Additional funds would allow NIST to work with the cybersecurity policy community to align deployment of these new resources to the highest priority

standardization efforts in both national and international forums. Investment in enhancing NIST engagement in these bodies ensures that U.S. interests are well represented, and that the standards developed and ratified can be leveraged successfully by U.S. government an industry to meet our challenges.

Action 3: National Cybersecurity Center of Excellence (NCCoE) ($5 million)

The NCCoE is a public-private collaboration that brings together experts from industry, government, and academia to design, implement, test, and demonstrate integrated cybersecurity solutions and promote their widespread adoption. Participants develop practical, interoperable cybersecurity approaches that address the real-world needs of complex information technology (IT) systems. Through research, development, and deployment acceleration efforts the center will:

- enhance trust in U.S. IT communications, data, and storage systems;
- lower risk for companies and individuals using IT systems; and
- encourage development of innovative, job-creating cybersecurity products and services

The NCCoE provides a state-of-the-art computing facility where researchers from NIST can work collaboratively with both the users and vendors of products and services on holistic cybersecurity approaches. Center projects demonstrate cybersecurity principles and practices that are feasible for businesses and measure them against standards. By providing a test bed where new ideas and technologies can be tried out before being deployed, the center provides the opportunity to thoroughly document and share each solution, supporting specific industry sector business challenges. This encourages the rapid adoption of comprehensive cybersecurity templates and approaches that support automated and trustworthy e-government and e-commerce.

Additional resources for this action will ensure that the NCCoE is able to meet a wide range of public and private sector cybersecurity solutions.

Statement of Need and Economic Benefits:

Cybersecurity is vital to the economic and national security interests of the United States. The Administration has declared the cyber infrastructure a strategic asset. In addition to nearly $200 billion of e-commerce transactions in the U.S. alone for 2011, interconnected networks of computers are essential for life-critical functions such as air traffic control, factory operation, and electric power distribution. These networked systems face an ever-increasing threat of attack from individuals, organizations, and nation states that target key information technology operations and assets. Many systems have security configurations that are poorly implemented and maintained, security controls that are hard to use, and security postures that are too complex for most administrators to understand. This combination allows many threats to successfully compromise systems and delays reactions to these compromises, allowing significant damage to occur. This undermines confidence in vital commercial and public information systems and has a large, direct economic impact—estimates show that Americans are losing billions of dollars each year to cyber crime. Achieving cybersecurity in the context of today's extensively networked information systems remains an elusive goal. For example, many implementations of security technologies have been developed to support a single application or protocol, operating system and application code has become orders of magnitude longer and more complex, and users are inadequately educated on the most fundamental concepts of cybersecurity and best practices for protecting their cyber identity.

The Nation's dependence on information technologies continues to deepen quickly, and cybersecurity efforts must expand accordingly to keep pace. Increasing investment in cybersecurity research and standards activities will accelerate progress in mitigating existing cybersecurity threats and potentially leave the U.S. less vulnerable to future threats. Delays in conducting this work will delay corresponding improvements in the efficiency of cybersecurity operations.

The Nation's ever-increasing reliance on the Internet for conducting transactions, providing services, and supporting national initiatives, such as smart grid and virtualization of energy management, is directly tied to the development of initiatives that strengthen the reliability and veracity of electronic commerce and authenticity of users, both individual and organizational. Through the funding of these initiatives, NIST can support the research and development research in response to the Administration's recommendation for improving the security, availability, and confidence of the Nation's cyberspace infrastructure. Failure to invest in research, the development of standards, and improvement of cybersecurity awareness outreach will continue to leave Federal government service providers, consumers, and private service providers vulnerable to ever-increasing cyber attacks that could damage the national critical infrastructure.

Base Resource Assessment:

In the areas of cybersecurity, NIST invested a total of $45 million in base STRS funds in FY 2012.

NIST collaborates with industry, consortia, and other Federal agencies to resolve critical cybersecurity issues for the Nation's cyber infrastructure. NIST's activities in support of cybersecurity cover the full range of the research lifecycle, from conducting fundamental research, such as improved techniques for measuring elements of security, to disseminating the results of that research in many forms. This includes the following:

- Developing and reviewing standards, and coordinating the development of large sets of standards.
- Writing guidelines on securing technologies for agencies and other organizations to follow.
- Developing tools, tests, and testbeds for evaluating cybersecurity technologies and the security of emerging information technologies.
- Establishing validation programs to confirm the proper implementation of standards in IT products and services.
- Conducting outreach to make the cybersecurity and IT communities aware of NIST activities and outputs.

NIST has a proven track record in the research and development of standards and guidance for data protection, security automation, continuous monitoring, identity management, and IT security. Critical to cybersecurity research is improving the protection of data and identity information and NIST has extensive expertise in the development of related standards. NIST has a leading role in the Department of Commerce program of cybersecurity and privacy initiatives that support realizing the potential for ecommerce to foster innovation, bolster U.S. industrial competitiveness, and enhance our economic prosperity and security. NIST is responsible for the development of Federal cryptographic standards for unclassified IT systems. The cornerstone cryptographic publication produced by NIST, *Federal Information Processing Standard 140 -2, Security Requirements for Cryptographic Modules*, is globally recognized and used and sets the gold standard by which cryptographic module evaluations are conducted worldwide. NIST led the development of and authored standards in support of Homeland Security Presidential Directive 12, *Federal Information Processing Standard 201-2, Personal Identity*

Verification (PIV). HSPD-12 mandated the use of secure identity credentials for all Federal government employees and certain contractors. To date, over three million FIPS 201-PIV credentials have been issued, with significant consequent adoption of the standard occurring at the state and local and level to meet regional cybersecurity and identity management requirements, a testimonial that the NIST work in cybersecurity is addressing real national needs.

Schedule & Milestones:

Action 1.1: Security for the Federal Mobile Environment

- FY 2014 - FY 2015: Complete guidelines, test reference, derived testing requirements for the critical random inputs needed for the creation of cryptographic keys, the foundational building block for cryptography used in organizational MDMs and Mobile Devices.
- FY 2014 - FY 2015: Extend NIST's guidance, leveraging NIST's Mobile Trust Foundations Document in key areas called out in the guidance on separation of data, trust chaining, periphery control and organizational trust measurements in mobile devices.
- FY 2014 - FY 2015: Create a test and validation program for assessing security controls against side channel attacks against mobile devices and smart cards.
- FY 2014 - FY 2015: Deploy a mobile app tool for voluntary use by app vendors to provide security related information with the app, promoting visibility and understanding of security capabilities of apps and to allow organizations to apply local risk policies in an informed manner.
- FY 2014 - FY 2015: Develop guidance on the creation, security properties and maintenance of an app "store."
- FY 2014 - FY 2015: Develop guidance on managing and security considerations with muti-connection devices, providing security guidance references on best practices in the use of blue tooth, LTE, 3GPP, and 802.11.
- FY 2014 - FY 2015: Work collaboratively with DoD on implementing a reference architecture using a PIV/CAC derived credential to assist with implementation, identify interoperability, scalability, usability and security issues prior to large scale deployment. (Assumption: DoD provides physical/virtual environment for development and reference as well as maintenance)

Action 1.2: Techniques for Measuring and Managing Security

- FY 2014 - 2016: Develop open data models for a variety of contexts such as cloud infrastructures, operating systems and mobile devices in support of federated information exchange.
- FY 2015 - FY 2018: Enhance the ability for robust and unambiguous technical data to be extended, managed, and shared federally, commercially, and internationally.
- FY 2014 - FY 2018: Research and develop new protocols and procedures to support the assessment of IT infrastructure including cloud, mobility and emerging technologies.
- FY 2014 - FY 2015: Research and develop measurement techniques and processes to support the development of sound security metrics for IT infrastructure.
- FY 2015 - FY 2018: Develop and test reference models and prototypes in support of mobile, cloud, and operating system monitoring and management architectures.
- FY 2015 - FY 2018: Work with Standards Development Organizations to encourage development and adoption of security measurement and management data models and processes.

- FY 2016 - FY2018: Publish guidance for implementing security measurement and management solutions using standards and best practices.

Action 2: Cybersecurity Standards

- FY 2014: Complete the identification of cybersecurity voluntary consensus standards for the critical infrastructure cybersecurity framework in support of the Executive Order
- FY 2014 - FY 2018: Enable the development of technical standards to enhance network and communications infrastructure protection.
- FY 2014 - FY 2018: Facilitate the development of technical standards to support the implementation of continuous monitoring through greater automation.
- FY 2014 - FY 2018: Engage with external stakeholders (government, industry, academia, standards bodies) to research and extend the application of technical cybersecurity standards to address sector-specific cybersecurity challenges.

Action 3: National Cybersecurity Center of Excellence

- FY 2014: Complete initial Healthcare IT Electronic Health Record (EHR) security template.
- FY 2014 - FY2015: Identify additional use cases and associated partners for research and development.

Deliverables:

Action 1.1: Security for the Federal Mobile Environment

- Complete guidelines, test reference, derived testing requirements for the critical random inputs needed for the creation of cryptographic keys.
- Test and validation program for assessing security controls against side channel attacks against mobile devices and smart cards.
- Develop guidance on the creation, security properties and maintenance of app "store".
- Reference architecture using a PIV/CAC derived credential to assist with implementation, identify interoperability, scalability usability and security issues prior to large scale deployment.

Action 1.2: Techniques for Measuring and Managing Security

- Creation of reference data sets for cloud infrastructure, mobile devices and operating systems.
- Standards developed in Standards Development Organizations.
- Industry products that implement standards.
- Creation of analytic tools that support NIST data constructs.
- Test constructs made available for security posture of individual devices.
- Published NIST guidelines and recommendations.

Action 2: Cybersecurity Standards

- Workshops and meetings to engage with government and industry partners to identify needed cybersecurity standards for development in standards development organizations.

- Cybersecurity standards adopted by national and international standards development organizations.
- Standards and best practices for the cybersecurity critical infrastructure framework available for industry adoption.

Action 3: National Cybersecurity Center of Excellence

- Disseminate applied principles and mechanics underlying security standards, metrics, and best practices for secure and privacy-preserving information technologies.
- Develop implementation templates for composing, monitoring, and measuring the security posture of computer and enterprise systems.
- Achieve broad adoption of practical, affordable, and useful cybersecurity capabilities across the full range of commercial and government sectors.

Performance Goals and Measurement Data:

Action 1.1: Security for the Federal Mobile Environment

Performance Goal: Documents published	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target	FY 2018 Target
With increase	2	3	4	5	6
Without increase	1	1	2	2	2
Description	Number of documents published based on NIST Mobile Trust Foundations document				

Action 1.2: Techniques for Measuring and Managing Security

Performance Goal: Technical specifications developed	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target	FY 2018 Target
With increase	4	6	8	10	12
Without increase	2	3	4	5	6
Description	Number of technical specifications developed and published				

Action 2: Cybersecurity Standards

Performance Goal: Experts participating in standards activities	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target	FY 2018 Target
With increase	2	4	4	4	4
Without increase	1	1	1	1	1
Description	Participation in standard development activities in support of national cybersecurity priorities, representing a core team of staff, not precluding existing staff already engaged standards activities.				

Action 3: National Cybersecurity Center of Excellence

Performance Goal: Use cases developed	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target	FY 2018 Target
With increase	2	3	4	5	6
Without increase	2	3	3	4	4
Description	Use cases identified and corresponding technical templates published				

PROGRAM CHANGE PERSONNEL DETAIL
(Dollar amounts in thousands)

Program: Measurement science, services, and programs
Sub-program: Laboratory programs
Program Change: Cybersecurity R&D and standards

Title:	Location	Grade	Number of Positions	Annual Salary	Total Salaries
Project lead	Gaithersburg	ZP V	4	$124,377	$497,508
Computer scientist	Gaithersburg	ZP V	8	124,377	995,016
Standards coordinator	Gaithersburg	ZP V	1	124,377	124,377
Standards liason	Gaithersburg	ZP IV	3	105,737	317,211
IT specialist	Gaithersburg	ZP IV	8	105,737	845,896
Administrative support	Gaithersburg	ZA III	3	75,246	225,738
Technology support	Gaithersburg	ZP III	4	75,246	300,984
Administrative/technical support	Gaithersburg	ZA II	3	51,888	155,664
Total			34		3,462,394
Less Lapse		25%	(9)		(865,599)
Total full-time permanent (FTE)			25		2,596,796
2014 Pay Adjustment (1%)					25,968
TOTAL					2,622,764

Personnel Data	Number
Full-Time Equivalent Employment	
Full-time permanent	25
Other than full-time permanent	0
Total	25
Authorized Positions:	
Full-time permanent	34
Other than full-time permanent	0
Total	34

PROGRAM CHANGE DETAIL BY OBJECT CLASS
(Dollar amounts in thousands)

Program: Measurement science, services, and programs
Sub-program: Laboratory programs
Program Change: Cybersecurity R&D and standards

	Object Class	2014 Increase
11	Personnel compensation	
11.1	Full-time permanent	$2,623
11.3	Other than full-time permanent	0
11.5	Other personnel compensation	0
11.8	Special personnel services payments	0
11.9	Total personnel compensation	2,623
12	Civilian personnel benefits	816
13	Benefits for former personnel	0
21	Travel and transportation of persons	139
22	Transportation of things	37
23.1	Rental payments to GSA	0
23.2	Rental Payments to others	0
23.3	Communications, utilities and miscellaneous charges	1,653
24	Printing and reproduction	32
25.1	Advisory and assistance services	0
25.2	Other services	2,300
25.3	Purchases of goods & services from Gov't accounts	1,252
25.4	Operation and maintenance of facilities	0
25.5	Research and development contracts	2,000
25.6	Medical care	0
25.7	Operation and maintenance of equipment	234
25.8	Subsistence and support of persons	0
26	Supplies and materials	1,277
31	Equipment	1,387
32	Lands and structures	0
33	Investments and loans	0
41	Grants, subsidies and contributions	1,250
42	Insurance claims and indemnities	0
43	Interest and dividends	0
44	Refunds	0
99	Total obligations	15,000

3. Advanced Communications: Enabling the development and deployment of next generation communication technologies (Base Funding: $10.6 million and 23 FTE; Program Change: +$10.0 million and 12 FTE).

NIST requests $10.0 million and 12 FTE to support research, standards, and testing efforts in the area of advanced communications for the development and deployment of next generation communication technologies.

Proposed Actions: Enabling the development and deployment of next generation and emerging communication technologies (+$10.0 million)

Rapid advances in communications technology have fundamentally changed the way we as a Nation work and live. With these advances have come significant challenges that, unless addressed, will adversely impact our Nation's ability to reap the benefits from these technologies while ensuring our national security needs are met. Examples of these challenges include: the exponential growth of wireless data usage – scarce spectrum must be more efficiently used to meet the demand; the evolution of broadband access in the home – this has moved from a luxury to a necessity with increasing needs for ever-higher bandwidth; and the vulnerability of all internet capable devices to various security threats. To address these challenges NIST will fund R&D, testing, and standards efforts relevant to advanced communications through the NIST Center for Advanced Communications Technologies headquartered at its Boulder laboratories. Through the Center NIST will leverage key research and engineering expertise and capabilities and build upon capabilities that are currently available within the NIST Boulder Laboratories and its sister agency, the National Telecommunication and Information Administration's (NTIA) Institute for Telecommunication Services (ITS) laboratories to provide opportunities for collaborative research and development. The Center will also provide access to a variety of test-bed resources in order to provide the infrastructure necessary to catalyze accelerated development, testing, and deployment of advanced communications technologies in support of both commercial and government applications.

Through this initiative NIST will target efforts at research to support the development and testing of advanced communications technologies, public safety communications R&D and testing, and coordination of spectrum testing and evaluation resources.

Action 1: Advanced Communications Research and Development and Testing

The request would support research and testing in 2 main categories:

- ***Research on next generation communication technologies*** – This request would provide funds to significantly extend NIST's work with industry to test, measure and improve designs for forward-looking advanced communication architectures, develop techniques to predict and control behavior of large systems, and expedite the seamless integration of heterogeneous wireless and wired network technologies. Given the business/mission critical stature of the Internet today, there is a vast chasm between academic designs and commercially viable Internet-scale technologies. NIST proposes to help bridge this gap by developing and employing advanced test and measurement techniques to characterize critical design requirements for next generation IP based architectures for advanced communication protocols and to work with industry to evaluate and improve their emerging protocols designs. Similarly, NIST will tackle the technical barriers facing the seamless integration of heterogeneous

networks for end-to-end interoperability by developing and evaluating standard interfaces and advanced protocol measurements and modeling techniques that will enable the support of applications and services regardless of the underlying networking infrastructure.

Modern society grows increasingly dependent on large scale information systems in which the interaction of millions of components can lead to dynamic global patterns that cannot be predicted by analyzing the behavior of individual components. Such global patterns include cascading failures, phase transitions, and oscillations that drive systems from normal operating ranges to degenerate regimes and failure. As the Nation's measurement laboratory, NIST, collaborating with industry and academia, has a leading role in identifying, evaluating, refining and testing techniques that can be used to measure and predict global behavior in such large information systems, which will characterize future communication systems. The request supports several targeted efforts to meet these objectives by: (1) developing and evaluating methods and algorithms to predict behaviors that can lead to large-scale system failures; (2) testing real-time methods to monitor global behaviors in large distributed systems; and (3) fostering commercial adoption and deployment of successful methods and technologies for measuring and predicting shifts in system behaviors. A thorough understanding of such failure mechanisms will enable designing more robust and resilient future communications systems.

- ***Metrology to support the testing and evaluation of advanced communications technologies*** - The requested funds would support the development of new measurement science required to improve and calibrate instruments essential for industry to generate and measure the next-generation of complex, high-speed data signals that are critical for advancing communications networks.

  New measurement science is critical to overcoming the serious limitations inherent to today's test methods and equipment. NIST's fundamental waveform metrology must be greatly extended to provide the underpinning measurement science that can reproducibly characterize and compare complex waveforms with reduced uncertainties, and thus providing quantitative descriptions of communications signal quality. From this foundation, we apply waveform measurement techniques to develop new or enhanced metrology required to support advances in high-speed communication systems. Importantly, by approaching these fundamental measurement challenges at the waveform or signal level, NIST can efficiently enable new technologies in both wireless and optical networks within one program.

  Wireless networks operating at the recently released 70, 80, and 90 GHz bands are capable of carrying gigabit/second (Gbps) data rates, and with advances in measurement infrastructure, even 10 Gbps wireless is within reach. However, the technology to measure complicated broadband signals at mm-wave frequencies and GHz bandwidths is not available. NIST's ultrafast electro-optic measurement technology, an approach that is unfamiliar to the wireless industry, may be used as a fundamental source of traceability for the millimeter wave wireless industry, enabling multi-Gbps internet access for mobile and "last mile" applications. Robust last-mile wireless may be the critical enabling technology for high-bandwidth access to the home or premises where fiber-to-the-premises does not apply or is too expensive.

  Our techniques will also improve the economic capacity of fiber optic communications links. Ten years ago, systems designers treated the bandwidth of optical fibers as infinite, focusing on developing the simplest and fastest transmitters and receivers possible, but using only a fraction of the available fiber bandwidth. Today, spectral efficiency is the key to economically expand network capacity. This is pushing fiber systems from inefficient "on-off " modulation formats, to highly-complex spectrally efficient modulation formats that are typical of wireless

systems. These formats present new challenges of measuring not only the amplitude of optical modulation but its phase and polarization as well, at the limit of or even beyond the bandwidth of conventional electronics. Optical constellation analyzers or optical vector signal analyzers (analogous to instruments used in the wireless realm) are new to optical communications. To enable their widespread use and effectiveness, their performance must be validated and calibrated– requiring even higher speed measurements and superior accuracies than can be attained through equipment and instruments currently deployed and used in the field.

Independent of the underlying hardware, whether relying on advanced modulation of optical signals or new wireless systems operating at mm-wave frequencies, all new communications systems face a common set of basic metrology challenges for the accurate characterization and validation of the complex signal waveforms. NIST will achieve substantial leverage by addressing these common challenges in an integrated program that applies common underlying measurement technologies to address the common challenges. To do so, NIST will build on its current strengths in waveform metrology to fully characterize very complex signals while simultaneously increasing the measurement bandwidth, reducing uncertainties, and simplifying the traceability chain to streamline manufacturing test.

Action 2: Advanced Public Safety Communications - 700 MHz Public Safety Broadband Demonstration Network

NIST will support the continued development and operation of the 700MHz Public Safety Broadband Demonstration Network, which allows real-world deployment of candidate public safety broadband technologies, and allows for testing and evaluation of public safety data applications, including voice and video. The Demonstration Network is instrumental in helping public safety officials obtain the information they need to make the transition to 700MHz broadband, and will allow for not only the evaluation of the technology in this new band, but also for determining the technology gaps to be addressed to enable a truly nationwide network deployment. This is in direct support of the Administration's priority of developing a nationwide public safety network in the 700MHz band. Public safety agencies have long struggled with effective cross-agency radio communications, due mainly to incompatibility of many legacy systems and non-contiguous spectrum assignments. But recently enacted Congressional legislation and FCC rulings have made broadband spectrum, cleared by the Digital Television (DTV) transition available to public safety, allowing for a unified system that would foster nationwide roaming and interoperability. Though public safety has been licensed to use this 700MHz spectrum, there are no government or independent laboratory facilities in the United States to test and demonstrate the public safety specific requirements, which pose unique challenges due to the mission critical nature of public safety. To address this gap, NIST's Public Safety Communications Research (PSCR) program (a joint program between NIST and NTIA) has created a 700MHz Broadband Public Safety Demonstration Network to provide manufacturers a site for early deployment of their systems, to foster an opportunity to evaluate systems in a multi-vendor environment, and to stimulate integration opportunities for commercial service providers. To date the Demonstration Network has signed Cooperative Research and Development Agreements (CRADAs) with 39 companies and institutions, through which those entities provide equipment and expertise in support of the test plans for the Demonstration Network. Results from the Demonstration Network not only provide valuable information about the state of current broadband technologies and how they do or do not meet public safety needs, but also provide the technical foundation to further refine public safety's requirements and to work within the international standards bodies to develop tools that can help engender greater confidence that those requirements are met.

Action 3: Spectrum Test-bed Coordination: An important element of this initiative will be the coordination of a network of Federal test-range capabilities to facilitate that provision of testing and evaluation capabilities to meet both industry and government requirements. In partnership with NTIA and other agencies, NIST will facilitate coordination of qualified Federal and non-federal modeling and simulation (M&S), laboratory, and test-range capabilities to enable industry, government and academic stakeholders to work together to address pressing spectrum sharing and co-existence issues. Coordination of these resources will accelerate deployment of new and innovative spectrum access solutions. This coordinated network of test-ranges will serve a ready-now, trusted, unbiased engineering and evaluation role in the testing and evaluation of spectrum sharing technologies and solutions. This will enable the deployment of spectrum sharing solutions that best address diverse economic development, national security, and public safety objectives.

Statement of Need and Economic Benefits:

In the areas of advanced communications, NIST invested a total of $10.6 million in base STRS funds in FY 2012.

The rapidly changing pace of communication technologies has been a major driver of technological innovation and economic development in the U.S. and around the world in the past two decades. The shrinking of technology development cycles, the increasing convergence of scientific disciplines and communication technologies is leading to the advent of new and disruptive communication technologies. This growth presents both unique opportunities and challenges.

Demand for capacity in aggregated traffic for fixed broadband is expected to grow exponentially for the foreseeable future. According to Akami's "State of the Internet" report for the 3rd quarter of 2011, the global average peak connection speed grew 45 percent from the 3rd Quarter of 2010 to 11.7 Mbps in Q3 2011. Considering just wireless users and devices in the U.S., a study by the Cable and Telecommunications Industry Association (CTIA) estimated that the number of mobile devices increased by 9 percent in the first half of 2012, to 327.6 million devices, exceeding the population of the U.S. (315 million). The report also estimated that internet traffic also rose 111 percent to 341.2 billion megabytes during that same time period. Considering such prolific growth and anticipated future demand, simple linear scaling of network capacity will not meet future requirements, both from economic- and technology-based perspectives and none of the present technologies can achieve the necessary scale. Network capacity is already strained. Paradigm-changing technologies must be developed that enable capacity increase of a factor of ten or more, but require only a marginal increase in capital and operating expenditures. The path to the required capacity is largely unknown, and without significant research, the ability to meet the future needs of a growing information-based economy is compromised.

Mobile broadband networks, including Wi-Fi systems and smart phones, employ wireless technologies in the microwave part of the frequency spectrum. There has been a 5000 percent growth in demand for wireless internet data in the last three years. Currently a mere three percent of wireless smart-phone customers are using up to 40 percent of the total available cell-phone bandwidth causing a huge bottleneck for mobile broadband. While the FCC has been very proactive in opening up additional spectrum, this will only go so far in reducing congestion caused by the so-called "spectrum crunch". The development of frequency-agile wireless systems is currently under way as a key component for using available spectrum more efficiently. These systems will require development of more sensitive and intelligent hardware to take advantage of temporarily available spectrum. The use of alternative spectrum such as the recently-allocated frequency bands at millimeter-wave frequencies could provide an increase in usable spectrum that is orders of magnitude greater than the current cell phone bands.

These systems will require development of faster, inexpensive integrated circuits, adaptive antennas, and new transmission protocols to take advantage of the huge increase in available bandwidth.

Besides the technical challenges that are specific to individual fixed and mobile broadband transmission technologies, there are several issues that transcend individual networks, and focus on the challenges posed by the need for interoperability, scale and security requirements of future-generation broadband Internets. The cross-cutting technical barriers include:

- Interoperability – Finding a common suite of protocols that is both efficient and effective across a rapidly growing and divergent set of link technologies will be an enormous challenge. From low power sensor networks, to high speed mobile mesh networks, to terabit fixed optical networks; if one were to design distinct protocols for each environment, they might look radically different. Yet the power of the Internet is based upon having a common, ubiquitous underlying protocol suite on all devices. Heterogeneity of host platforms is also a daunting challenge. From high performance computational clusters, to mobile smart phones, to the simplest networked sensor, protocols must be designed that are compatible and efficient on a vast range of computing devices. Achieving the goal of both seamless and efficient operation across such a broad range of environments will require research and development of "cognitive network" technologies – protocols that can sense and adapt to their ever-changing local environment and support collaborative resource control across many nodes.

- Scaling – Future communication networks will need to support an ever-increasing number of devices that is orders of magnitude larger than those connected to today's Internet. The "smart phone" has already created an environment where mobile broadband must support devices more capable than PCs of even a few years ago in terms of factors such as processing power, screen resolution and video generation. The coming "Internet of Things", also called "machine-to-machine" networks, with network sensors and simple control processors at scales that will dwarf human operated devices. The goal for the current generation broadband effort is 100 Mbps to every home in the Nation, and future generations of broadband will require that level of capability to every smart phone/person, and hundreds of Kbps to every control processor/sensor.

- Security – Ensuring the security of next-generation networks will require baking in security from the very beginning (i.e., security by design) and will also require existing security technologies to cope with the new protocols, network control systems and scale described above. It is not clear how applicable security technologies designed for today's environment of networked PCs, will scale to the extremes of low powered sensor networks, or terabit optical networks. Going forward, new challenges in network identity management, mobile access control and authentication, and privacy will have to be addressed to both fully enable, and protect users of network technologies of the future.

The future of public safety communications networks is a compelling example of these issues. There is a strong need for access to multiple means of communications over significant distances. Yet, the public safety community cannot use existing commercial networks because of concerns about robustness and availability during critical times, and the lack of resiliency and security, as well as capacity. Furthermore, there is a strong need to be able to move communications seamlessly among whatever communication avenue is available in an emergency. Current communications systems, both mobile and fixed broadband, do not offer this seamless switching and they do not have the network management tools to enable the public safety community to take advantage of commercially available networks.

Schedule & Milestones:

Action 1: Advanced Communications Research and Development and Testing

- FY 2014: Measure emerging 100 Gbps non-repetitive, complex optical signals using advanced NIST optical sampling techniques; Demonstrate methods for calculating, in a compact form, the uncertainty of long duration waveforms.

- FY 2014 - FY 2015: Evaluate mid-term approaches to scale the routing and addressing systems of the current Internet architecture to address future needs. Evaluate and improve the security and robustness of viable approaches to ensure that recent advances in routing security are carried forward into new architectures.

- FY 2014 - FY 2015: Identify challenges and alternatives for the realization of secure and seamless wireless/wireline networks and publish gap analyses and recommendations.

- FY 2014 - FY 2017: Conduct research into the test and measurement of seamless and security mobility protocols and networks and actively contribute to the development of standard specifications for such networks.

- FY 2014 - FY 2018: Develop metrics, mathematical and computer simulation models to accurately assess the behavior of seamless and secure networks.

- FY 2014 - FY 2018: Publish guidelines and disseminate research findings in professional conferences/journals and contributions to standard developing organizations.

- FY 2015: Demonstrate methods for characterizing communications test equipment errors due to critical signal processing steps when measuring longer bit sequences useful for communications diagnostics.

- FY 2015: Demonstrate techniques for using calibrated instruments to measure complex modulated signals e.g., quadrature amplitude modulation (QAM) and quadrature phase-shift keyed (QPSK), at frequencies between 40 and 110 GHz.

- FY 2015 - FY 2016: Test and evaluate proposals for software-defined networks based upon customized forwarding algorithms. Work with industry to define and promulgate consensus standards for programmable networks and to ensure that the introduction of such technologies into commercial networks can be achieved in an efficient, robust and secure manner.

- FY 2015 - FY 2016: Initiate realistic testing to evaluate algorithms that survived laboratory-based, theoretical evaluations. First, evaluate the surviving algorithms against traffic traces adapted from archived data collected by industry and academic groups. Second, evaluate the algorithms in real time on measurement data collected during empirical experiments. Third, test the algorithms in commercial systems and industrial laboratories.

- FY 2016: Demonstrate antenna and free-field sensor metrology for accurate transmission of mm-wave signals and verification of transmitted signals, in particular for dynamic spectral measurements.

- FY 2016 - FY 2017: Work with existing network measurement companies and potential startups to transfer the developed algorithms into viable technologies that can be included in products developed for sale in support of network measurement services.

- FY 2017: Demonstrate ultrafast electro-optic techniques for characterizing vector modulation formats at 70 GHz - 500 GHz, overcoming the limitations imposed by the coaxial connectors, limited bandwidth, and increased transfer uncertainty inherent when measuring these signals with conventional oscilloscopes.

- FY 2017: With test equipment manufacturers, establish traceability for optical signal analyzers as well as 100 Gbps optical components and systems.

- FY 2018: Develop large signal measurement capability for transistor and amplifier optimization at mm-wave frequencies.

Action 2: Advanced Public Safety Communications - 700 MHz Public Safety Broadband Demonstration Network

- FY 2014 - FY 2015: Test proposed architecture(s) for possible nationwide public safety broadband network.

- FY 2014 - FY 2015: Develop capability and test public safety mission critical voice service over an LTE network.

- FY 2014 - FY 2015: Demonstrate and test available mission critical public safety devices over the demonstration network.

- FY 2014 - FY 2015: Perform multi-vendor interoperability testing within the demonstrate network for LTE network components.

- FY 2014 - FY 2016: Develop public safety specific standards contributions based on demo network findings and lessons learned.

Action 3: Spectrum Test-bed Coordination

- FY 2014: Provide a trusted agent for industry, Federal, and non-federal spectrum users to facilitate technical studies in spectrum sharing and testing needs.
- FY 2014: Lead spectrum-related outreach and engagement activities with stakeholders in industry, government, and academia in order to identify spectrum sharing evaluation and testing needs, and to disseminate information about existing testing capabilities and opportunities, and needs
- FY2014 – FY2015: Facilitate partnerships formation with industry and other government agencies to meet testing needs necessary to solve issues related to spectrum sharing by providing common agreement frameworks (MOAs, user agreements, and Cooperative Research and Development Agreements.) among network partners.

- FY2014 – FY2015: Provide a centralized directory of available facilities and accepted testing methodologies.
- FY2014 – FY2016: Identify and facilitate access to modeling and simulation capabilities, of DOC, DOD, FCC and other participating organizations to provide industry, academic, and government users access to the widest range of capabilities for assessing candidate spectrum sharing technologies.
- FY2015 – FY 2017: Establish, manage and operate a national-level archive for system data, analysis, and test results, with mechanisms to protect proprietary, sensitive, and classified data as appropriate.

Deliverables:

Action 1: Advanced Communications Research and Development and Testing

- Definition of robustness, security and scalability of next generation Internet architectures.
- Modeling tools and data sets that enable researchers to accurately model the scale and dynamics of current and future Internet control systems.
- Published analyses and improved standard specifications for emerging specifications for software-defined networks.
- Gap analysis on challenges for seamless and secure network mobility.
- Publications and standard contributions on seamless and secure networks.
- Models and tools for measuring and predicting the performance of seamless and secure networks.
- A set of network simulation models capable of generating phase transitions of interest and of collecting data required for algorithmic analysis.
- Calibration artifacts with full point-by-point uncertainty characterization, which will enable a wide range of calibrated time- and frequency-domain measurements to be performed in industrial laboratories, thus accelerating product development by removing the need for intermediate calibration steps by NIST.
- Measurement methods for waveform metrology up to 500 GHz. Such new measurements are required to determine and minimize harmonic distortion in communication system amplifiers at frequencies above 100.
- New test methods to enable the development and verification of interoperable transmission protocols for frequencies at 70 GHz and above, newly made available by the FCC.
- Methods for quantitative measurements of modulated signal up to 100 GHz to enable industry to accurately verify their bit error rates, their adherence to the specified modulation format, and their exact spectral usage for efficiency goals and regulatory compliance.

- Measurement methods for industry to directly verify the over-the-air performance of mobile devices.

- Methods to quantify and validate large signal network analyzer measurements to enable communications networks with greater dynamic range and greater channel capacity to be achieved using base stations and mobile devices having higher efficiency, lower power consumption, and longer battery life (> 50 percent improvement).

Action 2: Advanced Public Safety Communications - 700 MHz Public Safety Broadband Demonstration Network

- Specifications and standard contributions for public safety specific requirements for broadband.

- Documented test plans and results from the execution of Phase 1-3 tests on the demonstration network.

- Technical analysis of possible nationwide public safety broadband architectures.

- Documented audio quality test results for mission critical voice and recommended requirements, standards, and test plans.

- Documentation of requirements for mission critical devices.

- Conferences and workshops on public safety use of broadband technologies.

Action 3: Spectrum Test-bed Coordination

- Coordinated network of spectrum test-range facilities.

- Ability of industry and government partners to rapidly access test-range capabilities and engineering expertise to meet spectrum testing needs.

- Centralized archive of spectrum testing data.

Performance Goals and Measurement Data:

Performance Goal: Publications	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target	FY 2018 Target
With increase	15	30	30	30	30
Without increase	9	9	9	9	9
Description:	Number of new NIST Special Publications, Internal Reports, Professional conference and journal articles, standard technical contributions annually.				

Performance Goal: Test & Measurement Tools	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target	FY 2018 Target
With increase	9	11	15	15	19
Without increase	4	4	4	4	4
Description:	Number of models, test and measurement tools released to public use annually.				

PROGRAM CHANGE PERSONNEL DETAIL
(Dollar amounts in thousands)

Program: Measurement science, services, and programs
Sub-program: Laboratory Programs
Program change: Advanced communications

Title:	Location	Grade	Number of Positions	Annual Salary	Total Salaries
Electrical engineer	Boulder	ZP V	2	$124,377	$248,754
Physicist	Boulder	ZP V	1	124,377	124,377
Physicist	Boulder	ZP IV	1	105,737	105,737
Computer scientist	Boulder	ZP V	1	124,377	124,377
Mathematician	Boulder	ZP V	1	124,377	124,377
Electronics engineer	Boulder	ZP IV	2	105,737	211,474
Electronics technician	Boulder	ZT IV	1	75,246	75,246
IT media specialist	Boulder	ZT IV	1	75,246	75,246
Administrative officer	Boulder	ZA IV	1	105,737	105,737
Administrative/technical support	Boulder	ZA III	2	75,246	150,492
Administrative assistant	Boulder	ZS III	2	38,173	76,346
Administrative/tech support	Boulder	ZA II	1	51,888	51,888
Total			16		1,474,051
Less Lapse		25%	(4)		(368,513)
Total full-time permanent (FTE)			12		1,105,538
2014 Pay Adjustment (1%)					11,055
TOTAL					1,116,593

Personnel Data	Number
Full-Time Equivalent Employment	
Full-time permanent	12
Other than full-time permanent	0
Total	12
Authorized Positions:	
Full-time permanent	16
Other than full-time permanent	0
Total	16

PROGRAM CHANGE DETAIL BY OBJECT CLASS
(Dollar amounts in thousands)

Program: Measurement science, services, and programs
Sub-program: Laboratory programs
Program change: Advanced communications

	Object Class	2014 Increase
11	Personnel compensation	
11.1	Full-time permanent	$1,117
11.3	Other than full-time permanent	0
11.5	Other personnel compensation	0
11.8	Special personnel services payments	0
11.9	Total personnel compensation	1,117
12	Civilian personnel benefits	347
13	Benefits for former personnel	0
21	Travel and transportation of persons	94
22	Transportation of things	27
23.1	Rental payments to GSA	0
23.2	Rental Payments to others	0
23.3	Communications, utilities and miscellaneous charges	1,127
24	Printing and reproduction	14
25.1	Advisory and assistance services	0
25.2	Other services	5,109
25.3	Purchases of goods & services from Gov't accounts	420
25.4	Operation and maintenance of facilities	0
25.5	Research and development contracts	500
25.6	Medical care	0
25.7	Operation and maintenance of equipment	150
25.8	Subsistence and support of persons	0
26	Supplies and materials	536
31	Equipment	559
32	Lands and structures	0
33	Investments and loans	0
41	Grants, subsidies and contributions	0
42	Insurance claims and indemnities	0
43	Interest and dividends	0
44	Refunds	0
99	Direct obligations	10,000
	Transfer to the Working Capital Fund	0
	Total obligations	10,000

4. Measurement Science for Cyber-Physical Systems (Base funding: $8.8 million and 22 FTE; Program Change: + $10.0 million and +25 FTE).

NIST requests an increase of $10.0 million and 25 FTE for a total of $18.8 million to improve the predictability, safety, and security of cyber-physical systems in support of NIST and Administration priorities in advanced manufacturing and in networking and information technology for complex systems.

Proposed Actions: Measurement Science for Cyber-Physical Systems ($10.0 million)

The convergence of networking and information technology with manufactured products, engineered systems of products, and associated services are enabling a new generation of "smart" systems. These integrated, hybrid networks of cyber and engineered physical elements – or Cyber-Physical Systems (CPS) – which are co-designed and co-engineered to create adaptive and predictive systems -- are the basic engine of innovation for a broad range of industries. In automotive, avionics/aerospace, production, telecommunications, consumer electronics, intelligent buildings, emergency response, and health and medical equipment, the value share of cyber-physical components (electronics, computing, communications, sensing, and actuation) will exceed 50% of cost by the end of the decade. The President's Council of Advisors on Science and Technology (PCAST) has noted that CPS "are a national priority for Federal R&D." Expectations for CPS are well beyond what can be delivered today: 24/7 availability, 100% reliability, 100% connectivity and interoperability, predictable behavior, instantaneous response, optimized performance, zero injuries/fatalities.

As CPS increased in complexity, dramatic improvements in the systems engineering, integration and testing are needed. Many technical problems are common across CPS application domains; however, efforts to address them occur in domain-specific silos with limited application. NIST has expertise in a number of CPS domains and is uniquely positioned to achieve breakthroughs by adapting measurement science solutions across domains and, where possible, developing domain-independent solutions. This initiative focuses on three key problems: model-based diagnostics and prognostics, time synchronization, and security. They are selected for initial focus because they are necessary to satisfying the most urgent requirements for CPS: predictable behavior, safety and security – attributes essential to systems people bet their lives on. This initiative will align with other Administration manufacturing priorities and will help to ensure that the US remains competitive in advanced manufacturing.

Action 1: Model-Based Diagnostics and Prognostics ($3M)

The request would develop a standardized software-based modeling platform for optimized control of large-scale distributed CPS through the formation and leadership of a consortium among key industry, university, and government research labs and by leveraging related NIST expertise and experience in developing modeling tools for other domains such as smart manufacturing and building automation. Physics-based software models are essential to CPS and are being developed for design and control applications in several domains, including automotive and aircraft systems, buildings, power plants, and robotics. Models for large-scale distributed CPS such as smart utility grids and intelligent transportation networks are more complex and require extensive data analysis with millions of widely-distributed networked sensors and control points. Component models that can be integrated to perform system-level optimization with distributed control do not exist. Examples of key research issues include diagnostics and prognostics for

dynamic systems with predictable behavior, anticipating emergent behaviors arising from interactions, and multi-scale, multi-temporal modeling across discrete and continuous domains. Modeling research is fragmented, and progress would be accelerated with a more coordinated and collaborative approach.

Action 2: Time Synchronization ($2 million)

Cyber-physical systems sense change in the physical world and respond by causing change in the physical world. This requires measured, real-time actions implemented at the right physical time and within the right system context. Inadequate time synchronization can cause failures due to unacceptable latency and data grid-lock. Time synchronization in CPS is difficult because conventional computing technologies are designed to tolerate timing deficiencies rather than treat them as failures. This problem is currently solved on a case-by-case basis in industries such as aerospace and automotive that use specific particular vintage hardware processors. Such methods are neither guaranteed to work if the conditions change nor portable to new products. NIST will develop tools, protocols, and standards for time synchronized CPS through the Object Management Group (OMG), IEEE, and ASME.

Action 3: Security for Cyber-Physical Systems ($5 million)

New modes of connectivity are bringing dramatic new opportunities for increased performance – but also new risks. The threat environment has changed dramatically with the appearance of advanced persistent attacks specifically targeted to CPS, such as viruses that can cause connected machinery to operate continuously leading damaged equipment and millions of dollars in damages. Many security technologies now commonly used in enterprise computing, such as encryption and device authentication, have not been widely applied in industrial systems both because of a perceived lack of threat and because the technologies were not always compatible with CPS performance and scale requirements. NIST will measure performance impacts of security technologies in industrial CPS; determine necessary standard performance requirements; develop a Risk Management Framework for CPS; develop lightweight encryption and protocols for trustworthy CPS networking and distributed control; and develop a framework for key management of large scale industrial CPS (up to millions of nodes).

Statement of Need and Economic Benefits:

By leading advances in CPS, the United States has the opportunity to capture strategic markets in healthcare, manufacturing, transportation, and other vital industries. This could improve our competition position in world markets, while accelerating domestic jobs creation along with new export and product markets. A number of reports have focused on the importance of CPS and the need to pursue R&D that will establish U.S. leadership in the field and enhance competitiveness in global markets (PCAST 2012, PCAST 2011; PCAST 2010, NITRD 2009). Improving public health and safety is also a national priority where CPS can have a significant impact.

Cyber-physical systems are rapidly becoming critical to the business success of many companies and the mission success of many government agencies. In transportation, manufacturing, telecommunications, consumer electronics, and health and medical equipment, and intelligent buildings the value share of electronics, computing, communications, sensing, and actuation is expected to exceed 50% of the cost by the end of the decade. CPS technologies, in the form of advanced robotics, computer-controlled processes, and real-time integrated systems, are critical for improving U.S. manufacturing competitiveness. With their unique functionalities, cyber-physical systems have the potential to change every aspect of life. Concepts such as connected

vehicle and highway systems, robotic surgery, intelligent buildings, smart electricity grid, and embedded medical devices are just some of the real-world examples that have already emerged. As systems continue to evolve, they will rely less on human decision-making and more on computational intelligence. As we become more dependent on CPS, the challenge is to design systems that are dependable and reliable – systems we can trust our lives with. There is an opportunity for the United States to gain competitive leadership through the ability to develop new cyber-physical systems with built-in assurance of their critical properties, including safety and security, and correct, timely performance of their intended functions. While progress is being made everyday, advancements to cyber-physical systems continue to be challenged by a variety of technical (i.e., scientific and engineering), institutional, and societal issues. These range from technical system-level issues such as interoperability, infrastructure, and reliability, to institutional challenges such as building a 21st century CPS workforce and better business models and value propositions for next generation systems.

The future potential for CPS is enormous, but we must think globally for U.S. industry to realize the opportunities. The market and product opportunities for CPS span all sectors of the economy – and there are significant markets outside the U.S. To be a leader in CPS, companies need to think globally. Systems must work in all countries – so standards and interfaces must be compatible around the world. Other countries are working on global compatibility – the U.S. must also if we want to be global leaders in CPS.

Human factors must be effectively addressed from a variety of perspectives. CPS must allow for integration of humans with varying degrees of training into operational loops. Systems must be able to account for unpredictable human interventions and work seamlessly with humans when needed. Practitioners of the physical domains should be able to design CPS without becoming software engineers.

Increasing cyber-threats and attacks are changing the way we view security. Future systems that are highly integrated within companies and across supply chain boundaries will require entirely new kinds of security systems to deal with multiple wireless and other networking technologies. Systems will not be isolated but instead more closely connected; this could require a united approach to cyber-security and resilience to attack.

Base Resources Assessment:

In the areas of cyber-physical systems, NIST invested a total of $8.8 million in base STRS funds and 22 FTEs in FY 2012.

NIST has deep expertise in a number of CPS domains and is uniquely positioned to achieve breakthroughs by adapting measurement science solutions across domains and, where possible, developing domain-independent solutions. NIST's activities in support of CPS cover the full range of the research lifecycle, from conducting fundamental research, such as improved techniques for measuring elements of security, to disseminating the results of that research in many forms. This includes the following:

- Developing and reviewing standards, and coordinating the development of large sets of standards.
- Writing guidelines on securing technologies for agencies and other organizations to follow.
- Developing tools, tests, and testbeds for evaluating cybersecurity technologies and the security of emerging information technologies.

- Establishing validation programs to confirm the proper implementation of standards in IT products and services.
- Conducting outreach to make the cybersecurity and IT communities aware of NIST activities and outputs.

NIST has a proven track record in the research and development of standards and guidance for data protection, security automation, identity management, and IT security. Critical to cybersecurity research is improving the protection of data and identity information and NIST has extensive expertise in the development of related standards. NIST has a leading role in the Department of Commerce program of cybersecurity and privacy initiatives that support realizing the potential for ecommerce to foster innovation, bolster U.S. industrial competitiveness, and enhance our economic prosperity and security. NIST is responsible for the development of Federal cryptographic standards for unclassified IT systems. The cornerstone cryptographic publication produced by NIST, Federal Information Processing Standard 140 -2, Security Requirements for Cryptographic Modules, is globally recognized and used and sets the gold standard by which cryptographic module evaluations are conducted worldwide. NIST led the development of and authored standards in support of Homeland Presidential Directive 12, Federal Information Processing Standard 201-2, Personal Identity Verification (PIV). HSPD-12 mandated the use of secure identity credentials for all Federal government employees and certain contractors. To date, over three million FIPS 201-PIV credentials have been issued, with significant consequent adoption of the standard occurring at the state and local and level to meet regional cybersecurity and identity management requirements, a testimonial that the NIST work in cybersecurity is addressing real national needs.

Schedule and Milestones:

Action 1: Model-Based Diagnostics and Prognostics

- Development of interface and data standards for large-scale CPS modeling software platforms (FY 2014-2015).
- Development of standardized smart grid model libraries (FY 2015-2016).
- Development of standardized smart water and natural gas grid model libraries (FY 2016-2017).
- Development of standardized intelligent transportation and EV model libraries (FY 2017-2018).

Action 2: Time Synchronization

- Publish a standard architecture for time synchronized CPS and tools for testing their time synchronization (FY 2014-2015).
- Develop standard protocols for event-based CPS time synchronization in OMG, IEEE, and ASME (FY 2015-2016).

Action 3: Cybersecurity for Cyber-Physical Systems

- Publish a Risk Management Framework (RMF) for CPS based on NIST SP 800-39 (FY 2014-2015).
- Publish measured performance impact of security technologies in industrial CPS (FY 2014-2015).
- Develop tools to assess the performance impact of security technologies in industrial CPS (FY 2016-2018).
- Publish implementation Guide for the CPS RMF (covering identity management, authentication, access control, security automation, usability, human experience, etc.) (FY 2016-2017).

- Publish standard defining requirements for secure industrial CPS platforms (FY 2016-2017).
- Protocols for trustworthy industrial CPS networking and distributed control (FY 2016-2017).
- Publish a Guide providing a framework for key management of large scale industrial CPS (FY 2017-2018).

Deliverables:

Action 1: Model-Based Diagnostics and Prognostics

- Needs Assessment
- Physics and physical sciences will be integrated with computer science and mathematics to aid in understanding complex system
- Diagnostics to detect failure modes in complex systems
- Prognostics to anticipate and repair failure modes in complex systems
- Interface and data standards developed for large-scale CPS modeling software platform
- Standardized software-based modeling platform for optimized control of utility infrastructure
- Stakeholder-defined model library definitions

Action 2: Time Synchronization

- Architecture for time synchronized CPS
- Tools for pilot demonstrations of time synchronized technologies
- Draft standards for event-based CPS time synchronization

Action 3: Cybersecurity for Cyber-Physical Systems

- Risk management framework for CPS based upon NIST SP 800-39
- Impact assessment for effects of cybersecurity on industrial productivity
- Performance requirements for CPS cybersecurity solutions, including encryption
- Conference and workshop on industrial cybersecurity threats
- CPS cybersecurity best practices guide, covering identity management, authentication, access control, security automation, usability, and human experience

Performance Goals and Measurement Data:

Action 1: Model-Based Diagnostics and Prognostics ($3M)

Performance Goal: Publications	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target	FY 2018 Target
With increase	4	5	5	3	2
Without increase	0	0	0	0	0
Description: Number of new data standard specifications for CPS modeling released each year (protocols, standards, etc.)					

Performance Goal: Standard Test Methods	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target	FY 2018 Target
With increase	1	2	3	3	2
Without increase	0	0	0	0	0
Description: Number of model libraries published each year for smart grid, smart water and natural gas grid, and intelligent transportation.					

Action 2: Time Synchronization ($2.0 million)

Performance Goal: Publications	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target	FY 2018 Target
With increase	5	10	12	10	12
Without increase	1	1	1	1	0
Description: Number of new related publications in the form of standards, frameworks, guidelines, interagency reports, consumer outreach, and gap analyses.					

Action 3: Cybersecurity for Cyber-Physical Systems ($5 million)

Performance Goal: Cybersecurity education business cases	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target	FY 2018 Target
With increase	2	1	1	1	1
Without increase	0	0	0	0	0
Description: Number of new cybersecurity education business cases.					

Performance Goal: Number of cybersecurity education conferences or workshops	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target	FY 2018 Target
With increase	2	2	3	3	2
Without increase	1	1	1	1	0
Description: Number of cybersecurity education conferences or workshops for cyber-physical systems users, manufacturers, and developers.					

PROGRAM CHANGE PERSONNEL DETAIL
(Dollar amounts in thousands)

Program: Measurement science, services, and programs
Sub-program: Laboratory programs
Program Change: Cyber-physical systems

Title:	Location	Grade	Number of Positions	Annual Salary	Total Salaries
Chief CPS advisor	Gaithersburg	ZP V	2	$124,377	$248,754
Computer scientist	Gaithersburg	ZP V	2	124,377	248,754
Mechanical engineer	Gaithersburg	ZP V	2	124,377	248,754
Electronics engineer	Gaithersburg	ZP V	2	124,377	248,754
Systems engineer	Gaithersburg	ZPV	2	124,377	248,754
IT specialist	Gaithersburg	ZP IV	2	105,737	211,474
Mechanical engineer	Gaithersburg	ZP IV	2	105,737	211,474
Physical scientist	Gaithersburg	ZP IV	1	105,737	105,737
Mathematician	Gaithersburg	ZP IV	1	105,737	105,737
Computer scientist	Gaithersburg	ZP IV	1	105,737	105,737
Grant administrator	Gaithersburg	ZA IV	1	105,737	105,737
Stakeholder coordinator	Gaithersburg	ZA IV	1	105,737	105,737
Network specialist	Gaithersburg	ZP III	2	75,246	150,492
Electronics technician	Gaithersburg	ZT III	2	57,141	114,283
Administrative support	Gaithersburg	ZA III	3	75,246	225,739
Administrative assistant	Gaithersburg	ZS III	1	38,173	38,173
IT specialist	Gaithersburg	ZP II	2	51,888	103,776
Control systems engineer	Gaithersburg	ZP II	2	51,888	103,776
Admin/technical support	Gaithersburg	ZA II	3	51,888	155,664
Subtotal			34		3,087,306
Less Lapse		25%	(9)		(771,827)
Total full-time permanent (FTE)			25		2,315,480
2014 Pay Adjustment (1%)					23,155
TOTAL					2,338,635

Personnel Data	Number
Full-Time Equivalent Employmen	
Full-time permanent	25
Other than full-time permanent	0
Total	25
Authorized Positions:	
Full-time permanent	34
Other than full-time permanent	0
Total	34

PROGRAM CHANGE DETAIL BY OBJECT CLASS
(Dollar amounts in thousands)

Program: Measurement science, services, and programs
Sub-program: Laboratory programs
Program Change: Cyber-physical systems

Object Class	2014 Increase
Personnel compensation	
Full-time permanent	$2,339
Other than full-time permanent	0
Other personnel compensation	0
Special personnel services payments	0
Total personnel compensation	2,339
Civilian personnel benefits	728
Benefits for former personnel	0
Travel and transportation of persons	92
Transportation of things	26
Rental payments to GSA	0
Rental Payments to others	0
Communications, utilities and miscellaneous charges	1,075
Printing and reproduction	19
Advisory and assistance services	0
Other services	1,076
Purchases of goods & services from Gov't accounts	1,080
Operation and maintenance of facilities	0
Research and development contracts	1,500
Medical care	0
Operation and maintenance of equipment	144
Subsistence and support of persons	0
Supplies and materials	865
Equipment	1,056
Lands and structures	0
Investments and loans	0
Grants, subsidies and contributions	0
Insurance claims and indemnities	0
Interest and dividends	0
Refunds	0
Total obligations	10,000

5. Health IT: Supporting a Robust and Interoperable Healthcare Enterprise (Base Funding: $3.6 million and 9 FTE; Program Change: +$3.0 million and 9 FTE).

NIST requests an increase of $3.0 million and 6 FTE for a total of $6.6 million to improve the interoperability of Electronic Healthcare Records (EHR) in coordination with Health and Human Services, Office of the National Coordinator (ONC) and Centers for Medicare and Medicaid Services (CMS).

Proposed Actions: Advances in the Interoperable Healthcare Enterprise ($3.0 million)
The development of a trusted, secure, reliable, and interoperable healthcare enterprise would require that we pursue the following tasks:

Action 1: Facilitate seamless interoperability of EHRs for Meaningful Use: Meaningful use is the set of standards defined by ONC as part of the CMS Incentive Programs that governs the meaningful use (MU) of electronic health records (EHRs) and allows eligible providers and hospitals to earn incentive payments by meeting specific criteria with the goal of promoting the spread of EHRs to improve health care in the United States. Seamless interoperability would require the development of test methods and tools beyond the ones currently used to support meaningful use (MU) stages. Achieving this goal requires that testing tools be able to perform conformance testing of EHR messages and also ensure that the semantics are preserved so that information is transmitted in an unambiguous manner between various applications. Our approach in achieving this would be: 1) develop testing methods for EHR-to-EHR interoperability and distribute to Accredited Testing Laboratory (ATL) to be used in certifying EHR technology in conjunction with ONC Authorized Certification Bodies (ONC-ACB); 2) work with ONC to identify appropriate vocabularies that can be used for encoding semantics; 3) design and implement test methods, which are robust and flexible through an internal test bed; and 4) validate interoperability test methods through the test bed described later.

Achieving true interoperability requires three tightly integrated activities to succeed: 1) standards development which is led by ONC; 2) implementation support for stage II tooling which is developed collaboratively with CMS and ONC; and 3) comprehensive conformance and interoperability testing for stage III which is collaboratively provided between NIST and ONC. Thus, true interoperability testing cannot be achieved without having the right standards, implemented in the right way, and tested – both for syntax and semantics – to the right requirements. See the PCAST report (http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-health-it-report.pdf) which recommends the establishment of "a 'universal exchange language' that enables health IT data to be shared across institutions; and also to create the infrastructure that allows physicians and patients to assemble a patient's data across institutional boundaries, subject to strong, persistent, privacy safeguards and consistent with applicable patient privacy preferences."

This request will provide resources to continue to assist ONC in meeting their goals for MU stages 2 and 3.

Statement of Need and Economic Benefits:

According to a report by the CMS, the United States spent nearly $2.6 trillion dollars on healthcare in 2010. It is estimated that this will nearly double by 2020. This is underscored by a statement made by Jonathan Bush, CEO of Athenahealth (see Fortune, January 16, 2012, p22), "The U.S. spends an amount equal to 300% of India's GNP on healthcare, and India's population is three times ours." In an attempt to improve the quality and value of health care, the Bush and Obama administrations initiated a

major effort in moving from paper-based medical records to EHRs, including the establishment of the ONC and providing appropriate incentives for the Nation's physicians to move to the use of EHRs. The goal is lead to considerable automation in the healthcare industry. In order to take advantage of such automation, it is imperative that the information generated in the healthcare enterprise is digitally encoded with the right semantics, archived for efficient storage and retrieval, and transported reliably, securely, efficiently, and without any information loss.

To encourage a more widespread adoption of health information technology, Congress passed the Health Information Technology for Economic and Clinical Health (HITECH) Act, enacted as part of the American Recovery and Reinvestment Act (ARRA) of 2009. HITECH calls for ONC, in consultation with NIST, to recognize a program for the voluntary certification of health IT as being in compliance with applicable certification criteria to meet defined requirements. Certified EHR technology can then be used by eligible providers to receive incentive payments as part of the Meaningful Use (MU) program.

The emphasis on MU Stage 1 and MU Stage 2 has been primarily on EHRs and interfaces to a wide variety of support services, such as e-prescription and clinical labs. Thus far, the focus has been on conformance testing, where a single implementation is compared to the standard to be sure that the implementation does what the standard specifies. Conformance testing is seen as a means to increase the probability that systems will interoperate. However, interoperability testing requires that several vendor systems are tested against each other, with the standard used as a reference to judge problems and incompatibilities, and as a guide to the functions that should be tested and the general behavior to be expected. Interoperability testing, using a test bed comprised of varying EHR products, may be viewed as a supplement to conformance testing, by verifying that diverse systems work together to deliver the expected results. Until we achieve full-scale interoperability of software systems in the healthcare enterprise, we will not realize the full benefits of using IT in healthcare. NIST will establish a testbed to support interoperability testing and implement a reference system for vendors to test against along with other vendor EHR systems.

Base Resource Assessment:

NIST has been collaborating with industry and others to improve the healthcare information infrastructure since the 1990s. NIST IT researchers have an internationally respected reputation for their knowledge, experience, and leadership. Since 2004, NIST has worked closely with the Department of Health and Human Services' Office of the National Coordinator for Health IT (HHS/ONC).The role of NIST is further articulated in the 2008-2012 Federal Health IT strategic plan and the Health Information Technology for Economic and Clinical Health (HITECH) Act to:

- Advance healthcare information enterprise integration through standards and testing
- Consult on updating the Federal Health IT Strategic Plan
- Consult on voluntary certification programs
- Consult on health IT implementation
- Provide pilot testing of standards and implementation specifications, as requested

To address these priorities, the NIST Health IT Program is engaged in the following activities:

- Enable the accelerated development and harmonization of standards for health IT technologies by creating a robust health IT technology testing infrastructure
- Support the usability of health IT technologies and continuous process improvement in healthcare delivery beyond traditional physical locations
- Perform cutting edge R&D on standards testing for related emerging technologies

Additionally, NIST collaboration with Health and Human Services Office of the National Coordinator on meaningful use rules, requirements, and testing has resulted in important steps being taken to improve the management of EHRs.

In the area of Health IT, NIST invested a total of $ 3.6M in base STRS funds in FY 2012.

Schedule & Milestones:

Action 1: Facilitate seamless interoperability of EHRs

- FY 2013-FY 2018: Design and establish a an EHR interoperability test bed, including a full dataset of EHR data to simulate a small healthcare system
- FY 2014-FY 2016: Coordinate with HHS/ONC and industry to facilitate the identification and development of interoperability standards in support of meaningful use stage 2 and 3
- FY 2014-FY 2016: With ONC and the National Library of Medicine, develop tools and techniques to translate concepts across multiple domain vocabularies
- FY 2015-FY 2018: Develop methods to test medical devices for interoperability
- FY 2015-FY 2018: Conduct research into emerging healthcare technologies

Deliverables:

Action 1: Facilitate seamless interoperability of EHRs

- Assist in the delivery of detailed and industry adoptable interoperability standards tests in support of meaningful use stages 2 and 3
- Demonstration of Electronic Healthcare Record interoperability via interoperability test bed
- Demonstration of traceability of software application interactions
- Patents, publications, and presentations related to EHR interoperability and conformance
- Work with ONC to get standards accepted by international Standards Development Organizations
- Industry usable test infrastructure to support meaningful use conformance
- Methods for data analysis to improve the efficiency and accuracy of data processing

Performance Goals and Measurement Data:

Action 1: Facilitate seamless interoperability of EHRs

NIST will design and establish an EHR interoperability test bed, including a full dataset of EHR data to simulate a small healthcare system. These actions will facilitate achieving the goals in the following table.

Performance Goal: Conformant and Interoperable EHR systems for MU	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target	FY 2018 Target
With increase	1,000	250	250	1,500	250
Without increase	0	0	0	0	0
Description	Number of new systems and modules conformant to meaningful use requirements and Interoperable				

PROGRAM CHANGE PERSONNEL DETAIL
(Dollar amounts in thousands)

Program: Measurement Science, Services, and Programs
Sub-program: Laboratory Programs
Program Change: Health IT

Title:	Location	Grade	Number of Positions	Annual Salary	Total Salaries
Project lead	Gaithersburg	ZP V	2	$124,377	$248,754
Computer scientist	Gaithersburg	ZP IV	4	124,377	497,508
IT Specialist	Gaithersburg	ZP IV	2	105,737	211,474
Administrative support	Gaithersburg	ZA III	1	75,246	75,246
Technology support	Gaithersburg	ZA III	2	75,246	150,492
Technical support	Gaithersburg	ZA II	1	51,888	51,888
Total			12		1,235,362
Less Lapse		25%	(3)		(308,841)
Total full-time permanent (FTE)			9		926,522
2014 Pay Adjustment (1%)					4,633
TOTAL					931,155

Personnel Data	Number
Full-Time Equivalent Employment	
Full-time permanent	9
Other than full-time permanent	0
Total	9
Authorized Positions:	
Full-time permanent	12
Other than full-time permanent	0
Total	12

PROGRAM CHANGE DETAIL BY OBJECT CLASS
(Dollar amounts in thousands)

Program: Measurement science, services, and programs
Sub-program: Laboratory programs
Program Change: Health IT

	Object Class	2014 Increase
11	Personnel compensation	
11.1	Full-time permanent	$931
11.3	Other than full-time permanent	0
11.5	Other personnel compensation	0
11.8	Special personnel services payments	0
11.9	Total personnel compensation	931
12	Civilian personnel benefits	290
13	Benefits for former personnel	0
21	Travel and transportation of persons	48
22	Transportation of things	8
23.1	Rental payments to GSA	0
23.2	Rental Payments to others	0
23.3	Communications, utilities and miscellaneous charges	534
24	Printing and reproduction	2
25.1	Advisory and assistance services	0
25.2	Other services	168
25.3	Purchases of goods & services from Gov't accounts	48
25.4	Operation and maintenance of facilities	0
25.5	Research and development contracts	200
25.6	Medical care	0
25.7	Operation and maintenance of equipment	36
25.8	Subsistence and support of persons	0
26	Supplies and materials	34
31	Equipment	53
32	Lands and structures	0
33	Investments and loans	0
41	Grants, subsidies and contributions	648
42	Insurance claims and indemnities	0
43	Interest and dividends	0
44	Refunds	0
99	Total obligations	3,000

6. Measurements and Standards for Disaster Resilience and Natural Hazards Risk Reduction (Base Funding: $1.0 million and 3 FTE; Program Change: + $5.0 million and +4 FTE).

NIST requests an increase of $5.0 million and 4 FTE for a total of $6 million and 7 FTE to provide critically needed metrics, tools, and standards to increase the resilience of our Nation's buildings and communities to damage from earthquake, windstorms, and fire.

Proposed Actions

Action 1: Convene private-sector group to develop resilience framework and model resilience standards and policies ($3 million)

U.S. communities can and do suffer catastrophic loss due to extreme events such as hurricanes, tornadoes, wildfires, earthquakes, and flooding. A large percentage of the Nation's buildings and infrastructure is concentrated in disaster-prone regions. Despite significant progress in disaster-related science and technology, natural and technological disasters in the United States are responsible for an estimated $55 billion in average annual costs in terms of lives lost, disruption of commerce and financial networks, properties destroyed, and the cost of mobilizing emergency response personnel and equipment. Critically needed metrics, tools, and standards to ensure community-level resilience will enable communities to recover more rapidly from these disasters with minimal loss of life, minimal damage to buildings and infrastructure lifelines, and minimal business disruption.

NIST will provide federal leadership to convene the highly diverse stakeholder interests (planners, designers, contractors, state and local officials, SDOs, code organizations, industry organizations, professional organizations, and other agencies) across all infrastructure sectors to develop and adopt a national resilience framework and associated model resilience standards and policies. This will include formation of a private sector-led, government-funded National Model Resilience Standards Panel (NMRSP) to engage the larger community and to accelerate the development of standards. Further, there is a critical knowledge gap and lack of standards, codes, and practices for measuring and enhancing the resilient performance nationwide of communities and regions. Standards for community and regional resilience need to address (1) lifeline systems, with an emphasis on critical physical infrastructure systems, (2) new and existing buildings, particularly those essential to community resilience, and (3) communities that are severely threatened by fires at the wildland-urban interface and by extreme weather events.

Action 2: Research and Development for Critical Building and Lifeline Resilience ($2 million)

NIST proposes to develop critical measurement science tools needed by U.S. industry for: (1) risk-based condition assessment of aging infrastructure systems; (2) determining the remaining service life-and guiding development and use-of sustainable infrastructure materials; and (3) for ensuring the disaster resilience of structures under extreme conditions (specifically, hurricanes, tornadoes, and other windstorms). Solutions will require active partnership with the private sector (including the NMRSP), academia, and other organizations and agencies.

Statement of Need and Economic Benefits:

As costs from disasters continue to rise, there is increasing recognition of the need to move from response and recovery to proactively identifying hazards that pose threats and taking action to reduce the potential impacts. Whether hazards become disasters depends upon the disaster resilience of our structures and communities. This, in turn, depends upon the capacity to prepare for and mitigate the impacts of hazards, preventing them from becoming disasters. This initiative is focused directly on

selected recommendations related to five of six Grand Challenges identified by the President's National Science and Technology Council in June 2005 for advancing science and technology to enhance disaster resilience and thus improve the Nation's ability to face disasters. These challenges include (1) provide hazard and disaster information where and when it is needed, (2) understand the natural processes that produce hazards, (3) develop hazard mitigation strategies and technologies, (4) assess disaster resilience using standard methods, and (5) promote risk-wise behavior.

Currently, there is a lack of the measurement science to improve the disaster resilience of buildings and infrastructure exposed to natural and man-made hazards. This initiative supports NIST's mission of promoting U.S. innovation and competitiveness by anticipating and meeting the measurement science, standards, and technology needs of U.S. industries, including the building and fire safety industries. The initiative leverages NIST core competencies in performance of buildings and infrastructure under extreme loads. NIST has significant statutory responsibilities in these areas, including the National Earthquake Hazards Reduction Program (NEHRP) (2004), the National Construction Safety Team Act (2002), the National Windstorm Hazard Reduction Act (2004), and the Fire Prevention and Control Act (1974). Further, NIST houses the Engineering Laboratory (EL), whose research is used by standards, codes, and practitioners around the world. This initiative addresses two critical national needs for disaster reliance: disaster and failure event studies and fire performance of structures.

Base Resource Assessment:

In the areas of disaster resilience NIST invested a total of $1 million in base STRS funds in FY 2012.

Schedule and Milestones:

Action 1: Convene private-sector group to develop resilience framework and model resilience standards and policies ($3 million)

- Establish National Model Resilience Standards Panel (NMRSP) (FY 2014).
- Develop a framework to enhance community resilience (FY 2014).
- Develop guidelines for the assessment and development of community and regional resilience goals and criteria for the built environment (FY 2015-2019).

Action 2: Research and Development for Critical Building and Lifeline Resilience ($2 million)

- Develop guidelines for the assessment of disaster resilience of critical buildings. (FY 2015)
- Develop initial set of protocols and model standards to enhance community resilience. (FY 2016)
- Develop design guidance for disaster resilience of new and existing critical buildings. (FY 2016)
- Develop guidelines for the assessment of disaster resilience of lifeline systems. (FY 2018)
- Develop design guidelines for disaster resilience of lifeline systems. (FY 2019)
- Develop expanded set of protocols and model standards to enhance community resilience. (FY 2019)

Deliverables:

Action 1: Convene private-sector group to develop resilience framework and model resilience standards and policies ($3 million)

- Formation of a private-sector led, government funded National Model Resilience Standards Panel (NMRSP), modeled after the Smart Grid Interoperability Panel.
- Framework for defining and improving the interactions of buildings and lifelines (*e.g.*, utilities - water supply and distribution, electricity and fuel distribution - and transportation) to optimize community and regional resilience to major natural hazards.
- Critical performance metrics, tools, and standards needed to achieve resilience within the framework.

Action 2: Research and Development for Critical Building and Lifeline Resilience ($2 million)

- Facility-specific resilience standards, guidelines, and methodology to achieve performance targets from a baseline of life safety to higher levels of performance—such as immediate occupancy or a fully operational system—more appropriate for buildings and lifelines essential to community resilience (e.g., utilities, transportation systems, communication systems, hospitals, schools, and emergency operations centers) for hazard levels typically used in safety-based design.
- Guidelines and methods for low probability, high-consequence hazard levels more appropriate for resilience-based design than hazard level typically used in safety-based design.
- Facility-specific resilience standards, guidelines, and methods that take into account: (1) the increased risks from multiple hazards that many communities face, (2) the preparedness of a community's emergency response and evacuation systems, and (3) the interaction of technical, social, and economic factors that determine pre-disaster mitigation and post-disaster response.
- Application of facility-specific resilience standards, guidelines, and methods for measuring and enhancing the resilience performance of lifeline systems for critical infrastructure, existing buildings, and communities threatened by extreme weather events or fires at the wildland-urban interface.

Performance Goals and Measurement Data:

Action 1: Convene private-sector group to develop resilience framework and model resilience standards and policies ($3 million)

Performance Goal: Development and adoption of critical performance metrics, tools, and standards to achieve building, infrastructure and community resilience	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target	FY 2018 Target
With Increase	20%	40%	60%	80%	100%
Without Increase	6%	12%	18%	24%	30%

Description: Percentage of milestones completed leading to the development and adoption of critical performance metrics, tools, and standards to achieve building, infrastructure and community resilience

Action 2: Research and Development for Critical Building and Lifeline Resilience ($2 million)

Performance Goal: Development of design guidelines and protocols for disaster resilience of new and existing critical buildings subject to extreme weather events	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target	FY 2018 Target
With Increase	20%	40%	60%	80%	100%
Without Increase	6%	12%	18%	24%	30%

Description: Percentage of milestones completed leading to development of design guidelines and protocols for disaster resilience of new and existing critical buildings subject to extreme weather events

PROGRAM CHANGE PERSONNEL DETAIL
(Dollar amounts in thousands)

Program: Measurement Science, Services, and Programs
Sub-program: Laboratory Programs
Program Change: Disaster Resilience

Title:	Location	Grade	Number of Positions	Annual Salary	Total Salaries
Research engineer	Gaithersburg	ZP V	2	$124,377	$248,754
Research structural	Gaithersburg	ZP V	4	124,377	497,508
Total			6		746,262
Less Lapse		25%	(2)		(186,566)
Total full-time permanent (FTE)			4		559,697
2014 Pay Adjustment (1%)					5,597
TOTAL					565,294

Personnel Data	Number
Full-Time Equivalent Employment	
Full-time permanent	4
Other than full-time permanent	0
Total	4
Authorized Positions:	
Full-time permanent	6
Other than full-time permanent	0
Total	6

PROGRAM CHANGE DETAIL BY OBJECT CLASS

(Dollar amounts in thousands)

Program: Measurement Science, Services, and Programs
Sub-program: Laboratory Programs
Program Change: Disaster Resilience

Object Class		2014 Increase
11.1	Full-time permanent	$565
11.3	Other than full-time permanent	0
11.5	Other personnel compensation	0
11.8	Special personnel services payments	0
11.9	Total personnel compensation	565
12	Civilian personnel benefits	176
13	Benefits for former personnel	0
21	Travel and transportation of persons	43
22	Transportation of things	16
23.1	Rental payments to GSA	0
23.2	Rental Payments to others	0
23.3	Communications, utilities and miscellaneous charges	575
24	Printing and reproduction	7
25.1	Advisory and assistance services	0
25.2	Other services	1,524
25.3	Purchases of goods & services from Gov't accounts	488
25.4	Operation and maintenance of facilities	0
25.5	Research and development contracts	600
25.6	Medical care	0
25.7	Operation and maintenance of equipment	114
25.8	Subsistence and support of persons	0
26	Supplies and materials	362
31	Equipment	530
32	Lands and structures	0
33	Investments and loans	0
41	Grants, subsidies and contributions	0
42	Insurance claims and indemnities	0
43	Interest and dividends	0
44	Refunds	0
99	Direct obligations	5,000

7. Measurement Science and Standards in Support of Forensic Science (Base Funding: $4.6 million and 12.3 FTE ; Program Change: +$5.0 million and 16 FTE).

This new initiative focuses on the establishment and maintenance of the science base to support the development of new measurement methods standards and quality assurance tools needed by the forensics community. The NIST laboratories will perform research to characterize and improve the accuracy and efficacy of many forensic approaches, aiding practitioners by providing tools for crime scene investigation, laboratory analysis, and court room use of this evidence while also enabling NIST laboratories to innovate completely new approaches to forensic science disciplines.

Proposed Actions:

The NIST laboratories require additional funding to develop a state-of-the-art measurement science and standards basis for forensic disciplines and technologies. The funds will be applied to staff and equipment necessary to develop standards, measurement methods, validation, and other technical expertise needed by the forensics community. Investing in technical expertise in forensic science at NIST, while requiring additional funding, leverages existing capabilities at NIST in measurement science and NIST leadership and prominence in developing standards and technology.

Working with stakeholders, NIST has identified the following critical areas for NIST to provide support to the forensics community. These areas have been selected based on a number of factors, including the types of forensic analyses currently used by practitioners, the forensic science disciplines that require more research in the near term, those areas in which quality control is acknowledged as the most pressing issue, and the required investment in human capital and/or equipment to substantially make an impact. NIST innovations in measurement science in these technical areas are also critical for moving the state of the science forward to the benefit of the forensic science community. Matching these present and future needs with technical competency across NIST laboratories, NIST will focus on the following areas:

- Develop, critically evaluate, and publish new reference methods and technologies for identifying criminals and understanding crime scenes
- Test and measure the uncertainty including such factors as bias, precision, and human errors in existing forensic methods
- Improve the accuracy, reliability, and interoperability of forensic methods and data through research in underlying science, rigorous testing, and methods for assessing conformance to standards
- Develop calibration systems, reference materials and databases, and technology test beds for reliable and accurate forensic practice
- Work with national and international Standards Developing Organizations, academia, instrument manufacturers, database creators and disseminators, and the forensic science user communities to encourage adoption of scientifically rigorous and well characterized methods and practices

Statement of Need and Economic Benefits:

> "The simple reality is that the interpretation of forensic evidence is not always based on scientific studies to determine its validity. This is a serious problem." - *Strengthening Forensic Science in the United States: A Path Forward, 2009, Page 8*

In 2009, the National Research Council of the National Academies (NRC) released a report titled *Strengthening Forensic Science in the United States: A Path Forward.* This technically rigorous examination of forensic science expresses concern over the lack of peer-reviewed and published validation of the scientific underpinnings of forensic science disciplines, the lack of uniform standards, and the highly fragmented state of forensic science in the U.S. Responding to this call to action and other indications of critical need, NIST proposes increased emphasis on forensics within our programs. The funding from this initiative would cement and build upon the foundations that NIST has laid by engaging with the broad forensics community; ultimately impacting crime laboratories and criminal courts across the U.S. NIST is unique in having the expertise and capacity to develop the needed forensic science measurement tools and methodologies, and to disseminate and coordinate this with the broad community.

The current scientific measurement basis and the state of standardization of forensic science are widely acknowledged as needing significant improvement. Forensic science is intended to provide the justice system with nonbiased, independent scientific evidence analysis and expert testimony: aiding police in catching criminals; understanding crime scenes; identifying suspects; and helping to correctly ascertain guilt or innocence. However, the reliability and scientific validity of forensic science has been called into question, with a number of critical issues identified by scientific and legal communities. This initiative in Forensic Science comprehensively addresses many of the issues identified by a number of stakeholders, including the National Academies, public policy organizations, Congress, and the Administration.

NIST is perfectly positioned to provide measurement science support to the forensic science community through the research and development of traceable standard materials, reference data, and calibration systems. The NIST laboratories have partnerships with professional associations, standards developing organizations, government, industry, and academia, which will enable NIST to strengthen and expand efforts to advance measurement quality for forensic science. The NIST laboratories have complementary expertise that will further enable research to characterize and improve the accuracy and efficacy of many forensic approaches, aiding practitioners by providing tools for crime scene investigation, laboratory analysis, and courtroom use of this evidence.

Specifically, this initiative impacts two major areas:

1. **Validity and reliability of evidence used in the U.S. justice system**

   Forensic science is one of the major structural elements of the U.S. justice system. Forensic science provides an objective, science and fact-based approach to understand crime scenes, identify suspects and overcome human bias in investigation and execution of the justice system. Improving the accuracy and reliability of forensic science directly impacts the trust in the system. As the impacts of this initiative are promulgated throughout the country, we expect that more criminals will be correctly identified and prosecuted and fewer innocent citizens will be accused or convicted of criminal activities.

2. Cost to the U.S. justice system

Tremendous cost savings are anticipated if the goal of this initiative (i.e., to produce sound scientific measurement tools for use in the forensic science community and to facilitate their implementation through the NFSC) is fully realized. The cost of building a trusted foundation in forensic science via this initiative is dwarfed by the total expenditure by local, state, and Federal government in the criminal justice system, which was estimated at $258 billion in 2009[11]. Providing certainty and accuracy to measurements in criminal laboratories will reduce the number of wrongful convictions and mistrials, impacting the number of criminal court cases (not an insignificant number: in 2008 nearly 22 million criminal cases were filed in U.S. state courts[12]). For those individuals who may be exonerated based on a reexamination of physical evidence such as DNA analysis, there is a cost savings to the penal system and an impact on that individual's quality of life. Another consideration is the cost of preventing future crimes: because rapists and serial killers are often repeat offenders, the societal value of conviction after the first offense using accurate forensic methodology should also be considered a benefit. One economic analysis of cost savings from forensic DNA testing alone estimated a cost savings of $35 for every dollar invested; the same analysis predicted that if DNA testing were fully utilized the U.S. could expect a $12.9 billion annual savings in prevented crime[13]. The safety of many Americans will benefit from improvements to the practice of forensic science. In 2009 alone, U.S. residents experienced an estimated 4.3 million violent crimes and 15.6 million property crimes[14].

Base Resources Assessment:

NIST has a long history of providing innovative solutions to technological forensic science challenges like those described in the 2009 NRC report. One example is the development at NIST of truncated DNA polymerase chain reaction primers to accurately detect and identify DNA short tandem repeats (STRs) in highly decomposed and partially incinerated human remains recovered from Ground Zero at the World Trade Center in 2001.

NIST measurement science capabilities are broadly applicable to a number of forensic science disciplines and challenges. Currently, specific efforts at NIST in forensic science-related areas are largely driven by funding from other agencies (e.g., DOJ) on a short-term directed task basis. Despite this NIST has an established core capability in a number of forensic science areas. For example, NIST research in human identity and forensic DNA testing, developed in collaboration with the National Institute of Justice (NIJ/DOJ), has resulted in the development of standard reference materials, new testing methods, inter-laboratory validations, and the creation of training materials. The successful development of this core competency in DNA testing is a product of technical expertise along with a commitment to and engagement with the forensic community to develop relevant products. The Forensic Science initiative empowers NIST to leverage this success in DNA testing, by continuing efforts in forensic DNA while also using the DNA testing successes as a model to establish strengths in other forensic specialty areas within NIST.

Breadth of expertise is an essential component of the Forensic Science initiative. Although DNA testing methodology has developed rapidly (due in large part to increased funding by Congress through the

[11] Direct expenditures (e.g., police, corrections, and judicial) as reported by the Department of Justice Office of Justice Programs.

[12] Court Statistics Project, State Court Caseload Statistics: An Analysis of 2008 State Court Caseloads (Natl. Center for State Courts 2010)

[13] John Butler, "Fundamentals of Forensic DNA Typing," Academic Press 2009, p. 261.

[14] National Crime Victimization Survey, Department of Justice Office of Justice Programs

$1 billion Justice for All Act of 2003 and to a smaller extent in academic and research institutions), the Innocence Project, a national litigation and public policy organization, notes that in 90 – 95% of criminal cases DNA testing is not an option: developing reliable measurement science in other areas of forensic science is essential[15].

In the area of Forensics, NIST invested a total of $ 4.6M in base STRS funds in FY 2012.

Schedule & Milestones:

- Support full operation of Guidance Groups framework (FY 2014).
- Develop NIST expertise in forensic measurement science specialty areas prioritized by the Forensic Science Commission or identified by the NIST Guidance Groups (FY 2014-2018).
- Develop new innovative approaches to aid forensic community (FY 2015-2018).
- Increased use and understanding of standards and measurement aids in forensic community as evidenced by increased number of documentary standards and measurement services (FY 2014-2017).

Deliverables:

- Improved quality of Federal, State, and Local laboratory results (i.e., accuracy, validity, precision, reliability, reproducibility).
- New innovative forensic science technologies.
- Increased use of documentary standards and measurement services by the forensic community.
- Creation of reference materials, reference databases, new calibration services to improve the consistency of the implementation of forensic science across the Nation.

[15] See www.innocenceproject.org

Performance Goals and Measurement Data: (All numbers per annum, not totaled)

Performance Goal Performance Measure: Reference materials and databases	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target
With increase	1	1	1	1
Without increase	-	-	-	-
Description: Number of new forensic science reference materials, reference databases, and documentary standards created.				

Performance Goal Performance Measure: Protocol validation	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target
With increase	2	2	2	2
Without increase	-	-	-	-
Description: Number of protocol validation studies completed and published.				

Performance Goal Performance Measure: Forensic standards	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target
With increase	-	2	3	4
Without increase	-	-	-	-
Description: Number of standards based on NIST technical content adopted by the forensic science community.				

PROGRAM CHANGE PERSONNEL DETAIL

(Dollar amount in thousands)

Program:Measurement Science, Services, and Programs
Subprogram:Laboratory Programs
Program Change: Forensic Science

Title:	Location	Grade	Number of Positions	Annual Salary	Total Salaries
Program Manager	Gaithersburg	ZP V	1	$124,377	$124,377
Assistant Program Manager	Gaithersburg	ZP	4	105,737	422,948
Physical scientist	Gaithersburg	ZA III	10	75,246	752,460
Students/graduate students	Gaithersburg	ZP III	5	75,246	376,230
Administrative/technical support	Gaithersburg	ZA II	2	51,888	103,776
Total			22		1,779,791
less Lapse		25%	(6)		(444,948)
Total full-time permanent (FTE)			16		1,334,843
2014 Pay Adjustment (0.1%)					6,674
TOTAL					1,341,517

Personnel Data	Number
Full-Time Equivalent Employment	
Full-time permanent	16
Other than full-time permanent	0
Total	16
Authorized Positions:	
Full-time permanent	22
Other than full-time permanent	0
Total	22

PROGRAM CHANGE DETAIL BY OBJECT CLASS
(Dollar amounts in thousands)

Program: Measurement science, services, and programs
Subprogram: Laboratory programs
Program Change: Forensic Science

	Object Class	2014 Increase
11	Personnel compensation	
11.1	Full-time permanent	$1,342
11.3	Other than full-time permanent	0
11.5	Other personnel compensation	0
11.8	Special personnel services payments	0
11.9	Total personnel compensation	1,342
12	Civilian personnel benefits	417
13	Benefits for former personnel	0
21	Travel and transportation of persons	153
22	Transportation of things	40
23.1	Rental payments to GSA	0
23.2	Rental Payments to others	0
23.3	Communications, utilities and miscellaneous charges	522
24	Printing and reproduction	6
25.1	Advisory and assistance services	0
25.2	Other services	1,348
25.3	Purchases of goods & services from Gov't accounts	228
25.4	Operation and maintenance of facilities	0
25.5	Research and development contracts	552
25.6	Medical care	0
25.7	Operation and maintenance of equipment	108
25.8	Subsistence and support of persons	0
26	Supplies and materials	156
31	Equipment	128
32	Lands and structures	0
33	Investments and loans	0
41	Grants, subsidies and contributions	0
42	Insurance claims and indemnities	0
43	Interest and dividends	0
44	Refunds	0
99	Total obligations	5,000

8. Pilots for National Strategy for Trusted Identities in Cyberspace (Base Funding: $16.5 million; Program Change: + 8.0 million and 0 FTE).

NIST requests an increase of $8.0 million and 0 FTE for a total of $ 24.5 million to improve the security and interoperability of our Nation's cyberspace infrastructure through the National Strategy for Trusted Identities in Cyberspace.

Proposed Action: National Program Office for the National Strategy for Trusted Identities in Cyberspace (NSTIC) and NSTIC Grant Program ($8.0 million)

In April, 2011, President Obama signed the National Strategy for Trusted Identities in Cyberspace (NSTIC), which charts a course for the public and private sectors to collaborate to raise the level of trust associated with the identities of individuals, organizations, networks, services, and devices involved in online transactions. The NSTIC was established in direct response to the recommendations of the *White House Cyberspace Policy Review* which outlined a need to raise the level of trust associated with the identities of individuals, organizations, services, and devices involved in online transactions.

The request continues and expands existing efforts led by the National Program Office (NPO) within the Department of Commerce to coordinate Federal activities needed to implement the Administration's National Strategy for Trusted Identities in Cyberspace (NSTIC).

Specifically, this request supports an expansion of pilots that will provide additional opportunities for incentivizing the private sector to provide leading roles in delivery of NSTIC solutions, enabling the private sector to work with state, local, and regional governments to improve acceptance of Identity Ecosystem components, and incentivizing cross-sector efforts. NIST will work with the private sector and Federal, state, and local partners to identify potential opportunities for pilots, and provide funding through grants or other funding vehicles.

The purpose of the NSTIC pilot programs is to advance the NSTIC vision, objectives and guiding principles; demonstrate innovative frameworks that can provide a foundation for the Identity Ecosystem; and tackle barriers that have, to date, impeded the Identity Ecosystem from being fully realized. The additional $8.0 million will enable the NSTIC NPO to achieve the initiative's mission objectives more rapidly and effectively, and help to catalyze support for NSTIC across a wide array of stakeholders.

Statement of Need and Economic Benefits:

The NSTIC acknowledges and addresses three major challenges in cyberspace:

1. A lack of confidence and assurance that people, organizations, and businesses are who they say they are online. Both businesses and governments are unable to offer many services online, because they cannot effectively identify the individuals with whom they interact.

2. A de-facto requirement in the current online environment for individuals to maintain dozens of different usernames and passwords, typically one for each Web site with which they interact. The complexity of this approach is a burden to individuals, and it encourages behavior – like the reuse of passwords – that makes online fraud and identity theft easier. And it is one that has created a number of problems for online businesses who face ever-increasing costs for managing customer accounts and the loss of business that results from individuals' unwillingness to create yet another account, consequences of online fraud.

Spoofed Web sites, stolen passwords, and compromised accounts are all symptoms of inadequate authentication mechanisms; our Nation's continued reliance on passwords directly exposes our cyber infrastructure to a variety of easily executed attacks that enable theft, fraud and espionage, and undermine confidence in vital commercial and public information systems.

3. A growing list of online privacy challenges, ranging from minor nuisances and unfair surprises, to disclosure of sensitive information in violation of individual rights, injury or discrimination based on sensitive personal attributes that are improperly disclosed, actions and decisions in response to misleading or inaccurate information, and costly and potentially life-disrupting identity theft. In the aggregate, even the harms at the less severe end of this spectrum have significant adverse effects, because they undermine consumer trust in the Internet environment. Diminished trust, in turn, may cause consumers to hesitate before adopting new services and may impede innovative and productive uses of new technologies.

NSTIC envisions addressing these challenges through a user-centric **Identity Ecosystem,** defined in the Strategy as: "an online environment where individuals and organizations will be able to trust each other because they follow agreed upon standards to obtain and authenticate their digital identities—and the digital identities of devices."

Base Resource Assessment:

Congress provided $16.5 million in FY 2012 appropriations for NSTIC. NIST awarded more than $9 million in FY 2012 for pilot projects in support of NSTIC. Five U.S. organizations will pilot identity solutions that increase confidence in online transactions, prevent identity theft, and provide individuals with more control over how they share their personal information. The pilot projects intend to advance the NSTIC vision, objectives and guiding principles and demonstrate innovative frameworks that can provide a foundation for the Identity Ecosystem, and tackle barriers that have, to date, impeded the Identity Ecosystem from being fully realized. The pilots span multiple sectors including health care, online media, retail, banking, higher education, and state and local government and will test and demonstrate new solutions, models, or frameworks that do not exist in the marketplace today.

Schedule & Milestones:

Action 1: National Program Office for the National Strategy for Trusted Identities in Cyberspace (NSTIC) and NSTIC Grant Program ($8.0 million)

- FY 2014-FY 2016: Award pilots to advance the NSTIC vision, objectives and guiding principles; demonstrate innovative frameworks that can provide a foundation for the Identity Ecosystem, and tackle barriers that have, to date, impeded the Identity Ecosystem from being fully realized. The actual number of pilots conducted will be influenced by the focus areas of the pilot, the number of responses to request for proposals, the complexity of the responses, and lessons learned from preceding pilots. Pilots will be scalable, with a migration path to a large-scale deployment and implementation. Pilots will initially be conducted collaboratively between the Federal Government and private industry but ultimately should not require Federal Government operational support for sustainability. Pilots will be assessed for transition to ongoing operations, and/or provide lessons learned that will improve the adoption, security, resilience, usability, interoperability and other Identity Ecosystem objectives. Pilot duration will be defined to align with the Strategy goals and objectives. Some examples of what pilots could achieve include:

- Enabling the user to have one credential that can be used by several service providers. Currently users have several passwords for each of the various online transactions they conduct. By using relying parties and other components that meet the Identity Ecosystem requirements, a user will no longer be required to maintain dozens of passwords, for both public and private use.
- Promoting two-factor authentication at different risk levels. Different kinds of hard tokens have been developed in the marketplace and a pilot could explore areas to determine the right tokens for different types of users (e.g., online access to records or services where government employees, parties and beneficiaries and the general public all need different levels of access). Pilots that test different types of issuance, including some type of in person proofing, would be desirable.

- Improving privacy and protection of data by demonstrating mechanisms that enable a user to authorize the secondary use or disclosure of personally identifiable information or limit collection of transactional information.

- Creating model trust frameworks that improve interoperability and could help put relying parties (corporate and governmental) and users on equal footing in the marketplace.

- Improving the security and interoperability of credentials through the use or creation of technology solutions based on private sector offerings that align with the goals and objectives of the Strategy.

- Improving the resilience of data breach recovery through the use of digital credentials that are created through known and trusted processes used by the Identity Ecosystem.

- FY 2014-FY 2015: Develop metrics for determining if pilots will be transitioned to ongoing operations or provide publications for lessons learned to improve security, usability, interoperability, and other NSTIC Goals and Objectives.

Deliverables:

Action 1: National Program Office for the National Strategy for Trusted Identities in Cyberspace (NSTIC) and NSTIC Grant Program ($8.0 million)

- Pilot demonstrations to advance the NSTIC vision, objectives and guiding principles; demonstrate innovative frameworks that can provide a foundation for the Identity Ecosystem, and tackle barriers that have, to date, impeded the Identity Ecosystem from being fully realized.

- Publications on pilots and lessons learned

- Web presence that provides global sharing of information, recommendations, and potential reference implementations

Performance Goals and Measurement Data:

Action 1: National Program Office for the National Strategy for Trusted Identities in Cyberspace (NSTIC) and NSTIC Grant Program ($8.0 million)

Performance Goal: Pilots	FY 2013 Target # of awards	FY 2014 Target # of awards	FY 2015 Target # of awards	FY 2016 Target # of awards	FY 2017 Target # of awards	FY 2018 Target # of awards
With Change		9-13	9-13	5-8	*	*
Without Change	4-7	4-7	4-7	2-4	*	*

Description: Minimum number of new pilot awards made In the listed fiscal year. Pilots will be performed for up to 2 years.
* No new awards will be made in FY2017 and FY2018; however, prior year awards may continue into FY2017 and FY2018.

PROGRAM CHANGE DETAIL BY OBJECT CLASS
(Dollar amounts in thousands)

Program: Measurement Science, Services, and Programs
Subprogram: Laboratory Programs
Program change: NSTIC

	Object Class	2014 Increase
11	Personnel compensation	
11.1	Full-time permanent	$0
11.3	Other than full-time permanent	0
11.5	Other personnel compensation	0
11.8	Special personnel services payments	0
11.9	Total personnel compensation	0
12	Civilian personnel benefits	0
13	Benefits for former personnel	0
21	Travel and transportation of persons	36
22	Transportation of things	1
23.1	Rental payments to GSA	0
23.2	Rental Payments to others	0
23.3	Communications, utilities and miscellaneous charges	909
24	Printing and reproduction	4
25.1	Advisory and assistance services	0
25.2	Other services	484
25.3	Purchases of goods & services from Gov't accounts	321
25.4	Operation and maintenance of facilities	0
25.5	Research and development contracts	0
25.6	Medical care	0
25.7	Operation and maintenance of equipment	102
25.8	Subsistence and support of persons	0
26	Supplies and materials	98
31	Equipment	48
32	Lands and structures	0
33	Investments and loans	0
41	Grants, subsidies and contributions	5,997
42	Insurance claims and indemnities	0
43	Interest and dividends	0
44	Refunds	0
99	Total obligations	8,000

9. Supporting the National Initiative for Cybersecurity Education (NICE) (Base Funding: $0.4 million and 1 FTE; Program Change: +1.0 million and 2 FTE).

NIST requests a total of $1 million and 2 FTE for a total of $1 million to support the National Initiative for Cybersecurity Education.

Proposed Actions: Coordinate development and implementation of NICE activities ($1 million)

Action 1: Coordinate implementation of NICE components by DHS and other Federal agencies:

NICE consists of four components, each led by a Federal agency with NIST providing overall coordination. The Department of Homeland Security has the lead in implementing the NICE framework. The four components are: (1) National Cybersecurity Awareness, led by the Department of Homeland Security; (2) Formal Cybersecurity Education, led by the Department of Education and the National Science Foundation (NSF); (3) Cybersecurity Workforce Structure, led by the Department of Homeland Security (DHS) and supported by the Office of Personnel Management (OPM); and (4) Cybersecurity Workforce Training and Professional Development, led by the Department of Defense (DoD), the Office of the Director of National Intelligence (ODNI), and DHS. NIST will continue to support DHS in this effort through FY2014 in order to ensure the successful implementation of key elements of the initiative.

Statement of Need and Economic Benefits:

The Administration has declared the cyber infrastructure a strategic asset and cybersecurity education programs are vital to the economic and national security interests of the U.S. In addition to more than $200 billion of e-commerce transactions in the U.S. alone for 2008, interconnected networks of computers are essential for life-critical functions such as air traffic control, and electric power distribution and for functions critical to the U.S. economy, such as factory operations. These networked systems face an ever-increasing threat of attack from individuals, organizations, and nation states that target key information technology operations and assets. For many systems, security configuration is poorly implemented and maintained, security controls are hard to use, and security postures are too complex for most administrators to understand. This combination allows many threats to successfully compromise systems and delays reactions to these compromises, allowing significant damage to occur. This undermines confidence in vital commercial and public information systems and has a large, direct economic impact with estimates showing that Americans are losing billions of dollars each year to cyber crime.

Base Resource Assessment:

NIST invested $0.4 million in base STRS funds and 1 FTE in FY 2012.

NIST collaborates with industry, consortia, and other Federal agencies to resolve critical cybersecurity issues for the Nation's cyber infrastructure. NIST's activities in support of cybersecurity cover the full range of the research lifecycle, from conducting fundamental research, such as improved techniques for measuring elements of security, to disseminating the results of that research in many forms.

Cybersecurity education programs benefit from the output of NIST research. General current and recent areas of research include authorization, biometrics, cryptography, forensics, identification and authentication, key management, network security, security automation, security metrics, security for emerging technologies, security for sector-specific applications, trustworthy software, and usability. Cybersecurity education programs seek to take these research areas and make the results

consumable in practical ways by the entire Nation while also informing the development of formal cybersecurity curriculums and expanding the knowledge of our Nation's cybersecurity workforce.
While billions of dollars are being spent on new technologies to secure the U.S. Government in cyberspace, it is the people with the right knowledge, skills, and abilities to implement those technologies who will determine success. It is generally believed that there are not enough people with cybersecurity expertise to improve cybersecurity to the point where it is no longer an economic and national security challenge. Existing cybersecurity training and personnel development programs, while good, are limited in focus and lack unity of effort. In order to effectively ensure our Nation's technological advantage underscored by gains in cybersecurity, we must develop a cyber-savvy society, a larger cybersecurity workforce, and an effective pipeline of future employees.

Schedule & Milestones:

Action 1: Coordinate implementation of NICE components by DHS and other Federal agencies

FY 2014: Coordinate with DHS, other Federal agencies and industry to facilitate the ongoing development and implementation of the four NICE components.

Deliverables:

Action 1: Support DHS and other Federal agencies in the implementation of NICE components

- Participate in planning and development meetings with Federal agencies and industry stakeholders
- Hold NICE Workshop to solicit feedback from stakeholders

Performance Goals and Measurement Data:

Action 1: Facilitate seamless interoperability of EHRs

Performance Goal: Workshops	FY 2013 Target	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target	FY 2018 Target
With increase	1	1	0	0	0	0
Without increase	0	0	0	0	0	0
Description	Number of NIST hosted workshops					

PROGRAM CHANGE PERSONNEL DETAIL
(Dollar amounts in thousands)

Program: Measurement Science, Services, and Programs
Subprogram: Laboratory Programs
Program change: NICE

Title:	Location	Grade	Number of Positions	Annual Salary	Total Salaries
Project lead	Gaithersburg	ZP V	1	$124,377	$124,377
Technology support	Gaithersburg	ZP IV	1	105,737	105,737
Administrative	Gaithersburg	ZP III	1	75,246	75,246
Total			3		305,360
Less Lapse		25%	(1)		(76,340)
Total full-time permanent (FTE)			2		229,020
2014 Pay Adjustment (1%)					2,290
TOTAL					231,310

Personnel Data	Number
Full-Time Equivalent Employment	
Full-time permanent	2
Other than full-time permanent	0
Total	2
Authorized Positions:	
Full-time permanent	3
Other than full-time permanent	0
Total	3

PROGRAM CHANGE DETAIL BY OBJECT CLASS
(Dollar amounts in thousands)

Program: Measurement Science, Services, and Programs
Subprogram: Laboratory Programs
Program change: NICE

	Object Class	2014 Increase
11	Personnel compensation	
11.1	Full-time permanent	$231
11.3	Other than full-time permanent	0
11.5	Other personnel compensation	0
11.8	Special personnel services payments	0
11.9	Total personnel compensation	231
12	Civilian personnel benefits	72
13	Benefits for former personnel	0
21	Travel and transportation of persons	15
22	Transportation of things	10
23.1	Rental payments to GSA	0
23.2	Rental Payments to others	0
23.3	Communications, utilities and miscellaneous charges	124
24	Printing and reproduction	5
25.1	Advisory and assistance services	0
25.2	Other services	115
25.3	Purchases of goods & services from Gov't accounts	45
25.4	Operation and maintenance of facilities	0
25.5	Research and development contracts	242
25.6	Medical care	0
25.7	Operation and maintenance of equipment	23
25.8	Subsistence and support of persons	0
26	Supplies and materials	87
31	Equipment	31
32	Lands and structures	0
33	Investments and loans	0
41	Grants, subsidies and contributions	0
42	Insurance claims and indemnities	0
43	Interest and dividends	0
44	Refunds	0
99	Total obligations	1,000

10. STEM Education- Summer Institute for Middle School Science Teachers Decrease (Base Funding: $0.3 million and 0 FTE; Program Change: -$0.3 million and 0 FTE).

NIST's budget includes a proposed decrease to STEM. As part of the Administration's comprehensive reorganization of STEM education programs to increase the impact of Federal investments, funding for the NIST Summer Institute for Middle School Science Teachers will be redirected to implement a Department of Education initiative to improve K-12 STEM instruction.

To facilitate a cohesive national strategy, the Administration is proposing a comprehensive reorganization of STEM education programs to increase the impact of Federal investments in four areas: K-12 instruction; undergraduate education; graduate fellowships; and education activities that typically take place outside the classroom. The reorganization involves consolidating or restructuring 90 programs across 11 agencies and improving the delivery, impact, and visibility of STEM efforts. Nearly $180 million will be redirected from consolidated programs to the Department of Education, the National Science Foundation (NSF), and the Smithsonian Institution to implement initiatives in the four core reform areas. The Administration will ensure that all science mission agencies have input into the development and implementation of these initiatives so that they align with agency goals while improving STEM education at all levels in a streamlined way.

The Department of Education will lead an initiative to improve K-12 STEM instruction by supporting partnerships between school districts and universities, science agencies, businesses, or other educational entities to transform teaching and learning. NSF will focus on improving the delivery of undergraduate STEM education through evidence-based approaches and reforming graduate fellowships so they reach more students and address national workforce needs. The Smithsonian Institution, which already has strong partnerships with several mission agencies, will improve the reach of federally-supported informal education activities, and help align those activities with State standards so that they are relevant to what students are learning in the classroom.

PROGRAM CHANGE DETAIL BY OBJECT CLASS
(Dollar amounts in thousands)

Program: Measurement Science, Services, and Programs
Sub-program: Laboratory Programs
Program Change: STEM Education- Summer Institute for Middle School Teachers Decrease

	Object Class	2014 Decrease
11	Personnel compensation	
11.1	Full-time permanent	$0
11.3	Other than full-time permanent	0
11.5	Other personnel compensation	0
11.8	Special personnel services payments	0
11.9	Total personnel compensation	0
12	Civilian personnel benefits	0
13	Benefits for former personnel	0
21	Travel and transportation of persons	(1)
22	Transportation of things	0
23.1	Rental payments to GSA	0
23.2	Rental Payments to others	0
23.3	Communications, utilities and miscellaneous charges	(34)
24	Printing and reproduction	0
25.1	Advisory and assistance services	0
25.2	Other services	(186)
25.3	Purchases of goods & services from Gov't accounts	(5)
25.4	Operation and maintenance of facilities	0
25.5	Research and development contracts	0
25.6	Medical care	0
25.7	Operation and maintenance of equipment	(4)
25.8	Subsistence and support of persons	0
26	Supplies and materials	(4)
31	Equipment	(2)
32	Lands and structures	0
33	Investments and loans	0
41	Grants, subsidies and contributions	(64)
42	Insurance claims and indemnities	0
43	Interest and dividends	0
44	Refunds	0
99	Total obligations	(300)

11. Reduction to NIST's STRS extramural grants (Base Funding: $78.9 million; Program Change: - 4.062 million)

NIST's budget includes proposed decrease to extramural grants for redirection to higher priority activities within the STRS appropriation.

PROGRAM CHANGE DETAIL BY OBJECT CLASS
(Dollar amounts in thousands)

Program: Measurement Science, Services, and Programs
Sub-program: Laboratory Programs
Program Change: Reduction to NIST's STRS Extramural Grants

	Object Class	2014 Decrease
11	Personnel compensation	
11.1	Full-time permanent	$0
11.3	Other than full-time permanent	0
11.5	Other personnel compensation	0
11.8	Special personnel services payments	0
11.9	Total personnel compensation	0
12	Civilian personnel benefits	0
13	Benefits for former personnel	0
21	Travel and transportation of persons	(18)
22	Transportation of things	(1)
23.1	Rental payments to GSA	0
23.2	Rental Payments to others	0
23.3	Communications, utilities and miscellaneous charges	(462)
24	Printing and reproduction	(2)
25.1	Advisory and assistance services	0
25.2	Other services	(245)
25.3	Purchases of goods & services from Gov't accounts	(71)
25.4	Operation and maintenance of facilities	0
25.5	Research and development contracts	0
25.6	Medical care	0
25.7	Operation and maintenance of equipment	(52)
25.8	Subsistence and support of persons	0
26	Supplies and materials	(50)
31	Equipment	(25)
32	Lands and structures	0
33	Investments and loans	0
41	Grants, subsidies and contributions	(3,136)
42	Insurance claims and indemnities	0
43	Interest and dividends	0
44	Refunds	0
99	Total obligations	(4,062)

Department of Commerce
National Institute of Standards and Technology
Laboratory Programs
REIMBURSABLE PROGRAM AND WORKING CAPITAL FUND INVESTMENTS
(Dollar amounts in thousands)

	FY 2012 Actual	FY 2013 CR (annualized)	FY 2014 Estimate
Department of Defense			
Air Force	$12,008	$11,066	$10,791
Army	3,126	1,805	1,788
Navy	1,527	1,677	1,419
Other, Department of Defense	14,410	15,554	13,721
Subtotal, Department of Defense	31,071	30,102	27,719
Department of Agriculture	63	60	60
Department of Commerce	15,042	16,980	17,744
Department of Energy	6,676	10,986	5,811
Dept. of Health & Human Services	4,377	4,556	4,529
Dept. of Homeland Security	20,251	21,763	16,255
Department of the Interior	26	20	20
Department of Justice	9,732	11,120	9,110
Department of Transportation	65	260	360
Environmental Protection Agency	173	100	100
General Services Administration	89	99	99
National Aeronautics & Space Admin.	3,866	3,986	4,468
National Science Foundation	2,542	3,973	4,242
Nuclear Regulatory Commission	826	1,886	1,500
Other	8,248	6,555	6,212
Subtotal, Other Agency	103,047	112,446	98,229
Calibrations & Testing	9,235	8,161	8,294
Technical & Advisory Services	27,087	22,030	20,526
Standard Reference Materials	17,342	14,286	14,439
Subtotal, Other Reimbursables	53,664	44,477	43,259
Total, Reimbursable Program	156,711	156,923	141,488
Equipment Transfers	1,695	0	1,500
Subtotal, WCF transfer	1,695	0	1,500
Equipment Investments	15,670	25,481	15,360
IE Amortization	(21,430)	(9,604)	(15,360)
Excess Amortizations over Equipment Investments	4,065	0	0
WCF Operating Adjustments	(3,768)	0	0
Total, WCF Investments	(5,463)	15,877	0
Total, Reimbursable Program and WCF Investments	152,943	172,800	142,988

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Corporate Services

Department of Commerce
National Institute of Standards and Technology
Scientific and Technical Research and Services
PROGRAM AND PERFORMANCE: DIRECT OBLIGATIONS
(Dollar amounts in thousands)

Program: Measurement science, services, and programs
Sub-program: Corporate services

Line Item		2012 Actual Personnel	2012 Actual Amount	2013 CR (annualized) Personnel	2013 CR (annualized) Amount	2014 Base Personnel	2014 Base Amount	2014 Estimate Personnel	2014 Estimate Amount	Increase/ (Decrease) over 2014 Base Personnel	Increase/ (Decrease) over 2014 Base Amount
Computer support	Pos./Approp	2	$8,124	2	$8,154	2	$8,157	2	$8,157	0	0
	FTE/Obl.	2	8,145	2	8,566	2	8,202	2	8,202	0	0
Business systems	Pos./Approp	35	10,423	35	10,507	35	10,577	35	10,577	0	0
	FTE/Obl.	33	10,414	35	10,815	35	10,635	35	10,635	0	0
Total	Pos./Approp	37	18,547	37	18,661	37	18,734	37	18,734	0	0
	FTE/Obl.	35	18,559	37	19,381	37	18,837	37	18,837	0	0

BUDGET SUB-PROGRAM: Corporate Services

BASE JUSTIFICATION:

Corporate Services Overview

This program includes the NIST central IT support for NIST's technical programs which provides secure, centrally managed IT infrastructure resources supporting NIST's technical mission leading to improved measurement methods, standards advances, reference data, and research results benefiting numerous sectors of the U.S. economy. This program also provides the necessary resources to operate and maintain administrative and financial management systems at NIST that satisfy the requirements established by the Department of Commerce; Office of Management and Budget; Government Accountability Office; Department of Treasury; General Services Administration; and Congress.

1. Computer Support

The scope of this effort includes: securely deploying and managing computing, software, and networking resources as well as distributed, redundant storage for NIST data; and, management of the central computing facilities to meet Federal IT security requirements and the specialized requirements of the IT equipment located therein. These resources enable NIST laboratories and programs to perform mission-specific needs, dissemination of NIST results to the public, and collaborations with NIST partners.

Examples of Accomplishments:

- Migrated IT Service Management support tool to a cloud Software as a Service provider, reducing costs and improving the quality of IT support
- Expanded secure support of mobile devices as NIST to include iPhones and iPads
- Purchased and implemented a Managed Trusted Internet Protocol Service (MTIPS) in support of OMB's Trusted Internet Connections (TIC) initiative, improving the ability to protect NIST IT infrastructure.

Priority Objectives for FY 2014:

- Manage the IT infrastructure including computing systems, software, data storage, networking, and security capabilities to support all NIST programs including in new research buildings
- Optimize the portfolio of computing platforms, data storage, backup storage, network interconnects, system security mechanisms including the mandated Enterprise Cybersecurity Monitoring and Operations (ECMO) infrastructure), and software components to meet the unique requirements of NIST users and programs
- Migrate services to cloud providers in cases where it would provide optimal benefit to NIST
- Migrate to Voice over IP (VoIP) in combination with a unified communications system that would allow for voice communications to be integrated with other information sharing

technologies both in Gaithersburg and the DoC Boulder sites, which also includes NOAA and NTIA.

2. Business Systems

The DoC and the Administration have undertaken major modernization initiatives of various business systems, functions, and processes. DoC envisions common, Department-wide, user-friendly, and flexible systems to support financial management, procurement management, travel management, grants management, property management, and other administrative functions. New business systems or upgrades to existing systems will be implemented over the next several years. Any new systems acquired will be integrated with the Department's Commerce Business System (CBS). They will also interface with other internal and external administrative and management systems. NIST's business systems are an integral part of the vision for the administrative and financial management systems formulated by the DoC.

Example Accomplishments:

- Used incremental upgrades and performance tuning to keep the financial system and associated business systems at NIST operating smoothly.

Priority Objectives for FY 2014:

- Implement, operate, and maintain administrative management systems that support the delivery of administrative services to NIST and its cross service customers.

- Operate and maintain CBS and the NIST CBS Portal that supports delivery of services to NIST and its cross-service customers.

Department of Commerce
National Institute of Standards and Technology
Corporate Services
REIMBURSABLE PROGRAM AND WORKING CAPITAL FUND INVESTMENTS
(Dollar amounts in thousands)

	FY 2012 Actual	FY 2013 CR (annualized)	FY 2014 Estimate
Department of Defense			
Subtotal, Department of Defense	0	0	0
Department of Commerce	$2,269	$597	$597
General Services Administration	8	12	12
Subtotal, Other Agency	2,277	609	609
Subtotal, Other Reimbursables	0	0	0
Total, Reimbursable Program	2,277	609	609
Subtotal, WCF transfer	0	0	0
Equipment Investments	1,111	4,281	653
IE Amortization	(1,186)	(670)	(653)
Excess Amortizations over Equipment Investments	75	0	0
Total, WCF Investments	0	3,611	0
Total, Reimbursable Program and WCF Investments	2,277	4,220	609

Standards Coordination
and Special Programs

Department of Commerce
National Institute of Standards and Technology
Scientific and Technical Research and Services
PROGRAM AND PERFORMANCE: DIRECT OBLIGATIONS
(Dollar amounts in thousands)

Program: Measurement science, services, and programs
Sub-program: Standards coordination and special programs

Line Item		2012 Actual Personnel	2012 Actual Amount	2013 CR (annualized) Personnel	2013 CR (annualized) Amount	2014 Base Personnel	2014 Base Amount	2014 Estimate Personnel	2014 Estimate Amount	Increase/ (Decrease) over 2014 Base Personnel	Increase/ (Decrease) over 2014 Base Amount
Standards coordination and special programs	Pos./Approp	77	$30,484	77	$30,671	77	$30,695	106	$58,241	29	$27,546
	FTE/Obl.	71	26,989	77	42,911	77	30,732	97	61,278	20	30,546
Total	Pos./Approp	77	30,484	77	30,671	77	30,695	106	58,241	29	27,546
	FTE/Obl.	71	26,989	77	42,911	77	30,732	97	61,278	20	30,546

BUDGET SUB-PROGRAM: Standards Coordination and Special Programs

BASE JUSTIFICATION:

Standards Coordination and Special Programs Overview

Standards Coordination and Special Programs houses two cross NIST activities managed by the Associated Director for Laboratory Programs that deal with coordinated high-profile R&D programs, Documentary standards coordination and policy development. In addition, the FY 2014 newly proposed NIST Centers of Excellence initiative will be managed under this sub-program.

1. Office of Special Program

The USP serves as the project and program management office for the Associate Director for Laboratory Programs, enhancing management oversight, planning, and resource coordination for high-profile programs that critically depend on the expertise and capabilities of two or more NIST laboratories.

The OSP currently consists of the following three programs:

- Law Enforcement Standards Office: Develops performance standards, measurement tools, operating procedures and equipment guidelines that help criminal justice, public safety, emergency responder, and homeland security agencies make informed procurement, deployment, applications, operating, and training decisions. Provides unique expertise on performance standards for critical technologies such as ballistic body armor, metal detectors, protective equipment, forensic science , computer forensics, DNA analysis, counterterrorism threat response technologies and public safety communication interoperability. Works with law enforcement, public safety and public security practitioners, universities, government agencies, professional and scientific organizations to solve difficult technical public safety and national security challenges.

- Greenhouse Gas Measurements and Climate Research Program: Provides the measurement science basis for accurate and comparable quantitative measurements of greenhouse gas emissions. Ensures measurement capabilities for accurate and reliable assessment of current greenhouse gas baselines, validation of greenhouse gas emission sources, and quantification of greenhouse gas sinks through improved quantitative measurements. Enables development of international measurement standards to ensure the accuracy of global assessments of greenhouse gas emissions.

- Coordinated National Security Standards Program: In cooperation with the Department of Homeland Security, develops and improves the effectiveness of measurement methods, standards, and technologies to address critical challenges in many areas relevant to homeland security, such as chemical and biological agent detection, biometrics, and first responder communications.

Examples of Accomplishments:

- Law Enforcement Standards: Created a standard reference material that has globally standardized forensic firearms examinations and propelled the next generation of ballistic imaging software and instrumentation. The standard bullet was pivotal in the creation of algorithms for data collection and is the basis of uniform image capture for the National Integrated Ballistics Information Network, a national system utilized to associate firearms used

in crimes to evidentiary fired bullets and casings. Developed repeatable, easy-to-use, low cost explosive test materials and methods using inkjet printing technology and made these materials available to Department of Homeland Security's Transportation Security Administration. Explosive material solutions are printed onto calibration tabs that are then used for testing the functionality and accuracy of explosive detectors.

- Greenhouse Gas Measurements and Climate Research Program: Completed the development of the spectral reference data for carbon dioxide at unprecedented levels of accuracy that directly support the observing instruments to be employed in NASA's Orbiting Carbon Observatory. Demonstrated a robust, low component cost, observing instrument technology prototype for carbon dioxide and methane intended for widespread use in surface-based observing networks.

Priority Objectives for FY 2014:

- Law Enforcement Standards Office: Utilize lessons learned from the 700MHz Public Safety Broadband Demonstration Network (a FY2011 project) to create a smaller, permanent network for testing key features of the evolving nationwide public safety network, including mission critical voice, priority access, roaming, and quality of service—all of which are critical to the vision of a nationwide interoperable network.

- Establish a Forensic Science Program Management Office that will be responsible for managing eighteen Federal scientific working groups to promulgate national standards, guidelines, and best practices throughout the forensic science community.

- Greenhouse Gas Measurements and Climate Research Program: Implement a high-spatial-density regional monitoring network as a test bed for investigating the performance of dense observing networks having significantly improved spatial resolution for greenhouse gas source and sink identification and quantification at local and regional scales.

2. Standards Coordination Office

The SCO advises NIST leadership on policy and strategy as they relate to NIST's statutory role and responsibilities in standardization and serves as a normative standards and conformity assessment related multi-functional resource for NIST and U.S. government staff. In particular, the SCO addresses issues at the intersection of technology, standards, trade and innovation.

The Standards Coordination Office carries out the following programmatic functions:

- Standards Policy Coordination: Formulates and implements NIST policy regarding standards and conformity assessment, including product testing, certification practices, and laboratory accreditation to promote U.S. technology and support international competitiveness; cooperates with domestic organizations in the private sector, state and local governments, Federal agencies, and with domestic foreign, and international organizations in matters related to standardization and conformity assessment; carries out standards policy and information functions established by Congress or as otherwise directed; recommends Federal policies regarding the development, approval, and use of voluntary standards, and the development and implementation of conformity assessment policy; chairs the Interagency Committee on Standards Policy (ICSP) which coordinates actions by which Federal agencies implement standards-related policies; coordinates domestic and international standards-related activities; monitors the global standards and

conformity assessment landscape and represents NIST at relevant domestic and international fora; administers and reports on the quality system for NIST measurement services; conducts training for NIST assessors and quality managers; oversees and reviews NIST divisions' quality systems assessments; and represents the U.S. and NIST at the SIM Quality System Task Force.

- Standards Guidance: Provides standards and conformity assessment related technical support to other U.S. govt. agencies to assist with both technical and policy issues. Provides early warning about emerging standards and conformity assessment related issues that can help NIST managers make decisions about preparing for and addressing these issues. Assists NIST staff in bridging the technical, standards and trade policy aspects in issues with the potential to impact U.S. competitiveness and ability to innovate. Provides unique standards and conformity assessment policy expertise relating to key trading partners. Assists U.S. government agencies and private sector organizations with the implementation of Mutual Recognition Agreements (MRAs) such as the APEC Tel and CITEL MRAs.

- Standards and Information Dissemination and Outreach: Operates the National Center for Standards and Certification Information, and the World Trade Organization, Technical Barriers to Trade related Inquiry Point and Notification Authority providing unique standards, conformity assessment and technical regulations related information to NIST staff, U.S. government employees, U.S. exporters, and foreign trading partners. Provides standards and conformity assessment related outreach and training to stakeholders. Analyzes impact and effectiveness of NIST participation in standards and conformity assessment related activities.

- Laboratory Accreditation: Operates the National Voluntary Laboratory Accreditation Program (NVLAP) for the U.S.; provides accreditation to testing and calibration laboratories based on evaluation of their technical qualifications and competence to perform certain types of tests in specified fields using internationally accepted guides and standards; designs and implements procedures for accrediting laboratories for their capability to provide calibrations traceable to national standards and for ability to conduct such important tests as those for asbestos fibers and electromagnetic telecommunications; provides evaluation and recognition of testing performance, especially in response to Congressional mandates and requirements of other Federal agencies, to domestic and foreign laboratories, state and local governments, and commercial interests.

Examples of Accomplishments:

- Standards Policy Coordination: Coordinated the development and publication of a report by the National Science and Technology Council's Subcommittee on Standards, on Federal Engagement in Standards Activities to Address National Priorities, and supports the development of a memorandum from the White House on the principles for Federal Engagement in Standards. The report included proposed policy recommendations currently under consideration in the Executive Office of the President.

- Standards Guidance: Designed and implemented the testing and certification system used by the Department of Health and Human Services, Office of the National coordinator to certify software according to meaningful use requirements. This program has certified over 1200 software modules for healthcare providers in less than one year. The program leverages private sector resources to provide a sustainable and competitive market for testing services to create an infrastructure to support interoperability and facilitate innovation in electronic healthcare records.

- Nanotechnology Documentary Standards: Organized and executed an international workshop exploring potential barriers to use of nanotechnology documentary standards, and how these barriers can be addressed.

- Mining Communications Systems and Tracking Technologies: Organized and executed a workshop on Mining Communications Systems and Tracking Technologies to identify major technological challenges impeding their operation and reliability and to understand the measurement, technical standards and conformity assessment needs required to overcome those challenges.;

- Laboratory Accreditation: Under a program requested by the U.S. Department of Homeland Security, NVLAP accredited the first biometrics testing laboratories that perform conformance testing, interoperability testing, technology testing, scenario testing, operational and usability testing for biometrics products. Also, in response from a request from the Office of the National Coordinator for Health IT, NVLAP established a program to accredit laboratories that perform functional and conformance testing of electronic health record (EHR) technology products.

Priority Objectives for FY 2014:

- Standards Policy Coordination: Coordinate implementation of White House-issued principles for enhancing Federal engagement in standards activities with the private sector to address national priorities. Continue to work with OMB's Office of Information and Regulatory Affairs on supplementary guidance for agency use of standards to enhance the efficiency and effectiveness of government programs.

- Standards Guidance: Issue updated guidance to agencies on conformity assessment and coordinate agency implementation. Further explore identification of external standards needs and priorities for NIST, examining standards needs and priorities in the context of potential impacts in specific technology areas, including cyber-physical systems; and the organization and execution of opportunities for technology leaders to relate their future standards-related challenges. Work with GSA to implement the initial operational capabilities of GSA's Federal Risk Management and Authorization Program (FedRAMP) for certifying cloud computing services providers for Federal agency procurement.

- Laboratory Accreditation: Continue to provide fee supported laboratory accreditation services to testing and calibration laboratories in support of Federal agency regulation, mandates, and industry needs

PROGRAM CHANGE:

1. NIST Centers of Excellence (Base Funding: $0 million; Program Change: +$20.0 million and +2 FTE)

The NIST Centers of Excellence will create multidisciplinary centers of excellence in critical areas of emerging technology that leverage cutting-edge measurement science capabilities of NIST with those of leading research activities ongoing in academia and industry in order to accelerate innovation through enhanced knowledge transfer, and stronger regional innovation clusters in order to increase the long-term competitiveness of industries throughout the United States.

Proposed Action:

With the proposed increase, NIST will provide grants to establish four competitively selected Centers of Excellence in measurement science areas defined by NIST. These grants to multi-university and/or single university Centers will be awarded for 5-7 year periods, after which the grants would be re-competed. Each Center of Excellence will provide an interdisciplinary environment in which NIST, academia and industry would collaborate in pursuing basic and applied research focused on innovations in measurement science and new technology development focused on emerging areas of national need such as:

- Advanced Communications
- Advanced Manufacturing
- Biomanufacturing
- Cyberphysical Systems
- Forensic Science
- Human-Robotic Integration
- Materials Modeling and Design
- Quantitative Biology
- Telecommunications

These specific areas and Centers will be evaluated periodically and, potentially, new areas will be selected, at which time the grants will again be competitively awarded. The Centers of Excellence will spark the development of regional expertise in measurement science, while educating scientists and engineers in the importance and specifics of measurement science. Prospective impact studies being conducted in FY 2013 will help to establish the specific areas to be targeted.

Statement of Need and Economic Benefits:

NIST's mission to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology provides for a broad swath of technical areas to consider, some of which stretch the technical expertise resident at NIST. To accomplish its mission, NIST engages with academia and industry in many ways that leverage base resources, from direct engagement to cooperative research to postdoctoral research opportunities. NIST has also found great value in joint institutes formed with universities in close proximity to our main campuses. These, and other, efforts have proven that the leveraging of NIST base resources through differing venues greatly enhances the value to industry and the public of funds provided to NIST.

Observations of the pace and methodology of innovation on a national scale reveal some characteristics which can be utilized to further leverage NIST resources. Amongst these characteristics are the following:

- Rapid pace of change and innovation. There is a tremendous international competition for innovation in all industries. The first mover advantage is critical to maintaining U.S. competitiveness.
- Regional centers of innovation. Not unique to the technology sector, similar industries and similar scientific research and development repeatedly coalesce in regions of the country. In the past this has been around skilled labor (automotive industry in Detroit) or natural resources (coal in Pennsylvania). Today, centers of innovation can be identified for many fields of research and industry.

Taken together, these two factors argue that to facilitate innovation, particularly in the critical areas of measurement science and standards, NIST must be involved "on the ground" in well-considered areas of research, in the heart of innovation for identified industries or areas of research.

Base Resource Assessment:

This is a new program with no current base resources.

Schedule and Milestones:

- Process for identification of emerging areas of national need in measurement science (FY 2014)
- Selection of identification of emerging areas of national need in measurement science (FY 2014, FY 2017)
- Competitive process to select NIST Centers of Excellence (FY 2014, FY 2018)
- Four new NIST Centers of Excellence (FY 2014)

Deliverables:

Funding for the NIST Centers of Excellence will benefit NIST, industry, and the United States through the following deliverables.

- NIST will more rapidly meet national needs in critical areas by enabling the best experts in technical fields and focusing them on measurement science at critical times on the innovation curve.
- Industry will be able to more easily and efficiently engage with the regional Centers of Excellence, increasing their competitiveness through more integrated use of measurements in their industrial processes.
- Technical innovation will be enhanced in the regional areas of the NIST Centers of Excellence by the addition of complementary measurement science and standards efforts and, conversely, measurement science will be enhanced by the complementary research and development at the base of the technical innovation in the region.
- New approaches to supporting multidisciplinary research will be facilitated within the Centers of Excellence.
- New approaches for accelerating technology commercialization and technology transfer of innovative processes and technologies will be facilitated through the Centers of Excellence.

If successful, NIST will have established a measurement science presence in regions throughout the United States. This presence will create leverage for the Centers of Excellence and create a larger impact for all of NIST efforts in measurement science and standards.

Performance Goals and Measurement Data:

Performance Goal Performance Measure:	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target
Number of companies utilizing or collaborating with COEs				
Number of NIST Centers of Excellence				
With increase	20	40	40	40
Without increase	-	-	-	-

Performance Goal Performance Measure:	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target
Number of doctoral candidates and post-docs				
Number of NIST Centers of Excellence				
With increase	30	60	60	60
Without increase	-	-	-	-

Performance Goal Performance Measure:	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target
Number of patents, copyrights (software), licenses				
Number of NIST Centers of Excellence				
With increase	-	4	8	8
Without increase	-	-	-	-

PROGRAM CHANGE PERSONNEL DETAIL

(Dollar amount in thousands)

Program: Measurement Science, Services, and Programs
Sub-Program: Standards coordination and special programs
Program Change: NIST Centers of Excellence

Title:	Location	Grade	Number of Positions	Annual Salary	Total Salaries
Program Manager	Gaithersburg	ZP V	1	$124,377	$124,377
Assistant Program Manager	Gaithersburg	ZP IV	2	105,737	211,474
Total			3		335,851
less Lapse		25%	(1)		(83,963)
Total full-time permanent (FTE)			4		251,888
2013 Pay Adjustment (0.1%)					2,519
TOTAL					254,407

Personnel Data	Number
Full-Time Equivalent Employment	
Full-time permanent	2
Other than full-time permanent	0
Total	2
Authorized Positions:	
Full-time permanent	3
Other than full-time permanent	0
Total	3

PROGRAM CHANGE DETAIL
BY OBJECT CLASS
(Dollar amounts in thousands)

Program: Measurement Science, Services, and Programs
Sub-program: Standards coordination and special programs
Program Change: NIST Centers of Excellence

	Object Class	2013 Increase
11	Personnel compensation	
11.1	Full-time permanent	$254
11.3	Other than full-time permanent	0
11.5	Other personnel compensation	0
11.8	Special personnel services payments	0
11.9	Total personnel compensation	254
12	Civilian personnel benefits	78
13	Benefits for former personnel	0
21	Travel and transportation of persons	16
22	Transportation of things	8
23.1	Rental payments to GSA	0
23.2	Rental Payments to others	0
23.3	Communications, utilities and miscellaneous charges	150
24	Printing and reproduction	2
25.1	Advisory and assistance services	3
25.2	Other services	414
25.3	Purchases of goods & services from Gov't accounts	23
25.4	Operation and maintenance of facilities	0
25.5	Research and development contracts	0
25.6	Medical care	0
25.7	Operation and maintenance of equipment	17
25.8	Subsistence and support of persons	0
26	Supplies and materials	18
31	Equipment	17
32	Lands and structures	0
33	Investments and loans	0
41	Grants, subsidies and contributions	19,000
42	Insurance claims and indemnities	0
43	Interest and dividends	0
44	Refunds	0
99	Total obligations	20,000

Department of Commerce
National Institute of Standards and Technology
Standards Coordination and Special Programs
REIMBURSABLE PROGRAM AND WORKING CAPITAL FUND INVESTMENTS
(Dollar amounts in thousands)

	FY 2012 Actual	FY 2013 CR (annualized)	FY 2014 Estimate
Department of Defense			
Army	0	$250	0
Navy	0	25	0
Subtotal, Department of Defense	0	275	0
Department of Energy	$25	0	0
Dept. of Homeland Security	4,707	1,600	$1,500
Department of Justice	1,703	71	100
Subtotal, Other Agency	6,435	1,946	1,600
Technical & Advisory Services	7,324	4,567	3,867
Subtotal, Other Reimbursables	7,324	4,567	3,867
Total, Reimbursable Program	13,759	6,513	5,467
Subtotal, WCF transfer	0	0	0
Equipment Investments	22	31	9
IE Amortization	(66)	(9)	(9)
Excess Amortizations over Equipment Investments	44	0	0
Total, WCF Investments	0	22	0
Total, Reimbursable Program and WCF Investments	13,759	6,535	5,467

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Object Class

Exhibit 16

Department of Commerce
National Institute of Standards and Technology
Scientific and Technical Research and Services
SUMMARY OF REQUIREMENTS BY OBJECT CLASS
(Dollar amounts in thousands)

	Object Class	2012 Actual	2013 CR (annualized)	2014 Base	2014 Estimate	Increase/ (Decrease) Over 2014 Base
11	Personnel compensation					
11.1	Full-time permanent	$198,586	$202,377	$203,106	$218,850	$15,744
11.3	Other than full-time permanent	14,590	14,625	14,686	14,686	0
11.5	Other personnel compensation	4,784	4,784	4,784	4,784	0
11.9	Total personnel compensation	217,960	221,786	222,576	238,320	15,744
12.1	Civilian personnel benefits	62,184	64,136	65,431	70,331	4,900
13	Benefits for former personnel	541	541	541	541	0
21	Travel and transportation of persons	9,173	10,235	10,235	11,436	1,201
22	Transportation of things	865	878	878	1,186	308
23.1	Rental payments to GSA	62	100	116	116	0
23.2	Rental payments to others	1,400	1,779	1,808	1,808	0
23.3	Communications, utilities, and miscellaneous charges	21,397	21,423	21,423	35,075	13,652
24	Printing and reproduction	375	267	267	433	166
25.1	Advisory and assistance services	1,421	908	1,215	1,218	3
25.2	Other services	72,609	89,722	58,941	84,771	25,830
25.3	Purchases of goods and services from Government accounts	15,539	15,640	15,808	22,533	6,725
25.5	Research and development contracts	1,342	1,498	1,498	15,869	14,371
25.7	Operation and maintenance of equipment	12,572	12,673	12,673	14,529	1,856
26	Supplies and materials	31,457	31,774	31,774	38,273	6,499
31	Equipment	47,242	46,883	48,006	56,189	8,183
32	Land and structures	5	5	5	5	0
41	Grants, subsidies, and contributions	78,912	78,912	78,912	106,362	27,450
42	Insurance claims and indemnities	1	0	0	0	0
43	Interest and dividends	2	0	0	0	0
99	Total Obligations	575,059	599,160	572,107	698,995	126,888

	Object Class	2012 Actual	2013 CR (annualized)	2014 Base	2014 Estimate	Increase/ (Decrease) Over 2014 Base
99	Total Obligations	575,059	599,160	572,107	698,995	126,888
	Less Prior Year Recoveries	(4,622)	(1,000)	(1,000)	(1,000)	0
	Less Prior Year Unobligated Balance	(15,924)	(18,439)	0	0	0
	Plus Unobligated Balance, End of Year	18,439	0			
	Plus Unobligated Balance, Expired	3	0			
	Unobligated Balance Transfer to ITS	1,600				
	Total Budget Authority	574,555	579,721	571,107	697,995	126,888
	Transfer to NIST Working Capital Fund	1,695	0	0	1,500	1,500
	Transfer from Election Assistance Commission	(2,750)	(2,750)	0	(2,750)	(2,750)
	Transfers from DoJ for Office of Law Enforcement Standards	(6,500)	(6,500)	0	(3,000)	(3,000)
	Appropriation	567,000	570,471	571,107	693,745	122,638

Personnel Data

Full-time equivalent employment:					
Full-time permanent	1,820	1,980	1,980	2,140	160
Other than full-time permanent	222	222	222	222	0
Total	2,042	2,202	2,202	2,362	160
Authorized Positions:					
Full-time permanent	2,155	2,155	2,155	2,373	218
Other than full-time permanent	48	48	48	48	0
Total	2,203	2,203	2,203	2,421	218

Exhibit 23

Department of Commerce
National Institute of Standards and Technology
Scientific and Technical Research and Services
SUMMARY OF INFORMATION TECHNOLOGY RESOURCES
(Dollar amounts in thousands)
(Budget Authority)

IT Projects by Activity/Subactivity: (Totals by Activity)	Unique Investment Identifier	IT Investment Title	2012 Actual	2013 CR (Annualized)	2014 Estimate	Increase/ Decrease
NIST Laboratories						
	006-000701100	NIST Administrative Support	$2,790	$3,132	$3,160	$28
	006-000704500	NIST Central IT Support for Science	2,973	2,985	3,010	25
	006-000702100	NIST Laboratories	30,308	30,413	26,043	(4,370)
	006-000702200	NIST IT Intrastructure and Office Automation	3,862	3,798	3,830	32
Total			39,933	40,328	36,043	(4,285)

Department of Commerce
National Institute of Standards and Technology
Scientific and Technical Research and Services
APPROPRIATION LANGUAGE AND CODE CITATIONS

1. For necessary expenses of the National Institute of Standards and Technology,

15 U.S.C. 272; 273; 278b-j; p
15 U.S.C. 290b-f
15 U.S.C. 1151-52
15 U.S.C. 1454(d-e)
15 U.S.C. 1511, 1512
15 U.S.C. 3710a-d
15 U.S.C. 3711a
15 U.S.C. 7301-7313
15 U.S.C. 7406
15 U.S.C. 7506(a)

15 U.S.C. 272; 273; 278b-j; p provides basic authority for the performance of the functions and activities of the National Institute of Standards and Technology, authorizes appropriations for these purposes to be provided to the general public and specific institutions, governments, firms, and individuals, and requires the notification of Congress of a reprogramming of funds that exceeds a limit specified in public law.

15 U.S.C. 290b-f directs the Secretary of Commerce to provide for the collection, compilation, critical evaluation, publication, and dissemination of standard reference data and the authority to establish a non-agricultural technology office.

15 U.S.C. 1151-1152 establishes within the Department of Commerce, a central clearinghouse for technical information useful to American business and industry and provides for the dissemination of this technical, scientific information via the National Technical Information Service.

15 U.S.C. 1454(d-e) provides NIST with the authority to request that manufacturers and distributors of a commodity participate in voluntary product standards when there is undue proliferation of weights, measures, and quantities. Reports and recommendations to Congress are to be made upon industry failure to adopt these standards.

15 U.S.C. 1511, 1512 specifies that all bureaus of the Department of Commerce come under the authority of the Secretary of Commerce and that such bureaus including NIST shall be subject to the authority of the Secretary of Commerce.

15 U.S.C. 3710a-d provides the authority to enter into CRADAs, to make cash awards to scientific personnel for inventions, to retain royalties and to distribute royalties for inventions, and to communicate and coordinate for the Offices of Research and Technology Applications in Federal laboratories.

15 U.S.C. 3711a provides the authority for the Baldrige National Quality award.

15 U.S.C. 7301-7313 establishes National Construction Safety Teams within NIST to respond to building and structural emergencies.

15 U.S.C. 7406 provides authority for NIST to conduct Cyber Security Research and Development to minimize security risks associated with computer systems used by the Federal government.

15 U.S.C. 7506(a) provides for the establishment of a nanotechnology research and development program within NIST.

P.L. 110-143 121 STAT 1809 provides NIST to assist in developing a research program to establish guidelines for the remediation of former methamphetamine laboratories in the United States as well as developing new detection technologies and appropriate Standard Reference Materials for methamphetamine detection testing..

2. $693,745,000, to remain available until expended,

no specific authority

3. of which not to exceed $9,000,000 may be transferred to the "Working Capital Fund." 15 U.S.C. 278b

15 U.S.C. 278b provides in part: "The National Institute of Standards and Technology is authorized to utilize in the performance of its functions the Working Capital Fund".

4. Public Law 110-69, America Competes Act, 121 Stat 572, passed August 9, 2007 reauthorizes the Scientific and Technical Research and Services appropriation through 2010. Public Law 111-358, America Competes Reauthorization Act, 2010, 124 Stat 3982, passed January 4, 2011 reauthorized the Scientific and Technical Research and Standards appropriation through 2013. In addition, an Emergency Communication and Tracking Technologies Research initiative and a Green Manufacturing and Construction initiative were authorized to develop advanced technologies in these areas.

5. Public Law 111-5 American Recovery and Reinvestment Act of 2009 appropriates $220,000,000 for the Scientific and Technical Research and Services appropriation from FY 2009 to FY 2010 and makes available by reimbursable agreement $10,000,000 from the Department of Energy for the development of Smart Grid Technology by reference to Public Law 110-140, the Energy Independence and Security Act of 2007, and makes available by reimbursable agreement $2,230,186 for a service level agreement with the National Telecommunications and Information Administration. In addition, $20,000,000 is transferred from the Department of Health and Human Services for continued work on advancing health care information enterprise integration.

Department of Commerce
National Institute of Standards and Technology
Scientific and Technical Research and Services
ADVISORY AND ASSISTANCE SERVICES
(Obligations in thousands of dollars)

	FY 2012 Actual	FY 2013 Estimate	FY 2014 Estimate
Management and professional support services	$536	$350	$650
Studies, analyses, and evaluations	448	308	315
Engineering and technical services	254	250	250
Total	1,238	908	1,215

Significant Activities

Advisory and assistance services funded by the STRS appropriation include the review and evaluation of the technical functions and operations of NIST by the Board on Assessment of the National Academy of Sciences. The Evaluation Panels consider the importance and relative priority of projects, quality of staff, equipment needs, and finances, and the relation of the programs to the mission of NIST.

Need for Advisory and Assistance Services:

The need for advisory and assistance services stems from the NIST role in dealing with the private sector, professional organizations, and the public sector. Inputs must be obtained from consultants who can bring their individual expertise to bear and help NIST in assessing its program plans to meet the needs of its customers. The alternative to utilizing these services is to make no attempt to have expertise from sources outside NIST and risk degradation of the working and professional relationship with those in the business of using the products and services offered by NIST.

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Industrial
Technology Services

Exhibit 5

Department of Commerce
National Institute of Standards and Technology
Industrial Technology Services
SUMMARY OF RESOURCE REQUIREMENTS
(Dollar amounts in thousands)

	Positions	FTE	Budget Authority	Direct Obligations	Appro-priation
2013 CR (annualized)	84	94	$129,229	$138,342	$129,229
less: Unobligated balance from prior year			0	(6,847)	0
2014 Adjustments to base:					
Other Changes:					
less: TIP closeout	0	(5)	0	(2,266)	0
plus: Uncontrollable cost changes	0	0	298	298	298
less: ATBs absorbed	0	0	(220)	(220)	(220)
2014 Base Request	84	89	129,307	129,307	129,307
less: 2014 Program changes	7	5	45,200	45,200	45,200
2014 Estimate	91	94	174,507	174,507	174,507

		2012 Actual		2013 CR (annualized)		2014 Base		2014 Estimate		Increase/ (Decrease) Over 2014 Base	
Comparison by program/sub-program:		Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount
Technology innovation program											
Technology innovation program	Pos./Approp	41	0	0	0	0	0	0	0	0	0
	FTE/Obl.	25	$4,373	5	$3,324	0	0	0	0	0	0
Advanced manufacturing technology consortia											
Advanced manufacturing technology consortia	Pos./Approp	0	0	0	0	0	0	5	$21,429	5	$21,429
	FTE/Obl.	0	0	0	0	0	0	4	21,429	4	21,429
Hollings manufacturing extension partnership											
Hollings manufacturing extension partnership	Pos./Approp	78	128,443	84	129,229	84	$129,307	86	153,078	2	23,771
	FTE/Obl.	89	129,055	89	134,960	89	129,307	90	153,078	1	23,771
Baldrige performance excellence program											
Baldrige performance excellence program	Pos./Approp	11	0	0	0	0	0	0	0	0	0
	FTE/Obl.	13	2,061	0	58	0	0	0	0	0	0
TOTALS	Pos./Approp	130	128,443	84	129,229	84	129,307	91	174,507	7	45,200
	FTE/Obl.	127	135,489	94	138,342	89	129,307	94	174,507	5	45,200

Comparison by program/sub-program:	2012 Actual		2013 CR (annualized)		2014 Base		2014 Estimate		Increase/ (Decrease) Over 2014 Base	
	Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount
Adjustments for:										
Recoveries		(4,171)		(2,266)		0		0		0
Refunds		(5)		0		0		0		0
Unobligated balance, start of year		(8,117)		(6,847)		0		0		0
Unobligated balance, end of year		6,847		0		0		0		0
Unobligated balance, transfer from STRS		(1,600)		0		0		0		0
Budget Authority/Appropriation		128,443		129,229		129,307		174,507		45,200


Adjustments
to Base

Exhibit 9

Department of Commerce
National Institute of Standards and Technology
Industrial Technology Services
JUSTIFICATION OF ADJUSTMENTS TO BASE
(Dollar amounts in thousands)

	FTE	Amount
Adjustments:		
TIP FTE reduction	(5)	0

Consistent with the Technology Innovation Program's closeout plan, five FTE's are reduced.

Other Changes:		
Annualization of 2013 pay raise	0	12

A pay raise of .5 percent is assumed to be effective January 1, 2013.

Total cost in FY 2014 of 2013 pay raise	$49,333
Less amount requested in FY 2013	(37,000)
Less amount absorbed in FY 2013	0
Amount requested in 2014 to provide full-year cost of 2013 pay raise	12,333

2014 Pay increase and related costs		0	78

A general pay raise of 1 percent is assumed to be effective January 1, 2014.

Total cost in FY 2014 of pay increase	$78,000
Less amount absorbed in FY 2014	0
Amount requested for FY 2014 pay increase	78,000
Payment to Departmental Management Working Capital Fund	0
Total adjustment for FY 2014 pay increase	78,000

Personnel benefits		0	55

Civil Service Retirement System (CSRS)	(10)
Federal Employees' Retirement System (FERS)	34
Thrift Savings Plan (TSP)	9
Federal Insurance Contribution Act (FICA) – OASDI	19
Health Insurance	23
Employees' Compensation Fund	(20)

Civil Service Retirement System (-$10,000) – The number of employees covered by the Civil Service Retirement System (CSRS) continues to drop as positions become vacant and are filled by employees who are covered by the Federal Employees' Retirement System (FERS). The estimated percentage of payroll for employees covered by CSRS will decrease from 8.7 percent in FY 2013 to 7.0 percent in FY 2014. The contribution rate will remain at 7.0 percent in FY 2014.

Payroll subject to retirement systems ($8,791,382)	
Cost of CSRS contributions in FY 2014 ($8,791,382 x .070 x .07)	$43,078
Cost of CSRS contributions in FY 2013 ($8,791,382 x .087 x .07)	53,540
Total adjustment to base	(10,462)

Federal Employees' Retirement System ($34,000) – The number of employees covered by FERS continues to rise as employees covered by CSRS leave and are replaced by employees covered by FERS. The estimated percentage of payroll for employees covered by FERS will increase from 91.3 percent in FY 2013 to 93.0 percent in FY 2014. The contribution rate increased from 11.7 percent for FY 2013 to 11.9 percent in FY 2014.

Payroll subject to retirement systems ($8,791,382)	
Basic benefit cost in FY 2014 ($8,791,382 x .930 x .119)	$972,942
Basic benefit cost in FY 2013 ($8,791,382 x .913 x .117)	939,104
Total adjustment to base	33,838

Thrift Savings Plan ($9,000) – The cost of agency contributions to the Thrift Savings Plan will also rise as FERS participation increases. The contribution rate increased from 4.54 percent in FY 2013 to 4.57 percent in FY 2014.

Thrift plan cost in FY 2014 ($8,791,382 x .930 x .0457)	$373,643
Thrift plan cost in FY 2013 ($8,791,382 x .913 x .0454)	364,405
Total adjustment to base	9,238

Federal Insurance Contributions Act (FICA) - OASDI (19,000) – As the percentage of payroll covered by FERS increases, the cost of OASDI contributions will increase. In FY 2014, the maximum salary subject to OASDI tax will increase from $113,100 in FY 2013 to $119,100 in FY 2014. The OASDI tax rate for employers remains at 6.2 percent in FY 2014.

FERS payroll subject to FICA tax in 2014 ($8,791,382 x .930 x .903 x .062)	$457,741
FERS payroll subject to FICA tax in 2013 ($8,791,382 x .913 x .882 x .062)	438,923
Increase (FY 2013-FY 2014)	18,818
OTP payroll subject to FICA tax in 2014 ($170,618 x .930 x .903 x .062)	8,884
OTP payroll subject to FICA tax in 2013 ($170,618 x .913 x .882 x .062)	8,518
Increase (FY 2013-FY 2014)	366
Total adjustment to base	19,184

Health insurance ($23,000) – Effective January 2012, NIST's contribution to Federal employees' health insurance premiums increased by 3.6 percent. Applied against the FY 2013 estimate of $647,000, the additional amount required is $23,292.

Employees' Compensation Fund (-$20,000) – The Employees' Compensation Fund bill for the year ending June 30, 2012 is $19,511 lower than for the year ending June 30, 2011.

Communications, utilities, and miscellaneous charges	0	(93)
Electricity rate decrease	(55)	
Natural Gas rate decrease	(38)	

The electricity ATB amount was derived using a year to year comparison of the cost per kilowatt hour. In analyzing the 12 months ended February 2012 and 2011, the per kilowatt hour rate decreased 10.3 percent (from .111 to .100) for Gaithersburg, Maryland; increased 20.1 percent (from .355 to .426) for Kauai, Hawaii; remained constant at .071 for Boulder, Colorado; and increased 1.0 percent (from .089 to .090) for Ft. Collins, Colorado for a net decrease of $55,000.

The natural gas ATB amount was derived using a year to year comparison of the average cost per therm. In analyzing the 12 months ended February 2012 and 2011, the per therm rate decreased 13.3 percent (from .891 to .772) and decreased 11.3 percent (from 1.720 to 1.526) for Gaithersburg and Boulder respectively resulting in a decrease of $38,000.

General pricing level adjustment	0	246

This request applies the OMB economic assumptions of 1.7 percent for FY 2014 where the prices that the government pays are established through the market system. Factors are applied to sub-object classes that result in the following adjustments to base: communications, utilities, and miscellaneous charges $3,264; printing $544; other services $232,441; supplies $6,358; and equipment $4,301.

Subtotal Other changes	(5)	298
Amount absorbed	0	(220)
Total Adjustments to base	(5)	78

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ITS

APPROPRIATION ACCOUNT: Industrial Technology Services (ITS)

For the ITS appropriation, NIST requests a total of $174.5 million. The ITS appropriation consists of two extramural programs in FY 2014: the Hollings Manufacturing Extension Partnership (MEP) and the Advanced Manufacturing Technology Consortia (AMTech) program.

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Technology Innovation
Program

Department of Commerce
National Institute of Standards and Technology
Industrial Technology Services
PROGRAM AND PERFORMANCE: DIRECT OBLIGATIONS
(Dollar amounts in thousands)

Program: Technology innovation program
Sub-program: Technology innovation program

Program Activity		2012 Actual		2013 CR (annualized)		2014 Base		2014 Estimate		Increase/ (Decrease) Over 2014 Base	
		Personnel	Amount	Personnel	Amount	Personnel	Amount	Personnel	Amount	Personnel	Amount
Technology innovation program	Pos./Approp	41	0	0	0	0	0	0	0	0	0
	FTE/Obl.	25	$4,373	5	$3,324	0	0	0	0	0	0

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Advanced Manufacturing
Technology Consortia

Department of Commerce
National Institute of Standards and Technology
Industrial Technology Services
PROGRAM AND PERFORMANCE: DIRECT OBLIGATIONS
(Dollar amounts in thousands)

Program: Advanced manufacturing technology consortia
Sub-program: Advanced manufacturing technology consortia

Program Activity		2012 Actual		2013 CR (annualized)		2014 Base		2014 Estimate		Increase/ (Decrease) Over 2014 Base	
		Personnel	Amount	Personnel	Amount	Personnel	Amount	Personnel	Amount	Personnel	Amount
Advanced manufacturing technology consortia	Pos./Approp	0	0	0	0	0	0	5	$21,429	5	$21,429
	FTE/Obl.	0	0	0	0	0	0	4	21,429	4	21,429

BUDGET PROGRAM: Advanced Manufacturing Technology Consortia (AMTech)

For FY 2014, the NIST request is an increase of $21.429 million and 4 FTE for AMTech.

BASE JUSTIFICATION FOR FY 2014:

The Advanced Manufacturing Technology Consortia (AMTech) is reproposed for FY 2014.

PROGRAM CHANGES:

Advanced Manufacturing Technology Consortia (AMTech) (Base Funding: $0 and 0 FTE; Program Change: $21.429 million and 4 FTE):

An Advanced Manufacturing Technology Consortia (AMTech) program is proposed to establish industry-led consortia, which will identify and prioritize research projects supporting long-term industrial research needs. AMTech creates the incentive for multiple industry stakeholders to share financial and scientific resources, together with state and local government interests, as well as technical innovators at universities and government laboratories.

In June 2011, the President launched the Advanced Manufacturing Partnership (AMP), a national effort that brings together industry, universities, and the Federal government to identify and invest in emerging technologies and programs that will create high-quality manufacturing jobs and enhance our global competitiveness. The proposed Advanced Manufacturing Technology Consortia (AMTech) program is an example of the kind of public-private partnership espoused by AMP needed to address common technological needs. Specifically, AMTech provides cost shared funding to consortia that are focused on developing advanced technologies to address major technical problems that inhibit the growth of advanced manufacturing in the U.S. AMTech consortia will develop detailed road maps of long-term technology needs. The AMTech program will provide incentives for addressing multiple components of the innovation cycle, from discovery to commercialization, and also provides funding to address the precompetitive R&D needs identified by the consortia members in order to accelerate the pace of innovation throughout various industrial sectors.

The AMTech model demonstrates how the Federal government may leverage resources for a greater societal and commercial outcome by supporting research that aligns with industry roadmaps. The AMTech program fills a critical gap by providing resources for directed basic and measurement research that is seen as too long-term and has too much market uncertainty for industry to invest in on its own. Research challenges addressed by an AMTech consortium are pre-competitive: all industry members will benefit from the R&D outcomes and the partnerships are built on open access to intellectual property. AMTech provides a mechanism to leverage agency investment in order to launch breakthrough technologies that will collapse the timescale of innovation.

AMTech creates the incentive for multiple industry stakeholders to share financial and scientific resources, together with state and local government interests, as well as technical innovators at universities and government laboratories. The proposed Advanced Manufacturing Technology Consortia (AMTech) program is an important element of the Administration's emphasis on advanced manufacturing. A number of studies point to industry-led consortia as a meaningful tool to drive directed research in areas of critical need. The AMTech program was singled out in the President's Council of Advisors on Science and Technology (PCAST) "Report to the President on Ensuring American Leadership in Advanced Manufacturing" (June 2011) as a public-private partnership model

that is needed to catalyze American excellence in advanced manufacturing. AMTech was also supported and endorsed by NIST's Visiting Committee for Advanced Technology in their 2012 Annual Report.

Schedule & Milestones:

- In FY 2014 the number of planning awards ($500,000 or less) may be commensurate with or exceed the number of large ($1-5 million) implementation awards to established consortia for targeted research following their technology roadmap.

- In FY 2015 - FY 2018, NIST will support and continually monitor newly established research consortia to track outputs and progress. R&D outputs will be assessed for relevance to the long-term roadmap created by the consortia at its inception. New awards will be made as funds become available.

Deliverables/Outputs:

- In FY 2014, each planning awardee is expected to produce a technology roadmap (or be on short term track to complete) which reflects the needs of consortia members representing industry, small business, and other stakeholder groups.

- Recipients of larger implementation awards will be expected to report on R&D outputs, which potentially include metrics such as

    - Direct funding of research activities and support for graduate and post-doctoral researchers

    - Production of new scientific knowledge and pre-competitive technology

    - Attraction of industry and state funding for directed basic research

    - Attraction of state and venture funds to support commercialization

    - Creation of new companies and jobs in high value-added sectors.

PROGRAM CHANGE PERSONNEL DETAIL
(Dollar amounts in thousands)

Program: Advanced Manufacturing Technology Consortia
Sub-program: Advanced Manufacturing Technology Consortia
Program Change: Advanced Manufacturing Technology Consortia

Title:	Location	Grade	Number of Positions	Annual Salary	Total Salaries
Program Manager	Gaithersburg	ZP IV	3	$105,737	$317,211
Admin Technical Support	Gaithersburg	ZP IV	2	105,737	211,474
Total			5		528,685
Less Lapse		25%	(1)		(132,171)
Total full-time permanent (FTE)			4		396,514
2014 Pay Adjustment (1%)					1,983
TOTAL					398,497

Personnel Data	Number
Full-Time Equivalent Employment	
Full-time permanent	4
Other than full-time permanent	0
Total	4
Authorized Positions:	
Full-time permanent	5
Other than full-time permanent	0
Total	5

CHANGE DETAIL BY OBJECT CLASS
(Dollar amounts in thousands)

Budget Program: Advanced Manufacturing Technology Consortia
Sub-program: Advanced Manufacturing Technology Consortia

	Object Class	2014 Increase
11	Personnel compensation	
11.1	Full-time permanent	$398
11.3	Other than full-time permanent	0
11.5	Other personnel compensation	0
11.8	Special personnel services payments	0
11.9	Total personnel compensation	398
12	Civilian personnel benefits	124
13	Benefits for former personnel	0
21	Travel and transportation of persons	18
22	Transportation of things	8
23.1	Rental payments to GSA	0
23.2	Rental Payments to others	0
23.3	Communications, utilities and miscellaneous charges	271
24	Printing and reproduction	3
25.1	Advisory and assistance services	0
25.2	Other services	140
25.3	Purchases of goods & services from Gov't accounts	313
25.4	Operation and maintenance of facilities	0
25.5	Research and development contracts	273
25.6	Medical care	
25.7	Operation and maintenance of equipment	29
25.8	Subsistence and support of persons	0
26	Supplies and materials	29
31	Equipment	21
32	Lands and structures	0
33	Investments and loans	0
41	Grants, subsidies and contributions	19,802
42	Insurance claims and indemnities	0
43	Interest and dividends	0
44	Refunds	0
99	Total obligations	21,429

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Hollings Manufacturing
Extension Partnership

Department of Commerce
National Institute of Standards and Technology
Industrial Technology Services
PROGRAM AND PERFORMANCE: DIRECT OBLIGATIONS
(Dollar amounts in thousands)

Program: Hollings manufacturing extension partnership
Sub-program: Hollings manufacturing extension partnership

Program Activity		2012 Actual		2013 CR (annualized)		2014 Base		2014 Estimate		Increase/ (Decrease) Over 2014 Base	
		Personnel	Amount	Personnel	Amount	Personnel	Amount	Personnel	Amount	Personnel	Amount
Hollings manufacturing extension partnership	Pos./Approp	78	$128,443	84	$129,229	84	$129,307	86	$153,078	2	23,771
	FTE/Obl.	89	129,055	89	134,960	89	129,307	90	153,078	1	23,771

BUDGET PROGRAM: Hollings Manufacturing Extension Partnership (MEP)

For FY 2014, NIST requests $153.1 million for the Hollings Manufacturing Extension Partnership (MEP) program

BASE JUSTIFICATION:

Hollings Manufacturing Extension Partnership (MEP) Overview

The Hollings Manufacturing Extension Partnership (MEP) is a Federal-state-industry partnership that provides U.S. manufacturers with access to technologies, resources, and industry experts. The MEP program consists of Manufacturing Extension Partnership Centers located across the country that work directly with their local manufacturing communities to strengthen the competitiveness of our Nation's domestic manufacturing base. Funding for the MEP Centers is a cost-sharing arrangement consisting of support from the Federal government, state and local government/entities, and fees charged to the manufacturing clients for services provided by the MEP Centers.

MEP's mission is to act as a strategic advisor to promote business growth and connect manufacturers to public and private resources essential for increased competitiveness and profitability. In doing so, MEP supports NIST's mission of promoting U.S. innovation and industrial competitiveness, while also advancing the goals of the U.S. Department of Commerce to maximize U.S. competitiveness and enable economic growth for U.S. industries, workers, and consumers.

A strong domestic manufacturing base is essential to supporting our Nation's middle class, our national security, and our growing renewable energy economy. To continue to foster the economic resurgence, we need strong, innovative manufacturing businesses that are expanding markets and creating good jobs. With Centers in every state and in Puerto Rico, MEP is positioned to connect manufacturers with the opportunities being made available through Federal and state governments to invest in environmentally sustainable manufacturing practices, develop innovative products, and diversify into new markets. MEP Centers know their communities and understand their local manufacturing industries. Across the country, they serve as trusted advisors to their manufacturing clients and help them navigate economic and business challenges, capitalize on opportunities and develop pathways leading to profitable growth.

- In FY 2014 MEP will maintain its national network, continuing to serve as a resource for manufacturing and innovation by leveraging resources to couple cost reduction strategies with profitable client company growth through new product development, technology adoption, and market expansion. MEP will continue to expand efforts to help manufacturers develop innovative practices designed to create ideas for new products, processes and services necessary to grow business opportunities. MEP will leverage the knowledge, information and connections from across the MEP system of centers and partner organizations. MEP will build on prior strategic programmatic competitions to identify areas for future investment and expansion across the MEP network to support the continued implementation of the MEP Next Generation Strategy. Technology acceleration, supplier development and environmental sustainability strategies represent the areas necessary to generate increased profit, create jobs, and bolster our Nation's long-term competitive position. MEP will work to create the tools, services and trained MEP Center field staff that are equipped to help firms innovate and create new sales, enter into new markets and adopt new technologies that build competitive advantage.

- The MEP program has a strong culture of partnership. At the state and local level, MEP Centers are often closely tied to state universities, community colleges, government economic development offices, as well as workforce development organizations. MEP Centers collaborate with third parties resources and partner organizations to ensure clients receive the most effective advice and assistance. At the Federal level, MEP has ongoing partnerships with several agencies including the Department of Energy, the Environmental Protection Agency, Department of Transportation, Department of Defense, National Aeronautics and Space Administration, the Small Business Administration and the Department of Labor. Within the Department of Commerce, MEP works with the International Trade Administration, the Economic Development Agency and the U.S. Patent and Trademark Office.

Examples of Accomplishments:

Each year the program tracks the impact of the MEP system. The most recent data based on services provided in FY 2011 have MEP clients reporting significant impacts, including:

- New Sales $2.5 billion
- Retained Sales $4.1 billion
- Cost Savings $900 million
- New Client Investment $2.5 billion
- Jobs Created 18,069
- Jobs Retained 43,070

The MEP network continues to use and expand partnerships and connections to work with companies to stabilize operations, diversify their customers, and create new business plans for moving towards a stronger future – saving jobs and helping firms identify new strategies for innovation and growth. The MEP continues to play an important role in the Administration's efforts to strengthen U.S. manufacturing, as evidenced in the various advanced manufacturing and "Make it in America" initiatives.

Priority Objectives for FY 2014:

The broad reach and extensive manufacturing knowledge of the MEP network puts the program in the position to strategically disseminate and implement Federal level initiatives and priorities throughout the country. MEP's connection to local manufacturing communities is unique and far-reaching. MEP will work to further leverage its network of Centers to focus on innovation and export opportunities for manufacturers, connect U.S. manufacturers to new technologies and commercialization opportunities, and lay the foundation for a clean energy economy that would keep jobs in the U.S., strengthen national security, and revitalize American communities. Priorities in FY 2014 include:

- Environmental Sustainability: MEP will continue to support its partnership with the Department of Energy and the Environmental Protection Agency focused on implementing sustainable manufacturing business practices through the Economy, Energy, and Environment (E3) community activities that result from a partnership between five Federal agencies and the Green Supplier Network (GSN).

- Technology Acceleration and Deployment:

  MEP program's strategic focus on technology acceleration and technology scouting through universities and Federal labs enables MEP Centers to work with manufacturing firms to innovate and increase business opportunities in green products and services. Identifying and accelerating technology development and deployment for and with manufacturing firms is a key element of MEP's innovation strategy.

- Export: Through its ExporTech program and partnership with the International Trade Administration, MEP will continue to work with manufacturers to help them expand into overseas markets. This addresses a high priority of the Administration's National Export Initiative.

- Partnerships: MEP will continue to identify partnership opportunities - at all levels of government - to leverage the Federal investment in support of the tools, services, and information needed by the manufacturing industry. Through these partnerships, MEP will expand the Make it in America activities by identifying manufacturers with current or future capabilities to address the procurement opportunities of the Federal government and original equipment manufacturers.

The MEP network has proved, through client reported impact metrics and long-standing Federal, state, and local partnerships, to be a valuable resource to America's manufacturers. As investments are being made in renewable energy, technology innovation, and export programs initiatives - investments in MEP programmatic resources will ensure that these initiatives reach the targeted manufacturing community and that these firms are connected with the opportunities at the Federal and state level. In a number of ways, investing in MEP increases the effectiveness of multiple Federal initiatives, programs, and investments.

SIGNIFICANT ADJUSTMENTS-TO-BASE (ATBs):

MEP will absorb most inflationary costs within its base to fund adjustments to current programs. These costs include a 2014 Federal Pay Raise and inflationary increases for non-labor activities. MEP ATBs in FY 2014 total $0.298 million, of which $0.220 million will be absorbed.

PROGRAM CHANGES:

MEP (Base Funding: $129.3 million and 89 FTE; Program Change: -$1.229 million and 0 FTE):

NIST's budget includes a decrease to MEP to align the program with the FY 2012 enacted level.

PROGRAM CHANGE DETAIL BY OBJECT CLASS
(Dollar amounts in thousands)

Program: Hollings Manufacturing Extension Partnership
Sub-program: Hollings Manufacturing Extension Partnership
Program Change: Hollings Manufacturing Extension Partnership

	Object Class	2014 Decrease
11	Personnel compensation	
11.1	Full-time permanent	$0
11.3	Other than full-time permanent	0
11.5	Other personnel compensation	0
11.8	Special personnel services payments	0
11.9	Total personnel compensation	0
12	Civilian personnel benefits	0
13	Benefits for former personnel	0
21	Travel and transportation of persons	0
22	Transportation of things	0
23.1	Rental payments to GSA	0
23.2	Rental Payments to others	0
23.3	Communications, utilities and miscellaneous charges	(6)
24	Printing and reproduction	0
25.1	Advisory and assistance services	0
25.2	Other services	(3)
25.3	Purchases of goods & services from Gov't accounts	(1)
25.4	Operation and maintenance of facilities	0
25.5	Research and development contracts	0
25.6	Medical care	0
25.7	Operation and maintenance of equipment	(1)
25.8	Subsistence and support of persons	0
26	Supplies and materials	(1)
31	Equipment	0
32	Lands and structures	0
33	Investments and loans	0
41	Grants, subsidies and contributions	(1,217)
42	Insurance claims and indemnities	0
43	Interest and dividends	0
44	Refunds	0
99	Total obligations	(1,229)

MEP Manufacturing Technology Acceleration Center (M-TAC) (Base Funding: $0 million and 0 FTE; Program Change: +$25 million and +1 FTE):

U.S. small manufacturers are a critical segment of our economy, comprising 90 percent of all manufacturing establishments and 45 percent of employment.[1] U.S. small and mid-sized manufacturers play a growing role in technology innovation, including product development and process improvement. This trend has been supported by the expanded portfolio of services for small and mid-sized manufacturers offered by NIST's Hollings Manufacturing Extension Partnership (MEP) through MEP's *Next Generation Strategies*. These strategies include specialized programs to promote technology acceleration, supply chain reinforcement, sustainability, continuous improvement and workforce development.

A critical component of the Administration's goal of enhancing U.S. competitiveness in advanced manufacturing is support for highly effective supply chains in technology intensive manufacturing sectors. To advance this objective NIST plans to establish through the MEP program Manufacturing Technology Acceleration Centers (M-TACs), teams of experts in specific technology/industrial sectors, offering specialized services to groups of firms. M-TACs will deploy content and services through the well-established national network of local centers, utilizing "tiger teams" and direct consulting for centers and manufacturers. M-TACs would serve as national centers of expertise aligned with industry specific associations, trade groups, and OEMs to identify key barriers to supply chain development and draw upon their resources to develop new approaches and establish/reinforce supply chain networks.

The M-TACs will provide technology acceleration support to U.S. small and mid-sized manufacturers through a program that is nationally connected and locally deployed, enhancing the ability of supply chains to adopt advanced technologies into their manufacturing processes and products.

Statement of Need and Economic Benefits:

The M-TAC initiative seeks to improve technology transfer and commercialization through a focus on supply chains that are critical to many U.S. manufacturers and that potentially result in increased job creation and economic growth. Specifically, the M-TACs will provide technology transition services to U.S. small manufacturers through a program that is locally driven and nationally connected, by fostering the small manufacturer's readiness to adopt and adapt advanced technologies into their manufacturing processes and products. Technology readiness and technology transition services may be delivered through M-TAC in-house expertise. The M-TACs will also foster connections between the MEP system, and initiatives tasked with linking technologically promising research discoveries and ideas for advanced, high-value-added products with existing U.S. manufacturers and aspiring start-up firms (such as the National Network for Manufacturing Innovation), state and local technology-based economic development intermediaries, industry associations, and manufacturing standards organizations.

As part of the President's focus on enhancing U.S. competiveness in advanced manufacturing, a key to success is support for highly effective supply chains in technology intensive manufacturing sectors. The M-TACs will complement the work of the MEP network of Centers, expanding the effective public-private partnership model of the current MEP network to address manufacturing technology commercialization. The M-TACs would consist of teams of experts in a specific technology/supply chain area, offer multiple services, and provide deep expertise supporting the national network of

[1] http://www.census.gov/econ/cbp/

MEP Centers. In effect, the M-TACs would have national rather than a local project scope. The M-TACs would interact with manufacturers through on-the-ground resident resources of the current MEP Centers. The M-TAC services would include: manufacturing technology content and deployment services, expert assistance and consulting to manufacturers, integration with industry specific associations and OEMs to identify key barriers to supply chain development and work with these stakeholders to develop new services for small and mid-size manufacturers. M-TACs will be evaluated based on their ability to build upon and extend the traditional manufacturing extension services delivered to include advanced manufacturing technology and techniques. The combined effectiveness of M-TACs and MEP Centers in creating and maintaining robust supply chains would be a second performance objective.

Base Resources Assessment:

Existing program base resources are for maintaining the nationwide program of Manufacturing Extension Partnership (MEP) Centers to assist small and medium size manufacturers and support their competitiveness and growth through innovation and technology.

The M-TACs will complement the base MEP program but at are fundamentally different from existing MEP Centers. New resources are needed to create and launch 3-4 M-TACs in FY 2014.

Deliverables:

- Launch 3-4 pilot M-TACs to accelerate and increase technology commercialization in the United States.
- Develop expanded network of manufacturing technology partnerships building upon the results of M-TAC pilots in FY 2013.

PROGRAM CHANGE PERSONNEL DETAIL
(Dollar amounts in thousands)

Program: Hollings Manufacturing Extension Partnership
Sub-program: Hollings Manufacturing Extension Partnership
Program Change: MEP Manufacturing Technology Acceleration Center (M-TAC)

Title:	Location	Grade	Number of Positions	Annual Salary	Total Salaries
Industrial specialist	Gaithersburg	ZA IV	1	$105,737	$105,737
Industrial specialist	Gaithersburg	ZA III	1	75,246	75,246
Total			2		180,983
Less Lapse		25%	(1)		(45,246)
Total full-time permanent (FTE)			1		135,737
2014 Pay Adjustment (1%)					1,357
TOTAL					137,094

Personnel Data	Number
Full-Time Equivalent Employment	
Full-time permanent	1
Other than full-time permanent	0
Total	1
Authorized Positions:	
Full-time permanent	2
Other than full-time permanent	0
Total	2

PROGRAM CHANGE DETAIL BY OBJECT CLASS
(Dollar amounts in thousands)

Program: Hollings Manufacturing Extension Partnership
Sub-program: Hollings Manufacturing Extension Partnership
Program Change: MEP Manufacturing Technology Acceleration Center (M-TAC)

	Object Class	2014 Increase
11	Personnel compensation	
11.1	Full-time permanent	$137
11.3	Other than full-time permanent	0
11.5	Other personnel compensation	0
11.8	Special personnel services payments	0
11.9	Total personnel compensation	137
12	Civilian personnel benefits	43
13	Benefits for former personnel	0
21	Travel and transportation of persons	29
22	Transportation of things	5
23.1	Rental payments to GSA	0
23.2	Rental Payments to others	0
23.3	Communications, utilities and miscellaneous charges	633
24	Printing and reproduction	12
25.1	Advisory and assistance services	0
25.2	Other services	3,334
25.3	Purchases of goods & services from Gov't accounts	334
25.4	Operation and maintenance of facilities	0
25.5	Research and development contracts	0
25.6	Medical care	0
25.7	Operation and maintenance of equipment	71
25.8	Subsistence and support of persons	0
26	Supplies and materials	168
31	Equipment	84
32	Lands and structures	0
33	Investments and loans	0
41	Grants, subsidies and contributions	20,150
42	Insurance claims and indemnities	0
43	Interest and dividends	0
44	Refunds	0
99	Total obligations	25,000

Department of Commerce
National Institute of Standards and Technology
Hollings Manufacturing Extension Partnership
REIMBURSABLE PROGRAM AND WORKING CAPITAL FUND INVESTMENTS
(Dollar amounts in thousands)

	FY 2012 Actual	FY 2013 CR (annualized)	FY 2014 Estimate
Department of Defense			
Navy	0	$1,500	0
Other, Department of Defense	0	2,000	$2,000
Subtotal, Department of Defense	0	3,500	2,000
Department of Commerce	0	1,500	0
Department of Energy	$1,473	0	0
Dept. of Homeland Security	23	0	0
Department of Transportation	249	530	0
Environmental Protection Agency	77	100	0
Subtotal, Other Agency	1,822	5,630	2,000
Subtotal, Other Reimbursables	0	0	0
Total, Reimbursable Program	1,822	5,630	2,000
Subtotal, WCF transfer	0	0	0
Equipment Investments	29	41	12
IE Amortization	(86)	(12)	(12)
Excess Amortizations over Equipment Investments	58	0	0
Total, WCF Investments	1	29	0
Total, Reimbursable Program and WCF Investments	1,823	5,659	2,000

Baldrige Performance
Excellence Program

Exhibit 10

Department of Commerce
National Institute of Standards and Technology
Industrial Technology Services
PROGRAM AND PERFORMANCE: DIRECT OBLIGATIONS
(Dollar amounts in thousands)

Program: Baldrige performance excellence program
Sub-program: Baldrige performance excellence program

Program Activity		2012 Actual		2013 CR (annualized)		2014 Base		2014 Estimate		Increase/ (Decrease) Over 2014 Base	
		Personnel	Amount	Personnel	Amount	Personnel	Amount	Personnel	Amount	Personnel	Amount
Baldrige performance	Pos./Approp	11	0	0	0	0	0	0	0	0	0
excellence program	FTE/Obl.	13	$2,061	0	$58	0	0	0	0	0	0

Department of Commerce
National Institute of Standards and Technology
Baldrige Performance Excellence Program
REIMBURSABLE PROGRAM AND WORKING CAPITAL FUND INVESTMENTS
(Dollar amounts in thousands)

	FY 2012 Actual	FY 2013 CR (annualized)	FY 2014 Estimate
Technical & Advisory Services	0	$650	$450
Total, Reimbursable Program	-	650	450
Subtotal, WCF transfer	0	0	0
Total, WCF Investments	0	0	0
Total, Reimbursable Program and WCF Investments	-	650	450

Object Class

Exhibit 16

Department of Commerce
National Institute of Standards and Technology
Industrial Technology Services
SUMMARY OF REQUIREMENTS BY OBJECT CLASS
(Dollar amounts in thousands)

	Object Class	2012 Actual	2013 CR (annualized)	2014 Base	2014 Estimate	Increase/ (Decrease) Over 2014 Base
11	Personnel compensation					
11.1	Full-time permanent	$12,346	$8,195	$8,232	$8,769	$537
11.3	Other than full-time permanent	834	1,309	616	616	0
11.5	Other personnel compensation	294	170	170	170	0
11.9	Total personnel compensation	13,474	9,674	9,018	9,555	537
12.1	Civilian personnel benefits	3,881	2,959	2,747	2,915	168
13	Benefits for former personnel	101	42	42	42	0
21	Travel and transportation of persons	700	644	644	691	47
22	Transportation of things	19	16	16	29	13
23.1	Rental payments to GSA	4	13	15	15	0
23.2	Rental payments to others	180	0	0	0	0
23.3	Communications, utilities, and miscellaneous charges	1,069	1,037	1,037	1,935	898
24	Printing and reproduction	32	32	32	47	15
25.1	Advisory and assistance services	182	191	195	195	0
25.2	Other services	8,636	21,305	13,132	16,603	3,471
25.3	Purchases of goods and services from government accounts	576	562	562	1,205	643
25.5	Research and development contracts	0	0	0	273	$273
25.7	Operation and maintenance of equipment	259	240	240	339	99
26	Supplies and materials	384	374	374	570	196
31	Equipment	271	253	253	358	105
32	Land and structures	0	0	0	0	0
41	Grants, subsidies, and contributions	105,721	101,000	101,000	139,735	38,735
42	Insurance claims and indemnities	0	0	0	0	0
43	Interest and dividends	0	0	0	0	0
99	Total Obligations	135,489	138,342	129,307	174,507	45,200

	Object Class	2012 Actual	2013 CR (annualized)	2014 Base	2014 Estimate	Increase/ (Decrease) Over 2014 Base
99	Total Obligations	135,489	138,342	129,307	174,507	45,200
	Less Prior Year Recoveries	(4,171)	(2,266)	0	0	0
	Less Prior Year Refunds	(5)	0	0	0	0
	Less Prior Year Unobligated Balance	(8,117)	(6,847)	0	0	0
	Plus Unobligated Balance End of Year	6,847	0	0	0	0
	Less Unobligated Balance, STRS Transfer	(1,600)	0	0	0	0
	Total Budget Authority/Appropriation	128,443	129,229	129,307	174,507	45,200
	Personnel Data					
	Full-time equivalent employment:					
	Full-time permanent	119	81	81	86	5
	Other than full-time permanent	8	13	8	8	0
	Total	127	94	89	94	5
	Authorized Positions:					
	Full-time permanent	125	79	79	86	7
	Other than full-time permanent	5	5	5	5	0
	Total	130	84	84	91	7

Exhibit 23

Department of Commerce
National Institute of Standards and Technology
Industrial Technology Services
SUMMARY OF INFORMATION TECHNOLOGY RESOURCES
(Dollar amounts in thousands)
(Budget Authority)

IT Projects by Activity/Subactivity: (Totals by Activity)	Unique Investment Identifier	IT Investment Title	2012 Actual	2013 CR (Annualized)	2014 Estimate	Increase/ Decrease
Baldrige Performance Excellence Program (BPEP)						
	006-000703000	Baldrige Program Systems	$336	$0	$0	$0
Technology Innovation Program (TIP)						
	006-000704000	TIP Systems	361	0	0	0
Hollings Manufacturing Extension Partnership (MEP)						
	006-000705000	MEP Systems	693	698	708	10
Total			1,390	698	708	10

Department of Commerce
National Institute of Standards and Technology
Industrial Technology Services
APPROPRIATION LANGUAGE AND CODE CITATIONS

1. For necessary expenses of the Industrial Technology Services appropriation of the National Institute of Standards and Technology,

15 U.S.C. 271 et seq.
15 U.S.C. 272(b)(1) and (b)(4)
15 U.S.C. 278b
15 U.S.C. 278k
15 U.S.C. 278l
15 U.S.C. 278n
15 U.S.C. 7506(a)(2)

15 U.S.C. 271 et seq. provides NIST's organic authorities.

15 U.S.C. 272(b)(1) authorizes the Secretary, through the Director of NIST, to assist industry in the development of technology and procedures needed to improve quality, to modernize manufacturing processes, to ensure product reliability, manufacturability, functionality, and cost-effectiveness, and to facilitate more rapid commercialization, especially by small- and medium-sized companies throughout the United States, of products based on new scientific discoveries in fields such as automation, electronics, advanced materials, biotechnology, and optical technologies.

15 U.S.C. 272(b)(4) authorizes the Secretary, through the Director of NIST, to enter into contracts, including cooperative research and development arrangements and grants and cooperative agreements, in furtherance of the purposes of the NIST Act.

15 U.S.C. 278b provides for a Working Capital Fund to support NIST activities.

15 U.S.C. 278k directs the Secretary, through the Director of NIST, to provide assistance for the creation of Regional Centers for the Transfer of Manufacturing Technology.

15 U.S.C. 278l provides authority for technical assistance to State technology programs.

15 U.S.C. 278n established the Advanced Technology Program within NIST to assist U.S. businesses in applying generic technology and research results to commercialize scientific discoveries and refine manufacturing technologies. Public Law 110-69 signed on August 9, 2007 has now abolished the Advanced Technology Program (ATP).

15 U.S.C. 7506(a)(2) instructs the NIST Director to utilize the Manufacturing Extension Partnership program to the extent possible to ensure that basic research on issues related to the development and manufacture of nanotechnology, including metrology; reliability and quality assurance; processes control; and manufacturing best practices reaches small- and medium-sized manufacturing companies.

2. $153,078,000, is provided for the Hollings Manufacturing Extension Partnership to remain available until expended.

$21,429,000 is provided for the Advanced Manufacturing Technology Consortia Program to remain available until expended.

3. Public Law 110-69, America Competes Act, 121 Stat 572, enacted August 9, 2007 reauthorized the Industrial Technology Services appropriation through 2010. In addition, it eliminated the Advanced Technology Program (ATP) and established the Technology Innovation Program (TIP) which provides grants to eligible companies or joint ventures whose proposed technology has strong potential to address critical national needs. It also amended 15 U.S.C. 3711 by changing the name of the National Medal of Technology from "Technology Medal" to "Technology and Innovation Medal".

Public Law 111-358, America Competes Reauthorization Act, 2010, 124 Stat 3982, enacted January 4, 2011 reauthorized the Industrial Technology Services appropriation through 2013 to include the Manufacturing Extension Partnership Program (MEP) and the Malcolm Baldrige National Quality Award program. In addition, authorization is provided for an Innovative Services Initiative to assist small and medium-sized manufacturers within the MEP program.

Public Law 112-55, Consolidated and Further Continuing Appropriations Act, 2012, 125 Stat 552, enacted November 18, 2011 did not contain funding for the Technology Innovation Program (TIP) and the Baldrige Performance Excellence Program (BPEP).

Department of Commerce
National Institute of Standards and Technology
Industrial Technology Services
ADVISORY AND ASSISTANCE SERVICES
(Obligations in thousands of dollars)

	FY 2012 Actual	FY 2013 Estimate	FY 2014 Estimate
Management and professional support services	$182	$191	$195
Studies, analyses, and evaluations	0	0	0
Engineering and technical services	0	0	0
Total	182	191	195

Significant Activities

Advisory and assistance services funded by the Industrial Technology Services appropriation are used to conduct evaluations of the programmatic outcomes, service delivery efficiency, and internal infrastructure requirements of the Hollings MEP Program.

Need for Advisory and Assistance Services:

The need for advisory and assistance services stems from the role of NIST's extramural programs with its outside partners and small businesses to relate to the private sector, professional organizations, and the public sector. Inputs must be obtained from consultants who can bring their individual expertise to bear and help NIST in assessing its program plans to meet the needs of its customers. The alternative to utilizing these services is to make no attempt to have expertise from sources outside NIST and risk having a poorer working and professional relationship with those in the business of using the products and services offered by NIST. These services provide for economic assessment and external evaluation of NIST's extramural programs.

Construction of
Research Facilities

Exhibit 5

Department of Commerce
National Institute of Standards and Technology
Construction of Research Facilities
SUMMARY OF RESOURCE REQUIREMENTS
(Dollar amounts in thousands)

	Positions	FTE	Budget Authority	Direct Obligations	Appro-priation
2013 CR (annualized)	89	89	$55,720	$91,161	$55,720
less: Unobligated balance from prior year			0	(34,441)	0
2014 Adjustments to base:					
plus: Uncontrollable cost changes	0	0	705	705	705
less: ATBs absorbed	0	0	(615)	(615)	(615)
Other Changes:					
Reduction of 2013 deobligation offset				(1,000)	
2014 Base Request	89	89	55,810	55,810	55,810
2014 Program changes	0	0	4,230	4,230	4,230
2014 Estimate	89	89	60,040	60,040	60,040

		2012 Actual		2013 CR (annualized)		2014 Base		2014 Estimate		Increase/ (Decrease) Over 2014 Base	
Comparison by program/sub-program:		Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount
Construction and major renovations											
Construction and major	Pos/Approp	118	$55,381	89	$55,720	89	$55,810	89	$60,040	0	$4,230
renovations	FTE/Obl.	89	34,668	89	91,161	89	55,810	89	60,040	0	4,230
Adjustments for:											
Prior year recoveries			(406)		(1,000)		0		0		0
Unobligated balance, start of year			(13,322)		(34,441)		0		0		0
Unobligated balance, end of year			34,441		0		0		0		0
Financing from transfers:											
Transfers to other accounts (+)			0		0		0		0		0
Appropriation			55,381		55,720		55,810		60,040		4,230

Exhibit 7

Department of Commerce
National Institute of Standards and Technology
Construction of Research Facilities
SUMMARY OF FINANCING
(Dollar amounts in thousands)

	2012 Actual	2013 CR (annualized)	2014 Base	2014 Estimate	Increase/ (Decrease) Over 2014 Base
Total Obligations	$35,598	$92,332	$55,810	$60,040	$4,230
Financing:					
Offsetting collections from:					
Federal funds	0	0	0	0	0
Non-Federal sources	(1,162)	0	0	0	0
Total offsetting collections	(1,162)	0	0	0	0
Adjustments for:					
Prior year recoveries (Direct)	(406)	(1,000)	0	0	0
Prior year recoveries (Reimbursable)	(9)				
Unobligated balance, start of year (Direct)	(13,322)	(34,441)	0	0	0
Unobligated balance, start of year (Reimbursable)	(930)	(1,171)	0	0	0
Unobligated balance, end of year (Direct)	34,441	0	0	0	0
Unobligated balance, end of year (Reimbursable)	1,171	0	0	0	0
Budget Authority	55,381	55,720	55,810	60,040	4,230
Financing:					
Transfer to other accounts	0	0	0	0	0
Transfer from other accounts	0	0	0	0	0
Appropriation	55,381	55,720	55,810	60,040	4,230


Adjustments
to Base

Department of Commerce
National Institute of Standards and Technology
Construction of Research Facilities
JUSTIFICATION OF ADJUSTMENTS TO BASE
(Dollar amounts in thousands)

		FTE	Amount
Other Changes:			
Annualization of 2013 pay raise		0	15
A pay raise of .5 percent is assumed to be effective January 1, 2013.			
Total cost in FY 2014 of 2013 pay raise	$ 58,667		
Less amount requested in FY 2013	(44,000)		
Less amount absorbed in FY 2013	0		
Amount requested in 2014 to provide full-year cost of 2013 pay raise	14,667		
2014 Pay increase and related costs		0	90
A general pay raise of 1 percent is assumed to be effective January 1, 2014.			
Total cost in FY 2014 of pay increase	$90,000		
Less amount absorbed in FY 2014	0		
Amount requested for FY 2014 pay increase	90,000		
Payment to Departmental Management Working Capital Fund	0		
Total adjustment for FY 2014 pay increase	90,000		

Personnel benefits	0	80
Civil Service Retirement System (CSRS)	($9)	
Federal Employees' Retirement System (FERS)	30	
Thrift Savings Plan (TSP)	8	
Federal Insurance Contribution Act (FICA) - OASDI	19	
Health Insurance	22	
Employees' Compensation Fund	10	

Civil Service Retirement System (-$9,000) – The number of employees covered by the Civil Service Retirement System (CSRS) continues to drop as positions become vacant and are filled by employees who are covered by the Federal Employees Retirement System (FERS). The estimated percentage of payroll for employees covered by CSRS will decrease from 8.7 percent in FY 2013 to 7.0 percent in FY 2014. The contribution rate will remain at 7.0 percent in FY 2014.

Payroll subject to retirement systems ($7,819,330)	
Cost of CSRS contributions in FY 2014 ($7,819,330 x .070 x .07)	$38,315
Cost of CSRS contributions in FY 2013 ($7,819,330 x .087 x .07)	47,620
Total adjustment to base	(9,305)

Federal Employees' Retirement System ($30,000) – The number of employees covered by FERS continues to rise as employees covered by CSRS leave and are replaced by employees covered by FERS. The estimated percentage of payroll for employees covered by FERS will increase from 91.3 percent in FY 2013 to 93.0 percent FY 2014. The contribution rate increased from 11.7 percent in FY 2013 to 11.9 percent in FY 2014.

Payroll subject to retirement systems ($7,819,330)	
Basic benefit cost in FY 2014 ($7,819,330 x .930 x .119)	$865,365
Basic benefit cost in FY 2013 ($7,819,330 x .913 x .117)	835,269
Total adjustment to base	30,096

Thrift Savings Plan ($8,000) – The cost of agency contributions to the Thrift Savings Plan will also rise as FERS participation increases. The contribution rate increased from 4.54 in FY 2013 to 4.57 in FY 2014.

Thrift plan cost in FY 2014 ($7,819,330 x .930 x .0457)	$332,329
Thrift plan cost in FY 2013 ($7,819,330 x .913 x .0454)	324,113
Total adjustment to base	8,216

Federal Insurance Contributions Act (FICA) - OASDI ($19,000) – As the percentage of payroll covered by FERS increases, the cost of OASDI contributions will increase. In FY 2014, the maximum salary subject to OASDI tax will increase from $113,100 in FY 2013 to $119,100 in FY 2014. The OASDI tax rate for employers will remain at 6.2 percent in FY 2014.

FERS payroll subject to FICA tax in 2014 ($7,819,330 x .930 x .903 x .062)	$407,129
FERS payroll subject to FICA tax in 2013 ($7,819,330 x .913 x .882 x .062)	390,392
Increase (FY 2013-FY 2014)	16,737
OTP payroll subject to FICA tax in FY 2014 ($859,670 x .930 x .903 x .062)	44,760
OTP payroll subject to FICA tax in FY 2013 ($859,670 x .913 x .882 x .062)	42,920
Increase (FY 2013-FY 2014)	1,840
Total adjustment to base	18,577

Health insurance ($22,000) – Effective January 2012, NIST's contribution to Federal employees' health insurance premiums increased by 3.6 percent. Applied against the FY 2013 estimate of $598,000, the additional amount required is $21,528.

Employees' Compensation Fund ($10,000) – The Employees' Compensation Fund bill for the year ending June 30, 2012 is $9,891 higher than for the year ending June 30, 2011.

General pricing level adjustment	0	520

This request applies the OMB economic assumptions of 1.7 percent for FY 2014 where the prices that the government pays are established through the market system. Factors are applied to sub-object classes that result in the following adjustments to base: communications, utilities, and miscellaneous $2,788; other services $486,761; supplies and materials $26,197; and equipment $4,318.

Subtotal, Other changes	0	705
Amount absorbed	0	(615)
Total Adjustments to base	0	90

Program and
Performance

Department of Commerce
National Institute of Standards and Technology
Construction of Research Facilities
PROGRAM AND PERFORMANCE: DIRECT OBLIGATIONS
(Dollar amounts in thousands)

Program: Construction and major renovations
Sub-program: Construction and major renovations

Program Activity		2012 Actual		2013 CR (annualized)		2014 Base		2014 Estimate		(Increase/ Decrease) Over 2014 Base	
		Personnel	Amount	Personnel	Amount	Personnel	Amount	Personnel	Amount	Personnel	Amount
Construction and major renovations	Pos/Approp	10	$13,900	0	$11,800	0	$11,800	0	$11,800	0	0
	FTE/Obl.	7	3,068	0	28,906	0	11,800	0	11,800	0	0
Safety, Capacity, Maintenance and Major Repairs	Pos/Approp	107	41,481	89	43,920	89	44,010	89	48,240	0	$4,230
	FTE/Obl.	81	31,373	89	59,794	89	44,010	89	48,240	0	4,230
External Projects	Pos/Approp	1	0	0	0	0	0	0	0	0	0
	FTE/Obl.	1	227	0	2,461	0	0	0	0	0	0
Total	Pos/Approp	118	55,381	89	55,720	89	55,810	89	60,040	0	4,230
	FTE/Obl.	89	34,668	89	91,161	89	55,810	89	60,040	0	4,230

APPROPRIATION ACCOUNT: CONSTRUCTION OF RESEARCH FACILITIES

BUDGET PROGRAM: CONSTRUCTION AND MAJOR RENOVATIONS

For FY 2014, NIST requests a total of $60.0 million and 89 FTE for Construction and Major Renovations.

BASE JUSTIFICATION:

CONSTRUCTION OF RESEARCH FACILITIES Overview

The Construction of Research Facilities (CRF) program funds new construction and renovation of NIST Facilities.

Specifically, the SCMMR program funds the maintenance, repair, improvements, and construction of facilities occupied or used by NIST in Gaithersburg, Maryland; Boulder and Fort Collins, Colorado; and Kauai, Hawaii to meet current and future measurement and research needs for the Nation.

Aging and deteriorating buildings and infrastructure threaten NIST's ability to meet its mission. Failure to properly maintain, repair, improve, and construct facilities used by NIST will cause reductions in measurement capabilities, impairing NIST's ability to meet its measurement and standards missions, and thus reducing U.S. innovation and industrial competitiveness. Other negative impacts include possible damage to staff and visitor safety and health, and reductions in staff productivity.

State-of-the-art facilities are essential to the capabilities of NIST's laboratories. NIST measurement capabilities must be maintained at the highest levels of precision and accuracy to meet the increasingly stringent needs of their users. Also, facilities must be compliant with various health and safety regulations. Other major considerations for facilities are to increase the capacity of facilities, to improve access for people with disabilities, and to safeguard the utility infrastructure of existing buildings.

NIST prioritizes its efforts to improve and upgrade its facilities to address its highest priority SCMMR projects. If major facilities-related emergency situations arise, previously planned facilities work is reprioritized as appropriate.

SIGNIFICANT ADJUSTMENTS-TO-BASE (ATBs):

NIST CRF will absorb most inflationary costs within its base to fund adjustments to current programs. These costs include a 2014 Federal Pay Raise and inflationary increases for non-labor activities. CRF ATBs in FY 2014 total $0.705 million, of which $0.615 million will be absorbed.

SUB-PROGRAM: SCMMR

The objectives of the SCMMR sub-program are to:

- continue the repair and upgrade of facilities that have a high impact on staff and visitor safety;
- continue abatement of hazardous materials from site buildings and structures;

- continue facilities modifications to comply with the Access to Federal Buildings Act and the Americans with Disabilities Act;

- continue repairs/replacements of utility systems, exhaust and air filtration systems, mechanical-electrical systems, and site alarm fire safety systems that are failing at an accelerated rate because they are over 40 to 50 years old;

- continue site infrastructure upgrades and repairs, to include roads, loading docks, pedestrian walk areas, and storm water drainage;

- enable or maintain building environmental conditions required for meeting scientific requirements;

- continue to reduce the backlog of deferred maintenance projects; and

- intensify targeted energy conservation, water efficiency, and building system upgrades to facilitate meeting sustainability requirements stipulated in Executive Orders 13423 and 13514.

PROGRAM CHANGES:

1. Safety, Capacity, Maintenance, and Major Repair (SCMMR) (+$4.23 million, +0 FTE):

NIST requests an increase to expedite the maintenance and repair of facilities and reduce the impact of facility deficiencies on laboratory projects.

Proposed Actions:

The increased funding will allow NIST to reduce the backlog of maintenance and repair projects across NIST facilities.

Statement of Need and Economic Benefits – Cost Benefit Analysis

The beneficial impact of renovating NIST's facilities on the U.S. economy is long-term and significant. NIST researchers seek to reliably and accurately measure everything from length, to time, to mass, to electric current – before industry or science hits a roadblock in its pursuit of a better product or new understanding of the way the world works. The critical measurement science and standards research performed by NIST enables scientific discovery and speeds the translation of these discoveries into economically meaningful products and services. These new and improved products make U.S. industry more competitive and enhance the quality of life and economic security of all Americans.

Postponement of NIST's facility repairs is not cost-effective. For each year that maintenance and repair projects are delayed, the buildings become less functional, building system failures become more commonplace, and the repair costs continue to escalate.

Base Resources Assessment

The NIST SCMMR base program funds necessary safety and capacity improvements, routine maintenance, and major repairs to the infrastructure and about 55 specialized laboratories, offices and support buildings at sites in Gaithersburg, Maryland; Boulder and Fort Collins, Colorado; and Kauai, Hawaii. The NIST Time Scale and Network Time Service System, a National Critical Infrastructure Asset, is represented at the NIST sites in Colorado and Hawaii. The Gaithersburg facilities and infrastructure were built in the early 1960s; the Boulder facilities and infrastructure in the 1950s, and the Fort Collins and Hawaii field sites in the mid to late 1960s.

An ever-pressing issue for NIST is the aging and obsolescence of the facilities and infrastructure at all NIST sites. These aging facilities and their extensive backlog of deferred maintenance have become serious impediments to the efficient completion of the NIST mission in all areas of research. While some progress has been made by strategically applying available SCMMR resources against the most critical repair needs, NIST still faces a large backlog of SCMMR projects. Some of NIST's most serious facility deterioration could affect the welfare and safety of the roughly 5,500 employees and guest researchers who are present on the two major sites at any given time. NIST laboratories have experienced systems capacity problems, including antiquated electrical systems (transformers, switchgear, and motor starters) and non-existent or inadequate delivery of chilled water to the laboratories. Based on the independent architectural and engineering reviews and in conjunction with the need to maintain world class research, the proposed level of funds will continue to target the most critical NIST SCMMR projects.

Schedule and Milestones:

- FY 2014 – Award projects that focus on reducing the overall backlog of maintenance projects and improve the overall Facility Condition Index (FCI) for all NIST sites.

Deliverables:

- FY 2014 – Reduce the overall facilities backlog annually by approximately three percent.
- FY 2014 – Reduce the FCI annually by approximately three percent.

Performance Goals and Measurement Data:

Performance Goal: Percent of facilities backlog reduced	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target	FY 2018 Target
With Increase	2.7%	2.7%	2.7%	2.7%	2.7%
Without Increase	2.5%	2.5%	2.5%	2.5%	2.5%
Description: Based on the program funding levels the backlog of repair work / deferred maintenance, to maintain NIST facilities acceptable working condition, will be reduced.					

Performance Goal: Percent of FCI reduced	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target	FY 2018 Target
With Increase	2.7%	2.7%	2.7%	2.7%	2.7%
Without Increase	2.5%	2.5%	2.5%	2.5%	2.5%
Description: The effect on the NIST overall Facility Condition Index (FCI) is based on the program funding levels and the number of projects that can be executed.					

PROGRAM CHANGE PERSONNEL DETAIL
(Dollar amounts in thousands)

Budget Program: Construction and Major Renovations
Sub-program: Construction and Major Renovations
Program Change: Safety, Capacity, Maintenance, and Major Repair Increase

No change in FTE is required.

PROGRAM CHANGE DETAIL BY OBJECT CLASS
(Dollar amounts in thousands)

Budget Program: Construction and Major Renovations
Sub-program: Construction and Major Renovations
Program Change: Safety, Capacity, Maintenance, and Major Repair Increase

	Object Class	2014 Increase
11	Personnel compensation	
11.1	Full-time permanent	0
11.3	Other than full-time permanent	0
11.5	Other personnel compensation	0
11.8	Special personnel services payments	0
11.9	Total personnel compensation	0
12	Civilian personnel benefits	0
13	Benefits for former personnel	0
21	Travel and transportation of persons	$19
22	Transportation of things	1
23.1	Rental payments to GSA	0
23.2	Rental Payments to others	0
23.3	Communications, utilities and miscellaneous charges	481
24	Printing and reproduction	2
25.1	Advisory and assistance services	0
25.2	Other services	3,522
25.3	Purchases of goods & services from Gov't accounts	73
25.4	Operation and maintenance of facilities	0
25.5	Research and development contracts	0
25.6	Medical care	0
25.7	Operation and maintenance of equipment	54
25.8	Subsistence and support of persons	0
26	Supplies and materials	52
31	Equipment	26
32	Lands and structures	0
33	Investments and loans	0
41	Grants, subsidies and contributions	0
42	Insurance claims and indemnities	0
43	Interest and dividends	0
44	Refunds	0
99	Total obligations	4,230

2. Building 1 Renovation Decrease (-$11.8 million, -0 FTE):

NIST requests a decrease in the amount of $11.8 million to reflect the completion of interior renovations to Wing 6 of Building 1.

PROGRAM CHANGE PERSONNEL DETAIL
(Dollar amounts in thousands)

Budget Program: Construction and Major Renovations
Sub-program: Construction and Major Renovations
Program Change: Building 1 Renovation Decrease

No change in FTE is required.

PROGRAM CHANGE DETAIL BY OBJECT CLASS
(Dollar amounts in thousands)

Budget Program: Construction and Major Renovations
Sub-program: Construction and Major Renovations
Program Change: Building 1 Renovation Decrease

	Object Class	2014 Decrease
11	Personnel compensation	
11.1	Full-time permanent	0
11.3	Other than full-time permanent	0
11.5	Other personnel compensation	0
11.8	Special personnel services payments	0
11.9	Total personnel compensation	0
12	Civilian personnel benefits	0
13	Benefits for former personnel	0
21	Travel and transportation of persons	0
22	Transportation of things	0
23.1	Rental payments to GSA	0
23.2	Rental Payments to others	0
23.3	Communications, utilities and miscellaneous charges	0
24	Printing and reproduction	0
25.1	Advisory and assistance services	0
25.2	Other services	0
25.3	Purchases of goods & services from Gov't accounts	0
25.4	Operation and maintenance of facilities	0
25.5	Research and development contracts	0
25.6	Medical care	0
25.7	Operation and maintenance of equipment	0
25.8	Subsistence and support of persons	0
26	Supplies and materials	0
31	Equipment	0
32	Lands and structures	($11,800)
33	Investments and loans	0
41	Grants, subsidies and contributions	0
42	Insurance claims and indemnities	0
43	Interest and dividends	0
44	Refunds	0
99	Total obligations	(11,800)

3. Building 1 Renovation Increase (+$11.8 million, +0 FTE):

NIST requests an increase of $11.8 million to move forward with the next phase of the multi-year interior renovations of Boulder's Building 1. The increase will fund the first phase of the interior and exterior renovation of Wing 5. The remaining renovations will be completed with future funding requests.

With Wing 6 renovation to be completed through FY 2013 funding, NIST requests an increase to fund the next planned phase: the renovation of Wing 5. Wing 5, when renovated, will be occupied by laboratory operations from the Time and Frequency Division, the Quantum Electronics and Photonics Division, and Electromagnetics Division. The conditions are currently insufficient to meet the performance requirements of a Level 1 and 2 renovation (described below) necessary for general electronic, optical, optoelectronic, and electromagnetic measurements, as well as experimental apparatus design, assembly and test required to support laboratory activities. The level 1 and 2 performance that provides moderate temperature control, improved electrical power capacity, and increases process chilled water availability will meet these programmatic needs.

Statement of Need and Economic Benefits – Cost Benefit Analysis

Aging laboratory facilities at NIST Boulder substantially hinder NIST's mission of fostering innovation and ensuring U.S. competitiveness. Scientific work at the NIST Boulder laboratories supports national priorities such as energy, environment, manufacturing, health care, physical infrastructure, information technology, and many other areas. However, this work is significantly impaired by aging facilities that cannot provide the control of temperature, vibration, humidity, and air cleanliness required for world-leading research and measurement to support 21st century innovation and competitiveness. The nearly 60-year-old facilities cause a productivity loss of at least 20 percent[1], and prevent NIST from performing the most demanding research and measurement needed by industry and the scientific community. Even for the limited range of work that can be attempted, current laboratory conditions create significant inefficiencies, and the aging facility systems present safety concerns. In terms of lost productivity, much research and many measurements can only be conducted sporadically when environmental conditions are temporarily stable and much experimental data and construction of nanoscale devices becomes worthless because of corruption due to poor laboratory conditions. Much research and measurement planned for the future will not be possible without significantly upgraded facilities.

The successful improvement of the NIST Boulder facilities – through construction of the Precision Measurement Facility (PML) and the extensive renovation of parts of the existing facilities – will enable NIST to support scientific discovery and technical development of transformational technology in homeland security, telecommunications, nanotechnology, precision timing, hydrogen energy sources, precision electrical standards, biotechnology, applications of lasers, electromagnetic interference testing, quantum computing and quantum communications, and other national needs.

The Building 1 Renovation (B1R) in Boulder is a phased project to modernize this nearly 60 year old facility that is no longer meeting the needs of the research community. The facility houses approximately 70 percent of NIST laboratory space in Boulder, most of which is below Level 1 (L1) performance level. The Facility Condition Index for the building rates as poor. Therefore, upgrades are essential to provide Level 1 (L1) through Level 3 (L3) General Lab performance requirements necessary for the 21st century research and measurement supporting U.S. innovation and economic security. The project is the continuation of the long-

[1] *NIST Boulder Facilities Review Team, Report on NIST Boulder Laboratory Facilities: Findings and Recommendations on Possible Renovation of Existing Facilities and Possible Construction of New Laboratory Facilities, January 31, 2006.*

range revitalization plan for the NIST laboratories at Boulder following the completion of construction of the high-performance (L4) PML.

The B1R renovation project will address the deterioration of this critical building by accomplishing specific SCMMR-type improvements. In planning for the B1R, NIST identified infrastructure projects related to air cleanliness, temperature, vibration and humidity control, plumbing systems, electrical distribution, and life safety systems. Examples of areas affected by those facility conditions include research to enable next generation optical atomic clocks for improved timekeeping, advanced spectroscopies for non-invasive medical diagnostics and chemical detection, and development of "NIST-on-a-chip" technologies to bring ultraprecise NIST measurements into end user applications. Failures and poor performance of the building infrastructure severely impact this research in these critical technologies. Much of the research currently housed in Wing 5 is not scheduled to relocate to the PML. Therefore, renovation of Wing 5 is crucial to the science described above. The Building 1 Renovation will provide the necessary infrastructure and environmental performance necessary to sustain these services in Building 1. Finally, the identified renovations will reduce the backlog of maintenance, repair and replacement issues identified in the 2008 Boulder Facility Condition Assessment by an estimated $15.3 million or almost 60 percent for Building 1.

Base Resources Assessment

There are no base resources associated with the Construction and Major Renovations program. Funding is requested each year for useable segments of the renovation or construction project.

Schedule and Milestones:

- FY 2014 – Award the next phase of renovation at Building 1, for the first phase of the interior and exterior renovation of Building 1, Wing 5.

Deliverables:

- FY 2014 – Award a construction contract for the first phase of interior and exterior renovations at Building 1, Wing 5 and begin construction.

Performance Goals and Measurement Data:

Performance Goal: Percent of Renovations Complete	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target	FY 2018 Target
With Increase	100% completion of exterior renovations of Wings 3 and 6, and the limited exterior renovations at the Center Spine; 80% completion of the interior renovation of Wing 3; 60% completion of the interior renovation of Wing 6; 5% completion of the first phase of exterior and interior renovation of Wing 5	100% completion of the interior renovation of Wing 3; 100% completion of the interior renovation Wing 6; 60% of the first phase interior and exterior renovation of Wing 5; 5% of the second phase interior and exterior renovation of Wing 5	100% completion of the first phase interior and exterior renovation of Wing 5; 60% of the second phase interior and exterior renovation of Wing 5; 5% of the third phase interior and exterior renovation of Wing 5	N/A	N/A

Performance Goal: Percent of Renovations Complete	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target	FY 2018 Target
Without Increase	100% completion of exterior renovations of Wings 3 and 6, and the limited exterior renovations at the Center Spine; 80% completion of the interior renovation of Wing 3; 60% completion of the interior renovation of Wing 6	100% completion of the interior renovation of Wing 3; 100% completion of the interior renovation of Wing 6	N/A	N/A	N/A
Description: With funding received in FY 2014, NIST can complete portions of the renovations to Building 1. Building 1 Renovations are planned as severable phases to the multi-wing building.					

Multi-Year Budget Information ($ in thousands)

Major Cost Categories	FY 2013 and Prior	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018
Building 1 Renovation Design and Renovation of Building 3	12,000					
Exterior Renovations	14,876					
Wing 3 Interior Renovation	11,000					
Wing 6 Interior Renovation	11,800					
Wing 5 Interior and Exterior Renovation	0	11,800	11,000	9,800		
*Total:	49,676	11,800	11,000	9,800		
FTE's (Initiative)		0	0	0		

* *The remaining wing renovations will be completed with future funding requests.*

PROGRAM CHANGE PERSONNEL DETAIL
(Dollar amounts in thousands)

Budget Program: Construction and Major Renovations
Sub-program: Construction and Major Renovations
Program Change: Building 1 Renovation Increase

Existing staff will be used to manage the Building 1 Renovation project and therefore no new FTE are required for this initiative.

PROGRAM CHANGE DETAIL BY OBJECT CLASS
(Dollar amounts in thousands)

Budget Program: Construction and Major Renovations
Sub-program: Construction and Major Renovations
Program Change: Building 1 Renovation Increase

	Object Class	2014 Increase
11	Personnel compensation	
11.1	Full-time permanent	0
11.3	Other than full-time permanent	0
11.5	Other personnel compensation	0
11.8	Special personnel services payments	0
11.9	Total personnel compensation	0
12	Civilian personnel benefits	0
13	Benefits for former personnel	0
21	Travel and transportation of persons	0
22	Transportation of things	0
23.1	Rental payments to GSA	0
23.2	Rental Payments to others	0
23.3	Communications, utilities and miscellaneous charges	0
24	Printing and reproduction	0
25.1	Advisory and assistance services	0
25.2	Other services	0
25.3	Purchases of goods & services from Gov't accounts	0
25.4	Operation and maintenance of facilities	0
25.5	Research and development contracts	0
25.6	Medical care	0
25.7	Operation and maintenance of equipment	0
25.8	Subsistence and support of persons	0
26	Supplies and materials	0
31	Equipment	0
32	Lands and structures	$11,800
33	Investments and loans	0
41	Grants, subsidies and contributions	0
42	Insurance claims and indemnities	0
43	Interest and dividends	0
44	Refunds	0
99	Total obligations	11,800

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Object Class

Exhibit 16

Department of Commerce
National Institute of Standards and Technology
Construction of Research Facilities
SUMMARY OF REQUIREMENTS BY OBJECT CLASS

	Object Class	2012 Actual	2013 CR (annualized)	2014 Base	2014 Estimate	Increase/ (Decrease) Over 2014 Base
11	Personnel compensation					
11.1	Full-time permanent	$7,776	$7,798	$7,837	$7,837	0
11.3	Other than full-time permanent	37	37	37	37	0
11.5	Other personnel compensation	844	844	844	844	0
11.9	Total personnel compensation	8,657	8,679	8,718	8,718	0
12.1	Civilian personnel benefits	2,438	2,490	2,541	2,541	0
13	Benefits for former personnel	0	0	0	0	0
21	Travel and transportation of persons	26	29	29	48	19
22	Transportation of things	16	16	16	17	1
23.1	Rental payments to GSA	0	0	0	0	0
23.2	Rental payments to others	0	0	0	0	0
23.3	Communications, utilities, and miscellaneous charges	165	165	165	646	481
24	Printing and reproduction	13	13	13	15	2
25.1	Advisory and assistance services	0	0	0	0	0
25.2	Other services	17,469	48,410	29,619	33,141	3,522
25.3	Purchases of goods and services from government accounts	49	51	51	124	73
25.5	Research and development contracts	0	0	0	0	0
25.7	Operation and maintenance of equipment	1,057	1,063	1,063	1,117	54
26	Supplies and materials	1,528	1,541	1,541	1,593	52
31	Equipment	254	254	254	280	26
32	Land and structures	2,996	27,931	11,800	11,800	0
41	Grants, subsidies, and contributions	0	519	0	0	0
43	Interest and dividends	0	0	0	0	0
99	Total Obligations	34,668	91,161	55,810	60,040	4,230

	Object Class	2012 Actual	2013 CR (annualized)	2014 Base	2014 Estimate	Increase/ (Decrease) Over 2014 Base
99	Total Obligations	34,668	91,161	55,810	60,040	4,230
	Less Prior Year Recoveries	(406)	(1,000)	0	0	0
	Less Prior Year Refunds	0	0	0	0	0
	Less Prior Year Unobligated Balance	(13,322)	(34,441)	0	0	0
	Plus Unobligated Balance End of Year	34,441	0	0	0	0
	Total Budget Authority	55,381	55,720	55,810	60,040	4,230
	Plus Transfers from Other Accounts	0	0	0	0	0
	Appropriation	55,381	55,720	55,810	60,040	4,230
	Personnel Data					
	Full-time equivalent employment:					
	Full-time permanent	89	89	89	89	0
	Other than full-time permanent	0	0	0	0	0
	Total	89	89	89	89	0
	Authorized Positions:					
	Full-time permanent	118	89	89	89	0
	Other than full-time permanent	0	0	0	0	0
	Total	118	89	89	89	0

Exhibit 23

Department of Commerce
National Institute of Standards and Technology
Construction of Research Facilities
SUMMARY OF INFORMATION TECHNOLOGY RESOURCES
(Dollar amounts in thousands)
(Budget Authority)

IT Projects by Activity/Subactivity: (Totals by Activity)	Unique Invetsment Identifier	IT Investment Title	2012 Actual	2013 CR (Annualized)	2014 Estimate	Increase/ Decrease
Construction and Major Renovations			0	0	0	0
Total			0	0	0	0

Department of Commerce
National Institute of Standards and Technology
Construction of Research Facilities
APPROPRIATION LANGUAGE AND CODE CITATIONS

1. For construction of new research facilities, including architectural and engineering design, and for renovation and maintenance of existing facilities, not otherwise provided for the National Institute of Standards and Technology, as authorized by 15 U.S.C. 278c-278e.

   15 U.S.C. 278c authorizes that the Secretary of Commerce to acquire land for such field sites as are necessary for the proper and efficient conduct of the activities authorized.

   15 U.S.C. 278d authorizes that the Secretary of Commerce to undertake such construction of buildings and other facilities and to make such improvements to existing buildings, grounds, and other facilities as are necessary for the proper and efficient conduct of authorized activities.

   15 U.S.C. 278e provides that in the performance of the functions of the National Institute of Standards and Technology the Secretary of Commerce is authorized to undertake: the care, maintenance, protection, repair, and alteration of Institute buildings and other plant facilities, equipment, and property.

2. $60,040,000 to remain available until expended.

3. Public Law 110-69, America Competes Act, 121 Stat 572, passed August 9, 2007 reauthorizes the Construction of Research Facilities appropriation through 2010. It also provided for the Retention of Fees to the Construction of Research Facilities account. "The Director is authorized to retain all building use and depreciation surcharge fees collected pursuant to OMB Circular A-25. Such fees shall be collected and credited to the Construction of Research Facilities Appropriation Account for use in maintenance and repair of the Institute's existing facilities". Public Law 111-358, America Competes Reauthorization Act, 2010, 124 Stat 3982, passed January 4, 2011 reauthorized the Construction of Research Facilities appropriation through 2013.

4. Public Law 111-5, American Recovery and Reinvestment Act of 2009 appropriated $360,000,000 to the Construction of Research Facilities appropriation from FY 2009 to FY 2010.


Working
Capital Fund

Exhibit 5

Department of Commerce
National Institute of Standards and Technology
Working Capital Fund
SUMMARY OF RESOURCE REQUIREMENTS
(Dollar amounts in thousands)

	Positions	FTE	Budget Authority	Obligations
2013 CR (annualized)	682	756	0	0
Reduction in transfers from prior STRS program changes	0	0	0	0
2014 Base	682	756	0	0
Transfer from STRS program changes for equipment investments	0	0	$1,500	$1,500
2014 Estimate	682	756	1,500	1,500

Exhibit 7

Department of Commerce
National Institute of Standards and Technology
Working Capital Fund
SUMMARY OF FINANCING
(Dollar amounts in thousands)

	2012 Actual	2013 CR (annualized)	2014 Base	2014 Estimate	Increase/ (Decrease) Over 2014 Base
Total Obligations	$170,802	$189,864	$150,014	$151,514	$1,500
Offsetting collections from:					
Federal funds	(121,245)	(120,631)	(102,438)	(102,438)	0
Non-Federal sources	(51,305)	(49,694)	(47,576)	(47,576)	0
Total offsetting collections	(172,550)	(170,325)	(150,014)	(150,014)	0
Unobligated balance, start of year	(125,879)	(135,484)	(115,945)	(115,945)	0
Unobligated balance, end of year	135,484	115,945	115,945	115,945	0
Change in uncollected customer payments - Federal	(6,162)	0	0	0	0
Budget Authority	1,695	0	0	1,500	1,500
Financing:					
Transfer from other accounts	(1,695)		0	(1,500)	(1,500)
Appropriation	0	0	0	0	0

Program and
Performance

Department of Commerce
National Institute of Standards and Technology
Working Capital Fund

This Working Capital Fund (WCF) reflects the full-time equivalent (FTE) employment and reimbursable obligations associated with the reimbursable work performed by NIST for other agencies and the public, and WCF investments. NIST's reimbursable services consist of technical work performed for other Federal agencies, state and local governments, and the private sector, including calibrations and special tests, advisory services, the sale of Standard Reference Materials (SRMs) and Baldrige Performance Excellence Program (BPEP) fees. The unique measurement and standards expertise developed with appropriated funding gives NIST the capability to perform these services on a reimbursable basis. NIST accepts other agency work based on an established set of criteria which include: (1) the need for traceability of measurements to national standards; (2) the need for work which cannot or will not be addressed by the private sector; (3) work supported by legislation that authorizes or mandates certain services; (4) work which would result in an unavoidable conflict of interest if carried out by the private sector or regulatory agencies; and (5) requests by the private sector for NIST action or services.

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Object Class

Exhibit 16

Department of Commerce
National Institute of Standards and Technology
Working Capital Fund
SUMMARY OF REQUIREMENTS BY OBJECT CLASS
(Dollar amounts in thousands)

	Object Class	2012 Actual	2013 CR (annualized)	2014 Base	2014 Estimate	Increase/ (Decrease) Over 2014 Base
11	Personnel compensation					
11.1	Full-time permanent	0	0	0	0	0
11.3	Other than full-time permanent	0	0	0	0	0
11.5	Other personnel compensation	0	0	0	0	0
11.9	Total personnel compensation	0	0	0	0	0
12.1	Civilian personnel benefits	0	0	0	0	0
13	Benefits for former personnel	0	0	0	0	0
21	Travel and transportation of persons	0	0	0	0	0
22	Transportation of things	0	0	0	0	0
23.1	Rental payments to GSA	0	0	0	0	0
23.2	Rental payments to others	0	0	0	0	0
23.3	Communications, utilities, and miscellaneous charges	0	0	0	0	0
24	Printing and reproduction	0	0	0	0	0
25.1	Advisory and assistance services	0	0	0	0	0
25.2	Other services	0	0	0	0	0
25.3	Purchases of goods and services from Government accounts	0	0	0	0	0
25.5	Research and development contracts	0	0	0	0	0
25.7	Operation and maintenance of equipment	0	0	0	0	0
26	Supplies and materials	$160	0	0	0	0
31	Equipment	1,535	0	0	$1,500	1,500
32	Land and structures	0	0	0	0	0
41	Grants, subsidies, and contributions	0	0	0	0	0
99	Total Obligations	1,695	0	0	1,500	1,500

Personnel Data	2012 Actual	2013 CR (annualized)	2014 Base	2014 Estimate	Increase/ (Decrease) Over 2014 Base
Full-time equivalent employment:					
Full-time permanent	715	706	706	706	0
Other than full-time permanent	50	50	50	50	0
Total	765	756	756	756	0
Authorized Positions:					
Full-time permanent	661	652	652	652	0
Other than full-time permanent	30	30	30	30	0
Total	691	682	682	682	0

Exhibit 23

Department of Commerce
National Institute of Standards and Technology
NIST Working Capital Fund
SUMMARY OF INFORMATION TECHNOLOGY RESOURCES
(Dollar amounts in thousands)
(Budget Authority)

IT Projects by Activity/Subactivity: (Totals by Activity)	Unique Investment Identifier	IT Investment Title	2012 Actual	2013 CR (Annualized)	2014 Estimate	Increase/ Decrease
NIST Working Capital Fund						
	006-000701100	NIST Administrative Support	$4,366	$4,900	$4,942	$42
	006-000704500	NIST Central IT Support for Science	5,265	5,287	5,331	44
	006-000702100	NIST Laboratories	3,904	3,917	4,013	96
	006-000702200	IT Infrastructure and Office Automation	27,047	26,597	26,825	228
	006-000702500	NIST IT Security Planning	3,619	3,632	3,665	33
	006-000702300	Enterprise Architecture & Planning	946	949	957	8
	006-000708000	Grants Management Information System	375	230	235	5
Total			45,522	45,512	45,968	456

Exhibit 34

Department of Commerce
National Institute of Standards and Technology
Working Capital Fund
ADVISORY AND ASSISTANCE SERVICES
(Obligations in thousands of dollars)

	FY 2012 Actual	FY 2013 Estimate	FY 2014 Estimate
Management and professional support services	$440	$24	$112
Studies, analyses, and evaluations	69	0	0
Engineering and technical services	0	0	0
Total	509	24	112

Significant Activities

Advisory and assistance services funded by the Working Capital Fund represent services funded by reimbursable funds in support of reimbursable work conducted at NIST.

Need for Advisory and Assistance Services

Advisory and Assistance services have been necessary to obtain additional expertise for conducting activities like the technical evaluation of the World Trade Center collapses, for example.

Wireless
Innovation Fund

MANDATORY ACCOUNT: WIRELESS INNOVATION (WIN) FUND

BUDGET ACTIVITY: WIRELESS INNOVATION (WIN) FUND

As part of the Middle Class Tax Relief and Job Creation Act of 2012, NIST received $100 million to conduct public safety research and development as part of a Wireless Innovation (WIN) Fund. The WIN Fund will initially provide $100 million from spectrum auction proceeds to help industry and public safety organizations conduct research and develop new standards, technologies and applications to advance public safety communications in support of the initiative's efforts to build an interoperable nationwide broadband network for first responders. Obligations for this program will not occur until well after FY 2014.

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National Network for
Manufacturing Innovation

Exhibit 5

Department of Commerce
National Institute of Standards and Technology
National Network for Manufacturing Innovation
SUMMARY OF RESOURCE REQUIREMENTS - MANDATORY APPROPRIATION
(Dollar amounts in thousands)

	Positions	FTE	Budget Authority	Direct Obligations	Appro-priation
2013 CR (annualized)	0	0	0	0	0
2014 Adjustments to base					
less: Unobligated balance end of year			0	0	0
2014 Base Request	0	0	0	0	0
plus: 2014 Program Change	25	19	1,000,000	147,640	1,000,000
2014 Estimate	25	19	1,000,000	147,640	1,000,000

		2012 Actual		2013 CR (annualized)		2014 Base		2014 Estimate		Increase/ (Decrease) Over 2014 Base	
Comparison by program/sub-program:		Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount
National Network for Manufacturing Innovation											
National Network for Manufacturing	Pos/Approp	0	0	0	$0	0	0	25	1,000,000	25	1,000,000
Innovation	FTE/Obl.	0	0	0	0	0	$0	19	$147,640	19	147,640
Total: National Network for Manufacturing	Pos/Approp	0	0	0	0	0	0	25	1,000,000	25	1,000,000
Innovation	FTE/Obl.	0	0	0	0	0	0	19	147,640	19	147,640
Adjustments for:											
Unobligated balance, end of year			0		0		0		852,360 [1/]		852,360
Appropriation/BA - Mandatory Account			0		0		0		1,000,000		1,000,000

[1/] The FY 2014 unobligated balance of $852,360 thousand will obligate over several fiscal years.

Exhibit 7

Department of Commerce
National Institute of Standards and Technology
National Network for Manufacturing Innovation
SUMMARY OF FINANCING - MANDATORY APPROPRIATION
(Dollar amounts in thousands)

	2012 Actual	2013 CR (annualized)	2014 Base	2014 Estimate	Increase/ (Decrease) Over 2014 Base
Total Obligations	0	0	0	$147,640	147,640
Adjustments for:					
Unobligated balance, end of year	0	0	0	852,360 [1/]	852,360
Appropriation/BA - Mandatory Account	0	0	0	1,000,000	1,000,000

[1/] The FY 2014 unobligated balance of $852,360 thousand will obligate over several fiscal years.

Program and
Performance

Department of Commerce
National Institute of Standards and Technology
National Network for Manufacturing Innovation
PROGRAM AND PERFORMANCE: MANDATORY APPROPRIATION
(Dollar amounts in thousands)

Program: National Network for Manufacturing Innovation
Sub-program: National Network for Manufacturing Innovation

Program Activity		2012 Actual		2013 CR (annualized)		2014 Base		2014 Estimate		(Increase/ Decrease) Over 2014 Base	
		Personnel	Amount	Personnel	Amount	Personnel	Amount	Personnel	Amount	Personnel	Amount
National Network for Manufacturing Innovation	Pos/Approp	0	0	0	$0	0	0	25	1,000,000	25	1,000,000
	FTE/Obl.	0	0	0	0	0	$0	19	$147,640	19	147,640
Total	Pos/Approp	0	0	0	0	0	0	25	1,000,000	25	1,000,000
	FTE/Obl.	0	0	0	0 [2/]	0	0	19	147,640	19	147,640

[2/] The FY 2014 unobligated balance of $852,360 thousand will obligate over several fiscal years.

MANDATORY APPROPRIATIONS ACCOUNT: NATIONAL NETWORK FOR MANUFACTURING INNOVATION (NNMI)

BUDGET PROGRAM: National Network for Manufacturing Innovation (NNMI)

As part of the Administration's efforts to revitalize U.S. manufacturing, the Budget proposes a one-time $1 billion investment to establish a National Network for Manufacturing Innovation (NNMI), a network of up to 15 institutes where researchers, companies, and entrepreneurs can come together to develop new manufacturing technologies with broad applications, nurturing innovation and accelerating commercialization.

Each institute would be industry-led, have a unique technology focus, and would leverage ecosystems of manufacturing activity in local and regional communities. The institutes would support manufacturing technology commercialization and productivity by creating a shared "industrial commons" bridging the gap from R&D to product development and manufacturing here in the U.S. A network leadership council will disseminate best practices and facilitate collaboration among the institutes. Program coordination will be led by a NIST-hosted, inter-agency Advanced Manufacturing National Program Office. The program is designed to support institutes that would be financially self-sustaining after a period of initial Federal co-investment.

A more detailed description of the NNMI's goals and objectives is available in the National Science and Technology Council (NSTC) January 2013 report, "National Network for Manufacturing Innovation: A Preliminary Design."

BASE JUSTIFICATION FOR FY 2014:

The NNMI is a new program and no base funding exists.

PROGRAM CHANGES FOR FY 2014:

National Network for Manufacturing Innovation (NNMI) (Base Funding: $0 million and 0 FTE; Program Change: + $ 1.0 billion and +19 FTE):

The FY 2014 President's Budget includes an increase of $1.0 billion in mandatory appropriations to strengthen the U.S. manufacturing sector through collaborative investments in a network of manufacturing innovation institutes to address industrially-relevant manufacturing challenges with broad applications and mature emerging technologies and their manufacturing readiness.

Proposed Actions:

This initiative would create a National Network for Manufacturing Innovation (NNMI) that will:

- Induce industry and non-federal co-investment to rapidly seize innovation opportunities that lead to industrial capabilities, bridging the gap between fundamental technical discoveries in the U.S. and manufactured products.

- Promote direct collaboration on industry-relevant research and development to address emerging technology areas where market failures are causing U.S. innovations to be scaled and manufactured elsewhere.

- Facilitate the adoption of new manufacturing technologies, tools, and methodologies that will make U.S. manufacturers more competitive, especially recognizing the role of small and medium manufacturers in supply chains and innovation.

- Build workforce skills and enhance education needed in advanced manufacturing.

- Support identification and diffusion of "best practice" approaches to governance structure, IP management, partnering, facilities access, etc.

Statement of Need and Economic Benefits:

U.S. competitive advantage in manufacturing requires continual innovation – a regular refreshing of the industrial knowledge base, capital stock, and daily practices of organizations and workers. Manufacturers who are not innovating with new processes, materials and technologies for new and improved products risk commoditization - which can quickly migrate to low-cost locations in the global economy. Advanced manufacturing capabilities based on continual innovation are much more difficult to move overseas or replicate. However, even these capabilities are increasingly dispersed and mobile globally, requiring even greater emphasis on speed and novelty, that is, innovation acceleration. Innovation is unpredictable and risky yet essential to the creation of new and improved products to remain globally competitive.

Innovation system gaps lead to market failures and these failures are magnified in advanced manufacturing. U.S. manufacturers individually are challenged to fund these technology development functions, and small- and medium-manufacturers especially struggle with individually investing in prototyping and scale up of new technologies and potential products. This initiative would help provide the critical mass and knowledge base necessary to address these challenges.

Partnerships that bring diverse organizations together to accelerate innovation for advanced manufacturing create a stronger innovation system and link those innovations more directly to domestic production capabilities. This proposal builds on the success of models deployed in other countries.

PROGRAM CHANGE PERSONNEL DETAIL
(Dollar amounts in thousands)

Program: National Network for Manufacturing Innovation
Sub-program: National Network for Manufacturing Innovation
Program Change: National Network for Manufacturing Innovation

Title:	Location	Grade	Number of Positions	Annual Salary	Total Salaries
Project manager	Gaithersburg	ZP V	1	124,377	$124,377
Grant specialist	Gaithersburg	ZP IV	19	105,737	2,009,003
Program lead	Gaithersburg	ZP IV	1	105,737	105,737
Secretary	Gaithersburg	ZA III	2	75,246	150,492
Administrative/technical support	Gaithersburg	ZA II	2	51,888	103,776
Total			25	462,985	2,493,385
Less Lapse		25%	(6)		(623,346)
Total full-time permanent (FTE)			19		1,870,039
2014 Pay Adjustment (1%)					18,700
TOTAL					1,888,739

Personnel Data	Number
Full-Time Equivalent Employment	
Full-time permanent	19
Other than full-time permanent	0
Total	19
Authorized Positions:	
Full-time permanent	25
Other than full-time permanent	0
Total	25

PROGRAM CHANGE DETAIL BY OBJECT CLASS
(Dollar amounts in thousands)

Program: National Network for Manufacturing Innovation
Sub-program: National Network for Manufacturing Innovation
Program Change: National Network for Manufacturing Innovation

	Object Class	2014 Increase
11	Personnel compensation	
11.1	Full-time permanent	$1,889
11.3	Other than full-time permanent	0
11.5	Other personnel compensation	0
11.8	Special personnel services payments	0
11.9	Total personnel compensation	1,889
12	Civilian personnel benefits	588
13	Benefits for former personnel	0
21	Travel and transportation of persons	93
22	Transportation of things	18
23.1	Rental payments to GSA	0
23.2	Rental Payments to others	0
23.3	Communications, utilities and miscellaneous charges	1,086
24	Printing and reproduction	8
25.1	Advisory and assistance services	1,400
25.2	Other services	1,954
25.3	Purchases of goods & services from Gov't accounts	1,566
25.4	Operation and maintenance of facilities	0
25.5	Research and development contracts	0
25.6	Medical care	0
25.7	Operation and maintenance of equipment	122
25.8	Subsistence and support of persons	0
26	Supplies and materials	155
31	Equipment	173
32	Lands and structures	0
33	Investments and loans	0
41	Grants, subsidies and contributions	138,588
42	Insurance claims and indemnities	0
43	Interest and dividends	0
44	Refunds	0
99	Total obligations	147,640

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Object Class

Exhibit 16

Department of Commerce
National Institute of Standards and Technology
National Network for Manufacturing Innovation
SUMMARY OF REQUIREMENTS BY OBJECT CLASS - MANDATORY APPROPRIATION

	Object Class	2012 Actual	2013 CR (annualized)	2014 Base	2014 Estimate	Increase/ (Decrease) Over 2014 Base
11	Personnel compensation					
11.1	Full-time permanent	0	0	0	$1,889	1,889
11.3	Other than full-time permanent	0	0	0	0	0
11.5	Other personnel compensation	0	0	0	0	0
11.9	Total personnel compensation	0	0	0	1,889	1,889
12.1	Civilian personnel benefits	0	0	0	588	588
13	Benefits for former personnel	0	0	0	0	0
21	Travel and transportation of persons	0	0	0	93	93
22	Transportation of things	0	0	0	18	18
23.1	Rental payments to GSA	0	0	0	0	0
23.2	Rental payments to others	0	0	0	0	0
23.3	Communications, utilities, and miscellaneous charges	0	0	0	1,086	1,086
24	Printing and reproduction	0	0	0	8	8
25.1	Advisory and assistance services	0	0	0	1,400	1,400
25.2	Other services	0	0	0	1,954	1,954
25.3	Purchases of goods and services from government accounts	0	0	0	1,566	1,566
25.5	Research and development contracts	0	0	0	0	0
25.7	Operation and maintenance of equipment	0	0	0	122	122
26	Supplies and materials	0	0	0	155	155
31	Equipment	0	0	0	173	173
32	Land and structures	0	0	0	0	0
41	Grants, subsidies, and contributions	0	0	0	138,588	138,588
42	Insurance claims and indemnities	0	0	0	0	0
99	Total Obligations	0	0	0	147,640	147,640

	Object Class	2012 Actual	2013 CR (annualized)	2014 Base	2014 Estimate	Increase/ (Decrease) Over 2014 Base
99	Total Obligations	0	0	0	147,640	147,640
	Unobligated balance, start of year	0	0		0	0
	Unobligated balance, end of year	0			852,360	852,360
	Appropriation/Budget Authority - Mandatory Account	0	0	0	1,000,000	1,000,000
	Personnel Data					
	Full-time equivalent employment:					
	Full-time permanent	0	0	0	19	19
	Other than full-time permanent	0	0	0	0	0
	Total	0	0	0	19	19
	Authorized Positions:					
	Full-time permanent	0	0	0	25	25
	Other than full-time permanent	0	0	0	0	0
	Total	0	0	0	25	25

Note: NNMI Appropriation/Budget Authority of $1.0 billion will obligate over several fiscal years.

Department of Commerce
National Institute of Standards and Technology
National Network for Manufacturing Innovation
APPROPRIATION LANGUAGE AND CODE CITATIONS

1. For necessary expenses of the National Institute of Standards and Technology,

   15 U.S.C. 272; 273; 278b-j; p

   15 U.S.C. 272; 273; 278b-j; p provides basic authority for the performance of the functions and activities of the National Institute of Standards and Technology, authorizes appropriations for these purposes to be provided to the general public and specific institutions, governments, firms, and individuals, and requires the notification of Congress of a reprogramming of funds that exceeds a limit specified in public law.

2. $1,000,000,000, no specific authority, mandatory

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Summary of National Institute of Standards and Technology (NIST)

The operations of the NIST Working Capital Fund are reported in a program and financing schedule printed in the President's Budget, as well as reflected in the reimbursable amounts throughout this budget. The fund finances the initial costs of work performed by NIST and is reimbursed by applicable appropriations and advances or reimbursements from other agencies. A detailed cost accounting system is used to ensure that the actual cost of work performed for each job or task is recorded and identified with the appropriate source of financing. In addition to its function as a revolving fund, the Working Capital Fund is also used to handle annual and sick leave on an accrued basis, to acquire equipment as an investment to be recovered through amortization charges to programs, to distribute indirect costs to programs as overhead, to carry the recoverable costs associated with the production of Standard Reference Materials, and to carry supply inventories until issued for program use.

The table below summarizes the total NIST program, according to the source of financing. Following this table is a summary of the NIST reimbursable program by sponsor and source of support.

Summary of Total NIST Discretionary Program

(Obligations in thousands)

	FY 2012			FY 2013 CR (annualized)			FY 2014			
Source and Use of Funds Spent	Perm. Pos. [1]	FTE	Oblig.	Perm. Pos. [1/]	FTE	Oblig.	Perm. Pos. [1/]	FTE	Oblig.	Approp. Requested
Direct Funding										
Discretionary										
Scientific and technical research and services	2,203	2,042	$575,059	2,203	2,202	$599,160	2,421	2,362	$698,995	$693,745
Industrial technology services	130	127	135,489	84	94	138,342	91	94	174,507	174,507
Construction of research facilities	118	89	34,668	89	89	91,161	89	89	60,040	60,040
Gifts and bequests	0	0	3,316	0	0	4,407 [3/]	0	0	4,844 [3/]	0
Mandatory										
National Network for Manufacturing Innovation	0	0	0	0	0	0	25	19	147,640 [4/]	1,000,000
Total, direct funding	2,451	2,258	748,532	2,376	2,385	833,070	2,626	2,564	1,086,026	1,928,292
Reimbursable Funding and WCF Investments										
Construction of research facilities - building surcharge	0	0	930	0	0	1,171	0	0	0	
Research, development and supporting services:										
Federal government	453	470	113,581	449	497	120,631	449	497	102,438	
Calibrations and tests, technical and advisory services:										
Federal government	33	34	9,244	32	36	7,854	32	36	7,454	
Public and non-federal government	96	99	27,071	95	105	23,000	95	105	21,829	
Subtotal, Services	129	133	36,315	127	141	30,854	127	141	29,283	
National Voluntary Laboratory Accreditation Program	27	28	7,331	26	29	4,554	26	29	3,854	
Standard reference materials (SRMs):										
SRM Sales:										
Federal government	1	2	291	1	2	254	1	2	258	
Public and non-federal government	81	82	15,985	79	87	14,032	79	87	14,181	
Subtotal, SRM sales	82	84	16,276	80	89	14,286	80	89	14,439	
SRM investment adjustment	0	0	1,066	0	0	0	0	0	0	
Subtotal, SRM	82	84	17,342	80	89	14,286	80	89	14,439	
Total, Reimbursable program	691	715	175,499 [2/]	682	756	171,496 [2/]	682	756	150,014	
WCF Investments and Operating Adjustments										
WCF investments	0	0	16,832	0	0	29,834	0	0	16,034	
WCF transfers	0	0	1,695	0	0	0	0	0	1,500	
WCF operating adjustments	0	0	474	0	0	0	0	0	0	
Total, WCF Investments and operating adjustments	0	0	19,001	0	0	29,834	0	0	17,534	
Total, NIST program	3,142	2,973	943,032	3,058	3,141	1,034,400	3,308	3,320	1,253,574	
Offsetting adjustment for amortization of equipment	0	0	(22,768)	0	0	(10,295)	0	0	(16,034)	
Adjusted total, NIST program	3,142	2,973	920,264	3,058	3,141	1,024,105	3,308	3,320	1,237,540	

[1/] Most NIST scientists and engineers are not engaged solely on one research project. Individuals may divide their time between two or more projects financed by different sources of support. Also, salary costs of many staff members are charged to an overhead account and subsequently prorated to all directly funded projects. For these reasons, it is not possible to report employment directly for any source of financing. The Permanent Positions above are statistically-derived numbers, based on the estimated work years distribution for NIST programs.

[2/] Total reimbursable numbers are different from the next page due to inclusion of CRF reimbursable obligations in FACTS II.

[3/] Estimate support from Foundation for the Malcolm Baldrige National Quality Award, Inc. to Baldrige Performance Excellence Program.

[4/] Of the $1,000 million NNMI, only $147.6 million will obligate in FY 2014.

Department of Commerce

National Institute of Standards and Technology

REIMBURSABLE PROGRAM AND WORKING CAPITAL FUND INVESTMENTS

(Dollar amounts in thousands)

	FY 2012 Actual	FY 2013 CR (annualized)	FY 2014 Estimate
Department of Defense			
Air Force	$12,008	$11,066	$10,791
Army	3,126	2,055	1,788
Navy	1,527	3,202	1,419
Other, Department of Defense	14,410	17,554	15,721
Subtotal, Department of Defense	31,071	33,877	29,719
Department of Agriculture	63	60	60
Department of Commerce	17,311	19,077	18,341
Department of Energy	8,174	10,986	5,811
Dept. of Health & Human Services	4,377	4,556	4,529
Dept. of Homeland Security	24,981	23,363	17,755
Department of the Interior	26	20	20
Department of Justice	11,435	11,191	9,210
Department of Transportation	314	790	360
Environmental Protection Agency	250	200	100
General Services Administration	97	111	111
National Aeronautics & Space Admin.	3,866	3,986	4,468
National Science Foundation	2,542	3,973	4,242
Nuclear Regulatory Commission	826	1,886	1,500
Other	8,248	6,555	6,212
Subtotal, Other Agency	113,581	120,631	102,438
Calibrations & Testing	9,235	8,161	8,294
Technical & Advisory Services	34,411	27,247	24,843
Standard Reference Materials	17,342	14,286	14,439
Subtotal, Other Reimbursables	60,988	49,694	47,576
Total, Reimbursable Program	174,569	170,325	150,014
Equipment Transfers	1,695	0	1,500
Equipment Investments	16,832	29,834	16,034
IE Amortization	(22,768)	(10,295)	(16,034)
Excess Amortizations over Equipment Investments	4,242	0	0
WCF Operating Adjustments	(3,768)	0	0
Total, WCF Investments	(5,462)	19,539	0
Total, Reimbursable Program and WCF Investments	170,802	189,864	151,514

Department of Commerce
National Institute of Standards and Technology
PERIODICALS, PAMPHLETS, AND AUDIOVISUAL SERVICES
(Obligations in thousands)

	2011 Actual	2012 Actual	2013 Estimate	2014 Estimate
Periodicals	$15	$3	$0	$0
Pamphlets	20	19	20	20
Audiovisuals	6	13	14	14
Total	41	35	34	34

NIST produces one periodical a year, *The Journal of Research of the National Institute of Standards and Technology.* The final paper production was issued in January 2012 and the periodical is now issued electronically. The Journal of Research of NIST reports NIST research and development in metrology and related fields of: physical science, engineering, applied mathematics, statistics, biotechnology, and information technology.

Exhibit 36

Department of Commerce
National Institute of Standards and Technology
AVERAGE SALARY

	2012 Actual	2013 Estimate	2014 Estimate
Average ES salary	$168,577	$169,420	$171,114
Average scientific and professional	169,777	170,626	172,332
Average Career Path Salary	107,440	107,977	109,056
Average salary of ungraded positions	56,428	56,710	57,277

FY 2013 average salaries reflects the 0.5% payraise and FY 2014 reflects the 1.0% payraise.

National Technical Information
Service

DEPARTMENT OF COMMERCE
NATIONAL TECHNICAL INFORMATION SERVICE
NTIS Revolving Fund
Budget Estimates, Fiscal Year 2014
President's Submission

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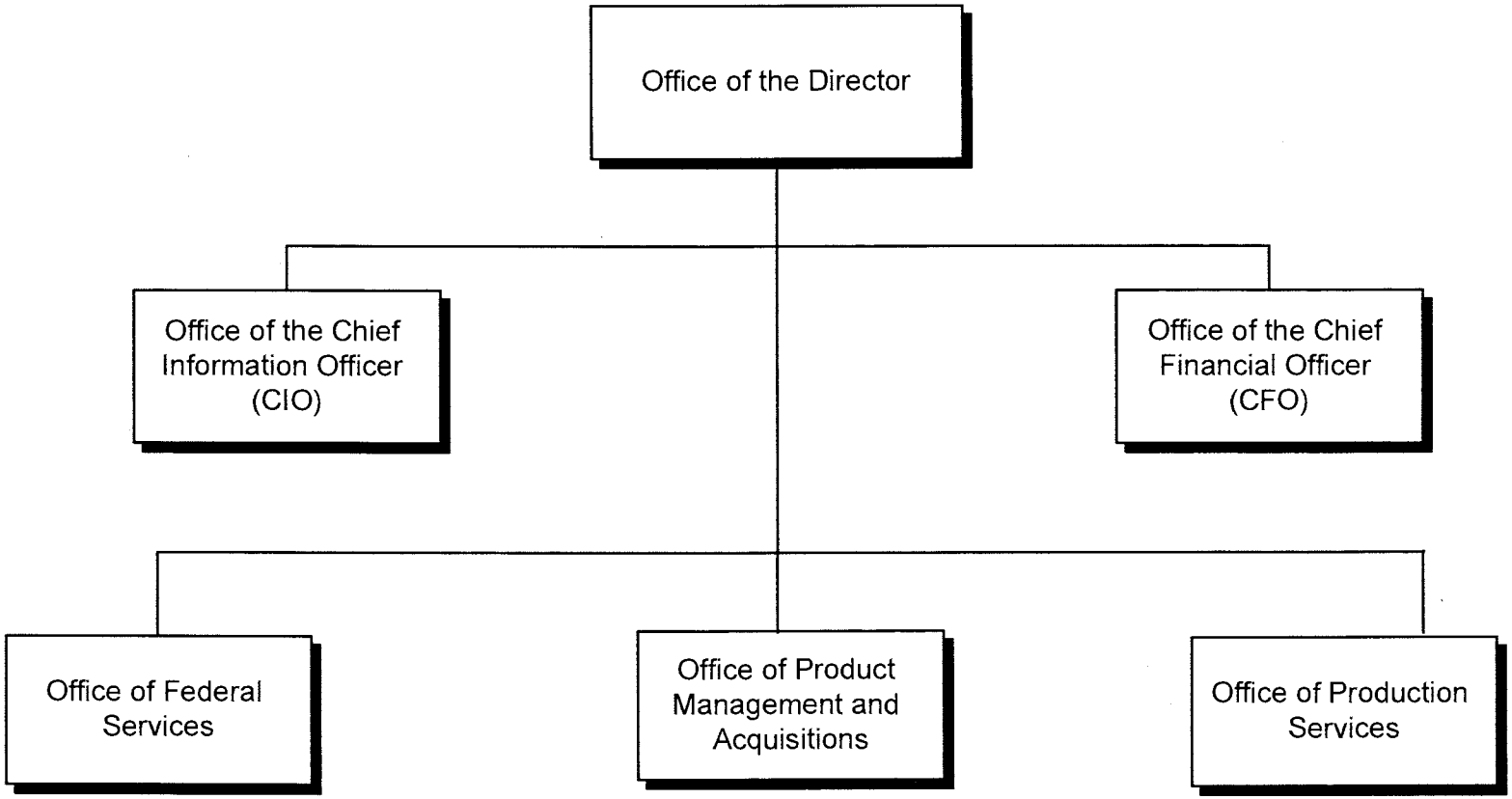
Exhibit 2

U.S. Department of Commerce
National Technical Information Service



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Department Of Commerce
National Technical Information Service
NTIS Revolving Fund
Budget Estimates, Fiscal Year 2014
President's Submission

General Statement

Goals of the Program

The National Technical Information Service (NTIS) seeks to promote innovation and economic growth by (a) collecting, classifying, coordinating, integrating, recording and cataloging scientific and technical information from whatever sources, domestic and foreign, that may be available, (b) disseminating this information to the public, and (c) providing information management services to other Federal agencies that help them interact with and better serve the information needs of their own constituents, and to do all without appropriated funds.

Statement of Objectives

NTIS' principal objective supports the Department's strategic plan to promote U.S. innovation and industrial competitiveness by providing business and industry, academia and the general public easy access to scientific and technical research and to ensure that such research is permanently available to future generations of researchers. To this end, NTIS acquires information products from agencies; abstracts, catalogs and indexes them so that they can easily be identified and merged into NTIS' permanent bibliographic database; and physically stores them or scans them into electronic image for reproduction on demand by customers.

NTIS' objectives are to (a) make it easier for the general public to locate federal technical information electronically; (b) build an array of collaborative working arrangements with private sector partners; (c) help other federal agencies meet their own information management and dissemination requirements; and (d) meet objectives in the most cost effective and efficient manner possible.

NTIS has demonstrated innovative achievements in its information dissemination activities as provided in the National Technical Information Act of 1988, codified in 15 U.S.C. 3704b. This Act directed NTIS to "implement new methods or media for the dissemination of scientific and technical, and engineering information." Supporting this directive, NTIS, as part of its base program and without appropriations, made its bibliographic database since 1990 available on the Internet, making the collection more widely available to the public and allowing customers to download products electronically. During FY 2014 those efforts will continue to be expanded and refined as analysis of the activities warrant. In this continuing effort, NTIS continues to follow all Administration policies restricting access to information that could be used improperly.

Summary of Performance and Resources

NTIS continues to make substantial progress in improving its service to the public. NTIS collects approximately 30,000 scientific and technical reports annually that are added to its permanent

collection. NTIS also makes available to the public another 910,350 items in the form of articles, updates, advisories, etc. that are contained in various subscription products and/or databases it distributes. NTIS' activities and accomplishments continue to support its basic public purpose of serving as a comprehensive point of access and dissemination to federally-funded scientific, technical and related information.

The explosive growth of the Internet has provided NTIS with a unique opportunity to expand its information dissemination activities. Information products are disseminated in a variety of formats, including paper, microfiche, diskettes, audio-visual, CD-ROM, database leases, web site hits and electronic downloads. NTIS estimates it will provide approximately 51.9 million information items to the public in FY 2014.

NTIS plans to obligate $66,500,000 of earned revenue in FY 2014.

(Dollar amounts in thousands)

	2012	2013	2014
National Technical Information Service:			
Reimbursement from offsetting collections:			
Information clearinghouse program	$66,311	$66,000	$66,500
Total, NTIS	$66,311	$66,000	$66,500

Note: Reimbursable Budget Authority, receipt and obligation data are estimates. Actuals will vary depending on products and services sold.

Administrative Savings

The Administration is continuing its pursuit of an aggressive government-wide effort to curb non-essential administrative spending. As a result, the Department of Commerce continues to seek ways to improve the efficiency of programs without reducing their effectiveness. Building on NTIS' administrative savings in FY 2012 ($0.674 million) and planned in FY 2013 ($0.170 million), an additional $0.009 million in savings is targeted for FY 2014 for a total saving in FY 2014 of $0.179 million. For additional information see the Administration Savings section of the Introduction to the Budget in Brief.

Department Of Commerce
National Technical Information Service
NTIS Revolving Fund
SUMMARY OF RESOURCE REQUIREMENTS
(Dollar amounts in thousands)

	Positions	FTE	Budget Authority	Direct Obligations
President's Budget, 2013	0	0	0	0
Plus 2014 Adjustments to Base	0	0	0	0
Less: Obligations from prior years	0	0	0	0
2014 Base Request	0	0	0	0
Plus 2014 program changes	0	0	0	0
2014 Estimate	0	0	0	0

		2012 Actual		2013 Currently Available		2014 Base		2014 Estimate		Increase/ (Decrease) over 2014 Base	
Comparison by Activity:		Personnel	Amount	Personnel	Amount	Personnel	Amount	Personnel	Amount	Personnel	Amount
National Technical Information Service:											
Organization, Preservation and Public	Pos./BA	0	0	0	0	0	0	0	0	0	0
Access to Technical Information	FTE/Obl.	0	0	0	0	0	0	0	0	0	0
TOTALS	Pos./BA	0	0	0	0	0	0	0	0	0	0
	FTE/Obl.	0	0	0	0	0	0	0	0	0	0
Adjustments to Obligations											
Recoveries		0	0	0	0	0	0	0	0	0	0
Unobligated balance, start of year		0	0	0	0	0	0	0	0	0	0
Unobligated balance, end of year		0	0	0	0	0	0	0	0	0	0
Financing from transfers:											
Transfer from other accounts (-)		0	0	0	0	0	0	0	0	0	0
Transfer to other accounts (+)		0	0	0	0	0	0	0	0	0	0
Appropriation		0	0	0	0	0	0	0	0	0	0

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Exhibit 7

Department Of Commerce
National Technical Information Service
NTIS Revolving Fund
SUMMARY OF FINANCING
(Dollar amounts in thousands)

	2012 Actual	2013 Currently Available	2014 Base	2014 Estimate	Increase (Decrease) over 2014 Base
Total Obligations	$66,311	$66,000	$66,500	$66,500	$0
Offsetting collections from:					
Federal funds	(54,770)	(52,200)	(57,200)	(57,200)	0
Trust funds	0	0	0	0	0
Non-Federal sources	(10,586)	(13,800)	(13,800)	(13,800)	0
Recoveries	0	0	0	0	0
Unobligated balance, start of year	(7,407)	(9,327)	(9,327)	(9,327)	0
Unobligated balance transferred	0	0	0	0	0
Unobligated balance, end of year	9,327	9,327	9,327	9,327	0
Budget Authority	0	0	0	0	0
Financing:					
Transferred from other accounts (-)	0	0	0	0	0
Transferred to other accounts (+)	0	0	0	0	0
Appropriation	0	0	0	0	0

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Program and
Performance

Department Of Commerce
National Technical Information Service
NTIS Revolving Fund
JUSTIFICATION OF PROGRAM AND PERFORMANCE

APPROPRIATION ACCOUNT: NTIS Revolving Fund

BUDGET ACTIVITY: Organization, Preservation and Public Access to Technical Information

For FY 2014, the National Technical Information Service plans to continue to operate on a self-supporting reimbursable basis, which will include estimated obligations of $66,500,000 and 150 FTE.

BASE JUSTIFICATION FOR FY 2014:

NTIS' basic authority is to operate a permanent clearinghouse of scientific and technical information, codified as chapter 23 of Title 15 of the United States Code (15 U.S.C. 1151-1157). This chapter also established NTIS' authority to charge fees for its products and services and to recover all costs through such fees "to the extent feasible."

Operating on a reimbursable basis NTIS acquires information products; abstracts, catalogs and indexes them so that they can easily be identified and merged into NTIS' permanent bibliographic database; and physically stores them or scans them into electronic image for reproduction on demand by customers. These information products are disseminated in a variety of formats, including paper, microfiche, diskettes, audio-visual, CD/DVD media, and through subscription and database lease services offered by NTIS and private sector partners.

NTIS also provides information management services to other federal agencies that help them interact with and better serve the information needs of their own constituents. These activities include: web based e-Training, digitization, distribution and archive services..

All activities are funded through the NTIS Revolving Fund, without direct appropriation.

Significant Adjustments-to-Base (ATBs):

- None

Department Of Commerce
National Technical Information Service
NTIS Revolving Fund
JUSTIFICATION OF PROGRAM AND PERFORMANCE

PROGRAM CHANGES FOR FY 2014:

None

Deliverables:

Performance Goals and Measurement Data

Performance Measure: Number of updated items available	FY 2012 Actual	FY 2013 Target	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2016 Target
Total	978,871	892,500	910,350	928,500	947,070	966,011

Description: The number of information items available to the public includes scientific, technical, and engineering information products added to the permanent collection, as well as items made available through online electronic subscriptions. Continually expanding and refining efforts to acquire new scientific and technical information products is reflected in future targets.

Performance Measure: Number of information products disseminated (annual)	FY 2012 Actual	FY 2013 Target	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target
Total	54.5M	48.1M	49.1M	50.1M	51.1M	52.1M

Description: This measure represents the volume of information products disseminated to the public and includes compact discs, diskettes, tapes, online subscriptions, web site pages, as well as the traditional paper and microfiche products. NTIS recently deployed its new Next Generation 2.0 website and has initiated the use of Social Media technology as part of its Outreach and Education activities to further the success of this goal.

Performance Measure: Customer Satisfaction	FY 2012 Actual	FY 2013 Target	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target
Total	98.4%	95%-98%	95%-98%	95%-98%	95%-98%	95%-98%

Description: This measure represents the percentage of NTIS customers that are satisfied with the quality of their order, the ease of order placement, and they timely processing of that order. Orders for NTIS' vast collection of scientific and technical information are received by phone, fax, mail and online, and are filled in a variety of formats. Customer satisfaction is key to NTIS' successful operation.

Object Class

Exhibit 16

Department Of Commerce
National Technical Information Service
NTIS Revolving Fund – Reimbursable Obligations
SUMMARY OF REQUIREMENTS BY OBJECT CLASS
(Dollar amounts in thousands)

Object Class		2012 Estimate	2013 President's Budget	2014 Base	2014 Estimate	Increase/ (Decrease) over 2013 Base
11.1	Full-time permanent (Compensation)	$11,900	$12,500	$13,609	$13,609	0
11.3	Other than full-time permanent	150	150	150	150	0
11.5	Other personnel compensation	650	700	116	116	0
11.8	Special personnel services payments	0	0	0	0	0
11.9	Total personnel compensation	12,700	13,350	13,875	13,875	0
12.1	Civilian personnel benefits	4,200	4,500	4,725	4,725	0
13	Benefits for former personnel	0	0	0	0	0
21	Travel and transportation of persons	200	200	200	200	0
22	Transportation of things	2,500	3,000	3,250	3,250	0
23.1	Rental payments to GSA	1,905	1,919	1,947	1,947	0
23.2	Rental payments to others	1,000	1,000	1,000	1,000	0
23.3	Communications, utilities and miscellaneous charges	1,800	1,800	1,800	1,800	0
24	Printing and reproduction	4,000	4,000	4,000	4,000	0
25.1	Consulting services	100	100	100	100	0
25.2	Other services	36,095	29,131	28,603	28,603	0
25.3	Purchase of goods and services from Government accounts	1,500	1,500	1,500	1,500	0
25.4	Operation of GOCOs	0	0	0	0	0
25.5	Research and development contracts	0	0	0	0	0
25.7	Operation and Maintenance of Equipment	500	500	500	500	0
26	Supplies and materials	3,000	3,000	3,000	3,000	0
31	Equipment	2,000	2,000	2,000	2,000	0

Exhibit 16

Department Of Commerce
National Technical Information Service
NTIS Revolving Fund – Reimbursable Obligations
SUMMARY OF REQUIREMENTS BY OBJECT CLASS
(Dollar amounts in thousands)

Object Class		2012 Actual	2013 Currently Available	2014 Base	2014 Estimate	Increase/ (Decrease) over 2013 Base
41	Grants, subsidies and contributions	0	0	0	0	0
42	Insurance claims and indemnities	0	0	0	0	0
43	Interest and dividends	0	0	0	0	0
44	Refunds	0	0	0	0	0
99	Total Obligations	66,310	66,000	66,500	66,500	0
	Earned Revenue/Reimbursable Obligations.	66,310	66,000	66,500	66,500	0
	Total Obligations	66,310	66,000	66,500	66,500	0
Personnel Data						
Full-Time Equivalent Employment:						
	Full-time permanent	103	145	145	145	0
	Other than full-time permanent	1	5	5	5	0
	Total	104	150	150	150	0
Authorized Positions:						
	Full-time permanent	110	190	190	190	0
	Other than full-time permanent	1	10	10	10	0
	Total	111	200	200	200	0

DEPARTMENT OF COMMERCE
NATIONAL TECHNICAL INFORMATION SERVICE
NTIS Revolving Fund
CONSULTING AND RELATED SERVICES
(Obligations in thousands)

Exhibit 34

	2012 Actual	2013 Estimate	2014 Estimate
Consulting Services	$21	$100	$100
Management and professional services	0	0	0
Special studies and analysis	0	0	0
Management and Support Services for research and development	0	0	0
Total	$21	$100	$100

Department of Commerce
National Technical Information Service
NTIS Revolving Fund
PERIODICALS, PAMPHLETS, AND AUDIOVISUAL PRODUCTS
(obligations in thousands)

Exhibit 35

	2012 Actual	2013 Estimate	2014 Estimate
Periodicals	$1	$2	$2
Pamphlets	0	0	0
Audiovisuals	0	0	0
Total	$1	$2	$2

DEPARTMENT OF COMMERCE
NATIONAL TECHNICAL INFORMATION SERVICE
NTIS Revolving Fund
AVERAGE GRADE AND SALARIES

Exhibit 36

	2012 Actual	2013 Estimate	2014 Estimate
Average GS/GM Grade	10.7	10.10	10.10
Average GS/GM Salary	$69,705	$87,930	$87,930

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