NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY

NATIONAL TECHNICAL INFORMATION SERVICE

FISCAL YEAR 2013

BUDGET SUBMISSION TO CONGRESS

National Institute of Standards
and Technology

Exhibit 1

Department of Commerce
National Institute of Standards and Technology
BUDGET ESTIMATES, FISCAL YEAR 2013
CONGRESSIONAL SUBMISSION

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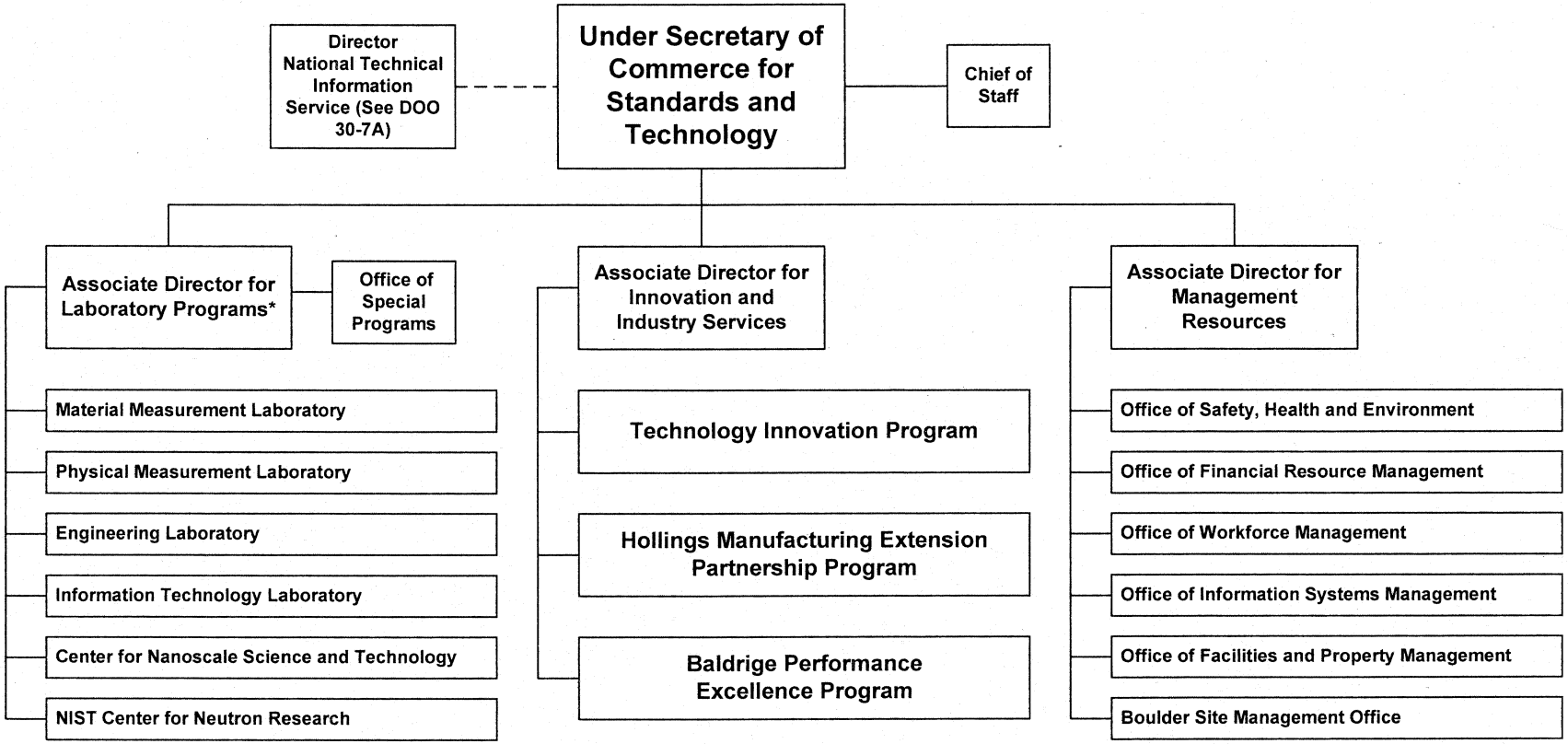
Exhibit 2

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 2013, NIST requests $857.0 million in discretionary funding, $106.2 million above FY 2012 enacted appropriations (excluding transfers). NIST Laboratories are part of the President's Plan for Science and Innovation, which proposes to double funding for research at key basic research agencies. The request is summarized below by appropriations account.

Discretionary Appropriations

Scientific and Technical Research and Services (STRS)

NIST's FY 2013 Core Laboratory research programs in the Scientific and Technical Research and Services (STRS) appropriation is funded at $648.0 million, an increase of $81.0 million from FY 2012 enacted appropriations. The request includes initiatives for:

- Supporting Advanced Manufacturing activities ($+45.0 million)
- Creating a competitive grant program for Universities to establish NIST Centers of Excellence (+$20.0 million)
- Addressing challenges in Forensic Science, Advanced Communications, and Disaster Resilience (+$20.0 million)
- Continuing to invest in the Administration's National Strategy for Trusted Identities in Cyberspace (NSTIC) (+$8.0 million)

The request also includes a $12.0 million decrease to NIST's STRS extramural grants.

Additional details of the initiatives are provided below.

+$45.0 million to support advanced manufacturing activities. Manufacturing plays a central role in technological progress and the overall growth and health of the U.S. economy. The ability to rapidly introduce product innovations will support future U.S. manufacturing market growth, competitiveness, and creation and retention of high quality jobs. With its FY 2013 budget request NIST is expanding its laboratory efforts in the following areas to address measurement and technology needs essential to advanced manufacturing:

- $10.0 million for metrology infrastructure and standards to support biomanufacturing. This NIST program will develop measurement methods, protocols, and standards for improved measurement of biologic products during manufacturing and for end-product characterization. NIST will work closely with industry, the FDA, and other standards organizations to achieve greater process understanding, higher quality biologic products through continuous improvement of manufacturing processes, and agile biomanufacturing processes required for next generation products such as stem cells and personalized biotherapeutics.

- $10.0 million for measurement science and standards to support nanomanufacturing. $8.0 million of these funds are requested for the development of measurement methods that will enable manufacturers to overcome a number of technical barriers to cost-effective, high-volume nanomanufacturing. $2.0 million is requested for measurement science and standards development in nanotechnology-related environmental health and safety (nanoEHS). The nanoEHS program will develop new reference materials,

measurement protocols, and documentary standards as well as new methodologies to evaluate the release of nanoparticles during manufacture and in consumer products.

- $10.0 million to support measurement science and standards in advanced materials for industry, as related to the national Materials Genome Initiative (MGI). The MGI is an interagency effort to significantly reduce the timeline from discovery to commercial deployment of new materials. The request will enable NIST to strengthen and extend its expertise in the development, use and integration of materials modeling and simulation, with a focus on standard reference databases, data assessment and validation, and standards development and implementation.

- $10.0 million for measurement science and standards to support Smart Manufacturing. Smart Manufacturing refers to equipment, factory, and enterprise level production methods that integrate computational (cyber) and physical systems to enable innovative production, products, and systems of products. NIST will develop the measurements and standards necessary to develop automated, in-process quality monitoring and control for factory-level production systems. NIST will also build a testbed integrating a systems architecture framework and an open standards platform to facilitate simultaneous engineering of the cyber and physical elements of manufacturing systems. It will include predictive modeling and simulation for automated control and performance optimization.

- $5.0 million for a NIST Manufacturing Fellowships Program. NIST manufacturing fellowships will provide opportunities for engineers and scientists to work with NIST staff on the measurement and standards required to create cutting-edge tools for manufacturers. Fellowships will be available to qualified candidates who are currently employed in industry and non-profit organizations, as well as to recent recipients of bachelors or masters degrees in relevant fields. NIST Manufacturing Fellowships Program awardees will work jointly with NIST to publicize NIST advanced manufacturing research opportunities.

+$20.0 million for NIST Centers of Excellence. NIST requests $20.0 million for funds to be used to provide grants to establish four competitively selected Centers of Excellence in measurement science areas defined by NIST that will leverage and expand NIST research capabilities. The intent is to provide continuing support to Centers for several years. Each Center of Excellence will provide an interdisciplinary environment in which NIST, academia and industry will collaborate in pursuing early stage basic and applied research focused on innovations in measurement science and emerging technology areas. Potential focus areas include:

- Advanced Communications
- Advanced Manufacturing
- Biomanufacturing
- Cyberphysical Systems
- Forensic Science
- Human-Robotic Integration
- Materials Modeling and Design
- Quantitative Biology
- Telecommunications

NIST would look to evolve the Center program as technologies evolve and 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.

+$20.0 million to address challenges in Forensic Science, Advanced Communications, and Disaster Resilience.

- $10 million for Secure, Scalable, and Interoperable Advanced Communications. National initiatives such as Health IT, telemedicine, Smart Grid, environmental monitoring, and cloud computing depend on an interoperable, scalable, secure, advanced networking technology. Current fixed and wireless network infrastructures already show strain meeting short-term, rapid increases in demand. In addition, the growing complexity of networked information systems built upon this infrastructure increases financial and security risks. The requested funding will allow NIST to research technical requirements and develop measurement techniques for future telecommunications technologies that can scale to the long-term demands of advanced networks while maintaining robustness and security.

- $5.0 million for Measurement Science and Standards in Support of Forensic Science. The funds requested will allow NIST to support the forensic science community through the research and development of traceable standards materials, reference data, and calibration systems; to facilitate standards development; and to provide measurement science research and training opportunities for forensic science practitioners. The NIST laboratories will perform research to characterize and improve many forensic approaches, providing practitioners 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. The funding will enable:
    - New reference methods and technologies for identifying criminals and understanding crime scenes
    - Uncertainty including such factors as bias, precision, and human errors in existing forensic methods
    - Accuracy, reliability, and interoperability of forensic methods and data
    - Calibration systems, reference materials and databases, technology test beds for reliable and accurate forensic practice
    - Forums for standards coordination and development
    - Opportunities for on-site training, research, and distance learning

- $5.0 million to support disaster resilience and natural hazards risk reduction. U.S. communities can and do suffer catastrophic loss, due to extreme events such as hurricanes, tornadoes, wildfires, earthquakes, and flooding. Through a multi-year, public-private partnership program strategy, this funding will enable NIST to work with stakeholder interests in all hazard areas to develop and adopt a national resilience framework and associated resilience models, standards and policies. In addition, NIST will help address the R&D gaps to realize the full potential of national resilience.

+$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 for 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 for 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.

-$12.0 million for a reduction to NIST's STRS extramural grants. NIST requests a $12.0 million decrease to its extramural STRS grant program to redirect funding to higher priority activities within the STRS. The reduction includes $6.0 million from one-time external grants to support industry-led consortia in the development of technology roadmaps. NIST will identify an additional $6.0 million from low priority research areas and areas where intramural efforts are sufficient to meet research requirements.

Industrial Technology Services (ITS)

- The request funds the Hollings Manufacturing Extension Partnership (MEP) at $128.0 million, a decrease of $443 thousand from the FY 2012 enacted appropriations. The funding decrease of $443 thousand to MEP will not affect funding available for MEP center renewals in FY 2013.

- The request includes $21.0 million for an Advanced Manufacturing Technology Consortia (AMTech) initiative. The proposed AMTech program 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, to accelerate the pace of innovation throughout various industrial sectors.

Construction of Research Facilities

- The request for the Construction of Research Facilities (CRF) appropriation totals $60.0 million. NIST requests an increase of $4.6 million from the FY 2012 enacted appropriations in order to provide $48.2 million for our Safety, Capacity, Maintenance, and Major Repairs account and $11.8 million is to fund Building 1 Renovation project in Boulder, Colorado.

Mandatory Appropriations

Wireless Innovation Fund

As part of the National Wireless Initiative included in the American Jobs Act, NIST will create a Wireless Innovation (WIN) Fund to help develop cutting-edge wireless technologies for public safety users. The WIN Fund will provide up to $300.0 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.

National Network for Manufacturing Innovation

As part of its efforts to revitalize U.S. manufacturing, the Administration will propose legislation creating a mandatory account making available $1.0 billion to establish a National Network for Manufacturing Innovation (NNMI), which would consist of a network of institutes where researchers, companies, and entrepreneurs can come together to develop new manufacturing technologies with broad applications. Each institute would have a unique technology focus. These institutes will help support an ecosystem of manufacturing activity in local areas. The Manufacturing Innovation Institutes would support manufacturing technology commercialization by helping to bridge the gap from the laboratory to the market and address core gaps in scaling manufacturing process technologies.

OVERVIEW OF NIST MISSION AND CURRENT PROGRAMS

NIST Mission: Promoting U.S. Innovation and Industrial Competitiveness

The NIST mission is to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve our quality of life. Since 1901, NIST, a non-regulatory agency, has been supplying the measurements and tools—from standardized high-precision gage blocks needed to manufacture interchangeable parts to the world's most accurate atomic clock—to help U.S. industry compete successfully through innovation. Over the last few decades, NIST has been assigned important new roles and responsibilities, including awarding competitive grants to foster development of promising, high-risk technologies; diffusing advanced technologies and business practices to smaller manufacturers; and promoting quality management methods in key sectors. Old and new, all NIST programs support the Nation's agility, innovation, and competitiveness.

NIST Laboratory Program

For more than 100 years, NIST has maintained the national standards of measurement, a role that the U.S. Constitution assigns to the Federal Government. Today, the NIST Laboratories 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., methods for testing electronic health record systems and the performance of walk-through metal detectors).

- The NIST Laboratories 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 work to assure that the U.S. realization of the basic and derived measurement units is consistent with the realization in other nations. NIST Laboratories engage in a number of international activities to support trade and global science, and to promote the international acceptance of U.S. measurement standards.

- The NIST Laboratories provide industry and academia with unique user facilities that support innovation in materials science, nanotechnology, and other emerging technology areas through the NIST Center for Neutron Research, which provides world class neutron measurement capabilities to the U.S. research community, and the NIST Center for Nanoscale Science and Technology, which supports nanotechnology development from discovery to production.

- The NIST Laboratories also support the development of 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 methods for conformity. In addition, NIST is designated under the National Technology Transfer Advancement Act (NTTAA) as the coordinator for all Federal agencies using documentary standards that are developed by private-sector consensus bodies to carry out their policy objectives.

Innovation and Industry Services

Hollings Manufacturing Extension Partnership

Through partnerships between Federal and state governments and non-profit organizations, NIST's Hollings Manufacturing Extension Partnership (MEP) provides technical and business assistance to smaller manufacturers through a nationwide network in all 50 states and Puerto Rico. Field agents and programs are helping manufacturers understand, adopt, and apply new technologies and business practices, as well as reap the benefits through increased productivity, better performance, cost savings, waste reduction, and creation and retention of manufacturing jobs. MEP acts as a strategic advisor to promote business growth and innovation and to connect manufacturers to public and private resources essential for increased profitability and competitiveness in the global marketplace.

NIST STRATEGIC GOALS AND PROGRAMMATIC PLANNING

The breadth of technology in the U.S. economy results in a broad technical portfolio for NIST. The NIST programs must maintain technical leadership in measurement science, while also responding effectively to the rapid pace of technological innovation. NIST uses a comprehensive annual planning process to develop program priorities that support NIST's mission to promote economic prosperity and job creation in a technology-based economy.

Strategic Goals

With the aim of promoting U.S. innovation and industrial competitiveness, NIST has established three overarching strategic goals to guide and align investments in its programs:

1. Position NIST to accelerate technology development, promote advanced manufacturing, and promote industrial competitiveness.

- Accelerate and strengthen engagement in documentary standards.
- Improve the development and delivery of measurement services.
- Enhance user access and collaboration at our unique facilities.

2. Strengthen our core technical and organizational capabilities.

- Invest in the basic research required to meet the NIST mission.
- Improve facilities and equipment to ensure NIST maintains a leading measurement capability.
- Develop world class operations and support activities, especially in safety management.

3. Promote innovation, commercialization, and business growth.

- Support the acceleration and promotion of innovation through AMTech and other programs.
- Support business success through MEP.

Programmatic Planning Priorities

Program planning for NIST seeks to align with our strategic goals and to focus on the most critical national priorities and challenges. To identify important trends, NIST continually gathers and assesses input from customers, potential stakeholders, Congress and the Administration. Based on this input, NIST will continue to invest resources organized across six investment priority areas (IPAs):

- **Manufacturing:** Improve the competitiveness of U.S. manufacturers through the development and deployment of new, green technologies and better business practices. Efforts include focus on enhancing high technology manufacturing innovation in products and processes, especially nanomanufacturing, resulting in new jobs.

- **Information Technology and Cybersecurity:** Help to develop more capable, secure, and interoperable information systems to ensure U.S. leadership in information technology. Provide technical support for successful deployment of next generation

broadband. Supply measurement capabilities necessary for next-generation information technologies.

- **Energy:** Speed development of alternative, clean-energy energy sources, from production through storage to final distribution. Help to ensure interoperability of Smart Grid devices and systems (as assigned in the 2007 Energy Independence and Security Act).

- **Health Care:** Advance efforts aimed at achieving lower-cost, higher-quality health care, including development of technologies that ensure more accurate diagnoses, reduce medical errors, and improve the efficiency and effectiveness of therapies. Develop standards essential to interoperable health-care information systems that seamlessly and accurately share information among all health-care providers; and ensure security and privacy of information.

- **Environment and Consumer Safety:** Promote efficient development of sustainable products and processes, from manufacturing to end-use by consumers. Help to establish the scientific measurement basis for accurate climate and greenhouse gas emissions measurements.

- **Physical Infrastructure:** Develop the needed measurement solutions, models, calibration inspection methods, and technologies that can be used to predict the remaining life or margins of safety for infrastructure systems to prioritize and optimize infrastructure spending.

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. The Department's total savings target for FY 2013 is $176.0 million, which includes $142.8 million in savings initiated in FY 2012 and an additional $33.2 million planned for FY 2013. Building on the NIST's administrative savings planned for FY 2012 ($11.6 million), an additional $2.7 million in savings is targeted for FY 2013 for a total savings of $14.3 million.

Resources

The following is a comparison of NIST's FY 2013 request level with the FY 2012 Enacted level.

Appropriation	(Dollar amounts in millions) FY 2012 Enacted		FY 2013 Request		Change from FY 2012 Enacted	
	FTE	Amount	FTE	Amount	FTE	Amount
Scientific and Technical Research and Services	2,175	567.0	2,292	648.0	117	81.0
Industrial Technology Services	133	128.4	87	149.0	(46)	20.6
Construction of Research Facilities	121	55.4	121	60.0	0	4.6
Working Capital Fund	765	0	756	0	(9)	0
TOTAL DISCRETIONARY	**3,194**	**750.8**	**3,256**	**857.0**	**62**	**106.2**
MANDATORY						
Wireless Innovation Fund	**0**	**0**	**13**	**300.0**	**13**	**300.0**
National Network for Manufacturing Innovation	**0**	**0**	**25**	**1,000.0**	**25**	**1,000.0**
TOTAL RESOURCES	**3,194**	**750.8**	**3,294**	**2,157.0**	**100**	**1,406.2**

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 $191.6 million in FY 2012 and $163.2 million in FY 2013.

FY 2013 Annual Performance Plan

National Institute of Standards and Technology/
National Technical Information Service

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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.

National Institute of Standards and Technology

NIST develops and disseminates measurement techniques, reference data, test methods, standards, and other infrastructural technologies and services required by U.S. industry to compete in the 21st century. In addition to its core measurement, testing, and standards functions, NIST also conducts several extramural programs including the Hollings Manufacturing Extension Partnership (MEP) to provide U.S. manufacturers with access to technologies, resources, and industry experts to strengthen the competitiveness of our Nation's domestic manufacturing base; and the Advanced Manufacturing Technology Consortia (AMTech) to establish industry-led consortia to identify and prioritize directed basic research projects supporting long-term industry needs in order to collapse the timescale of innovation.

Corresponding DoC Strategic Theme and Goal for NIST Programs

DoC Strategic Theme: Economic Growth

DoC Strategic Goal: Innovation and Entrepreneurship

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 (AMTech)

Advanced Manufacturing Technology Consortia (AMTech):

The AMTech program proposed for funding in FY 2013 will 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. In order to receive funding, each AMTech consortia must articulate an industry roadmap that identifies long-term technical obstacles to success. In this manner, AMTech creates the incentive to bring together members spanning the innovation cycle from idea to discovery, invention, and manufacturability. AMTech's strategy will drive economic growth, enhance U.S. manufacturing competitiveness, and spur the creation of a workforce in high value sectors.

DoC Strategic Goal: Innovation and Entrepreneurship

Performance Objective 5: Provide measurement tools and standards to strengthen manufacturing, enable innovation, and increase efficiency (NIST National Measurement and Standards Laboratories, NIST User Facilities)

NIST National Measurement and Standards Laboratories:

The NIST National Measurement and Standards Laboratories 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 National Measurement and Standards 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.

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 is the only national nanocenter with a focus on commerce. Located in NIST's Advanced Measurement Laboratory Complex on the Gaithersburg, Maryland site, the CNST supports the development of nanotechnology from discovery to production through research on measurement and fabrication methods and technology. The CNST has a unique design that supports the U.S. nanotechnology enterprise through the readily available, shared-use NanoFab, as well as by providing opportunities for collaboration in multidisciplinary research on new nanoscale measurement instruments and methods. It also serves as a hub linking the international nanotechnology community to the comprehensive measurement expertise throughout NIST.

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 dynamics, neutron trace analysis, neutron chemical spectroscopy, neutron imaging, and neutron spectroscopy.

DoC Strategic Goal: Market Development and Commercialization

Performance Objective 8: Improve the competitiveness of small and medium-sized firms in manufacturing and service industries (MEP)

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's middle class, our national security, and our growing renewable energy economy. Now more than ever, strong manufacturing businesses are needed to create good jobs and help the U.S. economy regain its momentum. 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.

Impact of American Recovery and Reinvestment Act (ARRA) for NIST

With the passage of the ARRA, NIST received $580 million in direct appropriations, as well as another $32million in transfers from other agencies ($20 million from the Department of Health and Human Services for healthcare IT and $12 million from the Department of Energy for Smart Grid).

In determining how to allocate these funds, NIST took the position that increased investment in measurement science would strengthen the platform upon which long-term economic recovery would be built, namely through future innovations in areas like green technology, alternative energies, advanced computing, and information technologies. Examples of NIST impact from the ARRA spending include:

- $110.0 million was used to purchase 60 pieces of advanced scientific and measurement equipment available from U.S. manufacturers that will strengthen NIST's capabilities targeting the development of alternative energy technologies, the environmental monitoring and mitigation tools, the development and fabrication of advanced nanotechnology, and many other technical areas. Examples include: advanced laser systems that are necessary for precise and accurate greenhouse gas monitoring tools or one of a kind high-speed, high resolution neutron imaging system that will allow the advanced design and testing of alternative energy sources and devices. The equipment purchased is enhancing NIST's ability to address its measurement science mission through significant increases in throughput, sensitivity, and resolution, as well as increased availability to users.
- $34.5 million in grants for measurement science and engineering research. The NIST Measurement Science and Engineering Research Grants Program, made possible through the ARRA, is currently funding 27 projects at higher-education, commercial, and nonprofit organizations in 18 states. These grants are advancing the state of the art in measurement science and engineering that is needed to sustain long-term economic growth through innovation in critical national priority areas: energy; environment; manufacturing; bioscience and healthcare; infrastructure; and information technology.
- $41.5 million to support the next generation of measurement scientists and expand NIST's interaction and collaborations with industry and academia.
    a. Of these funds, $22.0 million were used to expand the NIST postdoctoral research program providing recent PhDs in science and engineering with the opportunity to work at NIST and gain valuable experience and training in the area of measurement science. These funds extended the tenure of 65 postdocs at NIST and allowed an additional 98 postdocs to be brought to NIST.
    b. An additional $19.5 million dollars was competitively awarded to the University of Maryland and the University of Colorado to support the creation of a collaborative fellowship program that will bring top students and scientists to NIST from industry and universities for limited terms to work with NIST technical staff performing research in key

national priority areas. To date these efforts have brought 37 Senior Research Fellows, 30 Postdoctoral fellows, 16 Graduate students, and 79 Undergraduate research fellows from across the U.S. to work at NIST.

- $180.0 million invested in 16 construction projects that will improve the efficiency and reduce the environmental impact of NIST operations, and provide NIST with new facilities to support its research needs in fire resistance, robotics, energy efficient buildings, and advanced measurement science.
- $178.0 million in grants to fund construction of 16 scientific research facilities at 15 U.S. universities, and one research organization. The new research buildings will provide state-of-the-art laboratory facilities supporting academic research across a broad range of topics affecting the Commerce Department's mission, including fundamental physics research, nanotechnology, aquaculture and marine ecology.

NIST Priorities / Management Challenges

With the aim of promoting U.S. innovation and industrial competitiveness, NIST has established three overarching priorities to guide and align investments in its programs:

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.

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.

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.

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 U.S.

NIST Target and Performance Summary / FY 2013 Target Description / Measure Descriptions / 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 2008 Actual**	**FY 2009 Actual**	**FY 2010 Actual**	**FY 2011 Actual**	**FY 2012 Target**	**FY 2013 Target**
	Completed	Completed	Completed	Completed	Complete	Complete
Description: From FY 2007-FY2011, 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. The NRC Assessment Reports are available at http://www.nist.gov/director/nrc/. Beginning in FY 2012, the NRC assessments will be restructured to focus on NIST-wide ongoing needs and activities.						
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.	Beginning in FY 2012, the NRC assessments will focus on NIST-wide on-going needs and activities.	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 2008 Actual	FY 2009 Actual	FY 2010 Actual	FY 2011 Target	FY 2012 Target	FY 2013 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 2011 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 2008 Actual	FY 2009 Actual	FY 2010 Actual	FY 2011 Actual	FY 2012 Target	FY 2013 Target
	1,271	1,463	1,243	1,210	1,210	1,210

Description: This measure reflects the quality and demand for NIST publications providing measurements and standards to those in industry, academia, and government agencies. As of FY 2007, this reflects 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 are well within acceptable rates for an institution of its size.

Comments on Changes to Targets: Publications typically lag by a minimum of two years due to the time needed for research, writing, journal peer review, and publication processes. The lower targets for FY 2012 and FY 2013 were adjusted as NIST technical research staff has not grown as expected over the past few years and the revised number reflects a more realistic goal for the current number of scientists on staff.

Relevant Program Change(s): $81.0 million Million	**Title**: NIST Laboratories	**Exhibit 13 Page no:** NIST- 85, 106, 112, 124, 130, 142, and 147

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 2008 Actual	FY 2009 Actual	FY 2010 Actual	FY 2011 Actual	FY 2012 Target	FY 2013 Target
	33,373	29,769	31,667	32,684	31,000	31,000

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.

Comments on Changes to Targets: 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. Therefore, NIST predicts that the number of SRM units sold will remain at an equilibrium level in the outyears as a result of the balance between new and expanded programs and the retirement of old SRMs as they become technically obsolete or their supply is expended.

Relevant Program Change(s): $81.0 million	**Title**: NIST Laboratories	**Exhibit 13 Page no:** NIST- 85, 106, 112, 124, 130, 142, and 147

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 2008 Actual	FY 2009 Actual	FY 2010 Actual	FY 2011 Actual	FY 2012 Target	FY 2013 Target
Original Methodology	195.5M	226M	NA*	NA*	NA*	NA*
Revised Methodology	23.7M	34.2M	25.0M	19.1M	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.

Comments on Changes to Targets: The lower FY 2012 and FY 2013 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.

Relevant Program Change(s) $81.0 million	**Title:** NIST Laboratories	**Exhibit 13 Page no:** NIST- 85, 106, 112, 124, 130, 142, and 147

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. This measure reflects the number of times users access these datasets; it does not reflect unique users or capture how the data was used.	None

Measure 1F: Number of calibration tests performed	FY 2008 Actual	FY 2009 Actual	FY 2010 Actual	FY 2011 Actual	FY 2012 Target	FY 2013 Target
	25,944	18,609	17,697	18,195	14,000	13,500

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.

Comments on Changes to Targets: The reduced targets were based on the observed trend prior to FY 2011 of fewer calibration tests performed over the years as a result of efforts by NIST to transfer advanced measurement capabilities to primary standards labs. Prior to FY 2011, there were also fewer or delayed private sector calibrations due to economic conditions. The rate of calibration tests increased dramatically at mid-year FY 2011. Although private sector calibrations appear to have recovered, NIST expects significant reduction in calibration tests performed for Federal and military labs as well as their operating contractors.

Relevant Program Change(s) $81.0 million	**Title:** NIST Laboratories	**Exhibit 13 Page no:** NIST- 85, 106, 112, 124, 130, 142, and 147

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 2008 Actual**	**FY 2009 Actual**	**FY 2010 Actual**	**FY 2011 Actual**	**FY 2012 Target**	**FY 2013 Target**
	31,961	32,926	34,299	33,838	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.						
Relevant Program Change(s): -$.443 million	**Title:** Hollings Manufacturing Extension Partnership				**Exhibit 13 Page no:** NIST- 177	
Measure 2B: Increased sales attributed to MEP Centers receiving Federal funding ($ in Billions)	**FY 2008 Actual**	**FY 2009 Actual**	**FY 2010 Actual[1]**	**FY 2011 Target[2]**	**FY 2012 Target**	**FY 2013 Target**
	$3.61	$3.5	$3.6	$2.0	$2.2	$2.5
Measure 2C: Capital investment attributed to MEP Centers receiving Federal funding ($ in Billions)	**FY 2008 Actual**	**FY 2009 Actual**	**FY 2010 Actual[1]**	**FY 2011 Target[2]**	**FY 2012 Target**	**FY 2013 Target**
	$1.71	$1.9	$1.9	$1.1	$1.3	$1.4
Measure 2D: Cost savings attributed to MEP Centers receiving Federal funding ($ in Billions)	**FY 2008 Actual**	**FY 2009 Actual**	**FY 2010 Actual[1]**	**FY 2011 Target[2]**	**FY 2012 Target**	**FY 2013 Target**
	$1.41	$1.3	$1.3	$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. [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 2011 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 2011 actual will be available in January 2013 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 2011 client target of 30,000.						

Comments on Changes to Targets: The FY 2011, FY 2012, and FY 2013 targets are based on updated funding levels of $128.4M, $128.4M and $128.0M (including adjustments to base) respectively for MEP.					
Relevant Program Change(s): -$.443 million	**Title:** Hollings Manufacturing Extension Partnership				**Exhibit 13 Page no:** NIST- 177
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, Turner Marketing , located in Sanford, FL.	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 Turner Marketing.	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 FY 2013 Proposed Program Changes

	Accompanying GPRA		Base		Increase/Decrease		Page of Exhibit 13 Discussion
Program Change:	APP Page no.	Performance Measure no.	**FTE**	**Amount ($000)**	**FTE**	**Amount ($000)**	
NIST Laboratories	NIST- 22	1C,D,E,F	2,202	567,000	90	81,000	NIST- 85, 106, 112, 124, 130, 142, and 147
Advanced Manufacturing Technology Consortia (AMTech)	NIST- N/A	N/A	0	0	4	21,000	NIST- 171
Hollings Manufacturing Extension Partnership (MEP)	NIST- 26	2A,B,C,D	83	128,443	0	(443)	NIST- 177

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.

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 2013

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 2008 Actual**	**FY 2009 Actual**	**FY 2010 Actual**	**FY 2011 Actual**	**FY 2012 Target**	**FY 2013 Target**
	813,775	893,138	969,473	836,579	875,000	892,500
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 2013 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 2008 Actual	FY 2009 Actual	FY 2010 Actual	FY 2011 Actual	FY 2012 Target	FY 2013 Target
	32,267,167	49,430,840	50,333,206	48,958,993	49,878,000	50,875,560

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 2011, FY 2012, and FY 2013 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 2008 Actual	FY 2009 Actual	FY 2010 Actual	FY 2011 Actual	FY 2012 Target	FY 2013 Target
	96%	98%	98%	99.5%	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

NTIS FY 2013 Program Changes

	Accompanying GPRA		Base		Increase/Decrease		Page of Exhibit 13 Discussion
Program Change:	**APP Page no.**	**Performance Measure no.**	**FTE**	**Amount**	**FTE**	**Amount**	
National Technical Information Service		N/A	150	$66.0M	0	$0	N/A

NIST/NTIS Resource Requirements Table *

NIST Resource Requirements (obligations in M)

	FY 2008 Actual	FY 2009 Actual	FY 2010 Actual	FY 2011 Actual	FY 2012 Estimate	FY 2013 Base	Increase/ Decrease	FY 2013 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)	$54.5	$50.2	$77.2	$74.2	$8.4	-	-	-
AMTech (ITS)	-	-	-	-	-	-	$21.0	$21.0
Recovery Act funds	-	-	-	-	-	-	-	-
Total Funds	54.5	50.2	77.2	74.2	8.4	-	21.0	21.0
Performance Objective 5: Provide measurement tools and standards to strengthen manufacturing, enable innovation, and increase efficiency.								
Labs (STRS & majority of Reimbursable)	550.6	576.1	607.6	606.5	694.6	650.1	77.2	727.3
User Facilities (STRS)	70.5	74.5	72.9	74.2	91.0	80.5	6.5	87.0
SCMMR (CRF)	138.3	161.7	169.8	91.0	69.6	42.0	18.0	60.0
Recovery Act funds		125.1	475.6	4.4	8.4		-	
Total Funds	759.4	937.4	1,325.9	776.1	863.6	772.6	101.7	874.3
Performance Objective 8: Improve the competitiveness of small and medium-sized firms in manufacturing and service industries.								
MEP (ITS Approp)	91.2	112.6	126.8	129.3	134.1	129.1	(0.4)	128.7
Recovery Act funds							-	
Total Funds	91.2	112.6	126.8	129.3	134.1	129.1	(0.4)	128.7

NIST Total, Recovery Act Funds	-	125.1	475.6	4.4	8.4	-	-	-
NIST Total Original Funds	905.1	975.1	1,054.3	975.2	997.7	901.7	122.3	1,024.0
Total NIST	$ 905.1	$ 1,100.2	$ 1,529.9	$ 979.6	$ 1,006.1	$ 901.7	$ 122.3	$ 1,024.0

NTIS Resource Requirements (obligations in M)

	FY 2008 Actual	FY 2009 Actual	FY 2010 Actual	FY 2011 Actual	FY 2012 Estimate	FY 2013 Base	Increase/ Decrease	FY 2013 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	22.5	31.9	46.0	48.9	65.5	66.0	-	66.0
NTIS Total Funds	22.5	31.9	46.0	48.9	65.5	66.0	-	66.0

Grand Total (NIST & NTIS)	FY 2008 Actual	FY 2009 Actual	FY 2010 Actual	FY 2011 Actual	FY 2012 Estimate	FY 2013 Base	Increase/ Decrease	FY 2013 Request
Original Funding	927.5	1,007.0	1,100.1	1,023.9	1,063.2	967.7	122.3	1,090.0
Direct	733.1	803.4	894.7	806.5	791.4	738.5	120.8	859.3
Reimbursable	194.4	203.6	205.4	217.4	271.8	229.2	1.5	230.7
IT Funding	85.7	97.7	89.1	93.2	91.9	92.4	-	92.4
Recovery Act Funding	-	125.1	475.6	4.4	8.4	-	-	-
Direct	-	122.8	464.2	4.4	8.4	-	-	-
Reimbursable	-	2.3	11.4	-	-	-	-	-
IT Funding	-	-	-	-	-	-	-	-
Total Funding	927.5	1,132.1	1,575.7	1,028.3	1,071.6	967.7	122.3	1,090.0
Direct	733.1	926.2	1,358.9	810.9	799.8	738.5	120.8	859.3
Reimbursable	194.4	205.9	216.8	217.4	271.8	229.2	1.5	230.7
IT Funding	85.7	97.7	89.1	93.2	91.9	92.4	-	92.4
Original FTE	2,934	2,982	3,014	3,123	3,344	3,312	94	3,406
Recovery Act FTE	-	18	106	11	-	-	-	-
Total FTE	2,934	3,000	3,120	3,134	3,344	3,312	94	3,406

*Dollars reflect obligations for all fund sources and excludes $300M Wireless Innovation Fund and $1,000M National Network for Manufacturing Innovation

Scientific and Technical
Research and Services

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
2012 Currently Available	2,203	2,175	$574,555	$589,879	$567,000
less: Unobligated balance from prior year	0	0	0	(15,924)	0
plus: Unobligated balance from prior year transferred to ITS	0	0	0	1,600	0
less: Transfers from DoJ	0	0	(6,500)	(6,500)	0
less: Transfer from EAC	0	0	(2,750)	(2,750)	0
2013 Adjustments to base:					
Annualization of positions financed in FY 2012	0	27			
plus: Restoration of 2012 deobligation offset	0	0	1,000	0	1,000
plus: Adjustment of WCF transfer for prior program changes	0	0	1,695	1,695	0
plus: Uncontrollable cost changes	0	0	7,788	7,788	7,788
less: Amount absorbed	0	0	(7,788)	(7,788)	(7,788)
less: Estimated recoveries, 2013	0	0	(1,000)	0	(1,000)
2013 Base Request	2,203	2,202	567,000	568,000	567,000
Administrative savings (amount reinvested)	[0]	[0]	[2,693]	[2,693]	[2,693]
plus: 2013 Program changes	124	90	79,500	79,500	81,000
plus: Transfer from EAC			2,750	2,750	0
2013 Estimate	2,327	2,292	649,250	650,250	648,000

		2011 Actual		2012 Currently Available		2013 Base		2013 Estimate		Increase/ (Decrease) Over 2013 Base	
Comparison by activity/subactivity:		Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount
Measurement science, services, and programs											
Laboratory programs	Pos./Approp	1,960	$463,188	2,092	$517,969	2,092	$517,969	2,183	$572,640	91	$54,671
	FTE/Obl.	1,898	473,959	2,066	532,270	2,092	518,829	2,159	574,750	67	55,921
Corporate services	Pos./Approp	49	18,842	49	18,547	49	18,547	49	18,547	0	0
	FTE/Obl.	47	19,274	48	18,650	48	18,650	48	18,650	0	0
Standards coordination and special programs	Pos./Approp	58	15,346	62	30,484	62	30,484	95	56,813	33	26,329
	FTE/Obl.	56	16,354	61	38,959	62	30,521	85	56,850	23	26,329
TOTALS	Pos./Approp	2,067	497,376 [1/]	2,203	567,000	2,203	567,000	2,327	648,000	124	81,000
	FTE/Obl.	2,001	509,587	2,175	589,879	2,202	568,000	2,292	650,250	90	82,250

[1/] The Baldrige Performance Excellence Program transferred from the STRS appropriation to the ITS appropriation consistent with the approved NIST reorganization.

Comparison by activity/subactivity:	2011 Actual Personnel	2011 Actual Amount	2012 Currently Available Personnel	2012 Currently Available Amount	2013 Base Personnel	2013 Base Amount	2013 Estimate Personnel	2013 Estimate Amount	Increase/ (Decrease) Over 2013 Base Personnel	Increase/ (Decrease) Over 2013 Base Amount
Adjustments for:										
Recoveries		(4,678)		(1,000)		(1,000)		(1,000)		0
Refunds		(46)		0		0		0		0
Unobligated balance, start of year		(18,931)		(15,924)		0		0		0
Unobligated balance, end of year		15,924		0		0		0		0
Unobligated balance, expired account		7		0		0		0		0
Unobligated balance transfer to ITS for TIP shutdown/BPEP transition				1,600						
Budget Authority		501,863		574,555		567,000		649,250		82,250
Financing from transfers:										
Transfers to other accounts		0		1,695		0		1,500		1,500
Transfers from DoJ to OLES		(1,243)		(6,500)		0		0		0
Transfer from Election Assistance Commission		(3,244)		(2,750)		0		(2,750)		(2,750)
Transfers to ITS, Reorganization		9,608 [1/]		0						
Appropriation		506,984		567,000		567,000		648,000		81,000

[1/] The Baldrige Performance Excellence Program transferred from the STRS appropriation to the ITS appropriation consistent with the approved NIST reorganization.

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

	2011 Actual	2012 Currently Available	2013 Base	2013 Estimate	Increase/ (Decrease) Over 2013 Base
Total Obligations	$509,587	$589,879 [3/]	$568,000	$650,250	$82,250
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	(4,733) [1/]	(1,000)	(1,000)	(1,000)	0
Unobligated balance, start of year	(19,758) [2/]	(15,924) [3/]	0	0	0
Unobligated balance, end of year	15,924 [3/]	0	0	0	0
Unobligated balance, expired	843 [4/]	0	0	0	0
Unobligated balance transfer to ITS		1,600	0	0	0
Budget Authority	501,863	574,555	567,000	649,250	82,250
Financing:					
Transfer to other accounts	0	1,695	0	1,500	1,500
Transfer from other accounts	(4,487) [5/]	(9,250) [5/]	0	(2,750) [5/]	(2,750)
Reorganization to ITS	9,608	0			
Appropriation	506,984	567,000	567,000	648,000	81,000

[1/] Including $9K from ARRA reimbursable.

[2/] Carryover includes $6,174K from regular STRS, $12,757K from ARRA HHS transfer (no year), and $827K from ARRA reimbursable.

[3/] Including $8,382K from ARRA HHS transfer, which is no year.

[4/] Including $836K from ARRA reimbursable.

[5/] $3,244K from EAC and $1,243K from COPS, DoJ in FY 2011; $2,750K from EAC and $6,500 from DoJ in FY 2012; and planned $2,750K from EAC in FY 2013.

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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 2012 deobligation offset	0	1,000

In FY 2012, 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 2013.

Financing:		
Recoveries of prior year deobligations	0	(1,000)

NIST's FY 2013 STRS budget authority is reduced by the estimated level of prior year deobligations in FY 2013.

Other Changes:

2013 Pay increase and related costs	0	978

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

Total cost in FY 2013 of pay increase	$978,000
Less amount absorbed in FY 2013	0
Amount requested for FY 2013 pay increase	978,000
Payment to Departmental Management Working Capital Fund	0
Total adjustment for FY 2013 pay increase	978,000

Annualization of positions financed in FY 2012	27	0

NIST requires an additional 27 FTE to staff FY 2012 requested increases at their full operating level in FY 2013.

New positions in 2012	136
Less 5 percent lapse	(7)
Full-Year FTE	129
Less FTE Funded in 2012	(102)
Annualization of Positions/FTE in 2013	27

Personnel benefits		$1,795
Civil Service Retirement System (CSRS)	($224)	
Federal Employees' Retirement System (FERS)	374	
Thrift Savings Plan (TSP)	107	
Federal Insurance Contribution Act (FICA) - OASDI	292	
Health Insurance	1,270	
Employees' Compensation Fund	(24)	

Civil Service Retirement System (-$224,000) – 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 10.2 percent in FY 2012 to 8.7 percent in FY 2013. The contribution rate will remain at 7.0 percent in FY 2013.

Payroll subject to retirement systems ($213,314,516)	
Cost of CSRS contributions in FY 2013 ($213,314,516 x .087 x .07)	$1,299,085
Cost of CSRS contributions in FY 2012 ($213,314,516 x .102 x .07)	1,523,066
Total adjustment to base	(223,981)

Federal Employees' Retirement System ($374,000) – 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 89.8 percent in FY 2012 to 91.3 percent in FY 2013. The contribution rate remained at 11.7 percent for FY 2013.

Payroll subject to retirement systems ($213,314,516)	
Basic benefit cost in FY 2013 ($213,314,516 x .913 x .117)	$22,786,470
Basic benefit cost in FY 2012 ($213,314,516 x .898 x .117)	22,412,103
Total adjustment to base	374,367

Thrift Savings Plan ($107,000) – The cost of agency contributions to the TSP will also rise as FERS participation increases. The contribution rate will decrease from 4.56 to 4.54 percent in FY 2013.

Thrift plan cost in FY 2013 ($213,314,516 x .913 x .0454)	$8,841,929
Thrift plan cost in FY 2012 ($213,314,516 x .898 x .0456)	8,734,973
Total adjustment to base	106,956

Federal Insurance Contributions Act (FICA) - OASDI ($292,000) – As the percentage of payroll covered by FERS rises, the cost of OASDI contributions will increase. In FY 2013, the maximum salary subject to OASDI tax will increase from $110,175 in FY 2012 to $113,100 in FY 2013. The OASDI tax rate will remain at 6.2 percent in FY 2013.

FERS payroll subject to FICA tax in 2013 ($213,314,516 x .913 x .882 x .062)	$10,650,045
FERS payroll subject to FICA tax in 2012 ($213,314,516 x .898 x .873 x .062)	10,368,184
Increase (FY 2012-FY 2013)	281,861
OTP payroll subject to FICA tax in FY 2013 ($7,898,484 x .913 x .882 x .062)	394,344
OTP payroll subject to FICA tax in FY 2012 ($7,898,484 x .898 x .873 x .062)	383,907
Increase (FY 2012-FY 2013)	10,437
Total adjustment to base	292,298

Health insurance ($1,270,000) – Effective January 2011, NIST's contribution to Federal employees' health insurance premiums increased by 8.8 percent. Applied against the FY 2012 estimate of $14,430,00 the additional amount required is $1,269,840.

Employees' Compensation Fund (-$24,000) – The Employees' Compensation Fund bill for the year ending June 30, 2011 is a net $13,015 lower than for the year ending June 30, 2010. The STRS share of this decrease is $-23,637.

Travel and transportation of persons 0 345

The General Services Administration (GSA) standard per diem rate for destinations within the Continental United States (CONUS) increased by 6% from $116 to $123. This percentage was applied to the FY 2012 estimate of $5,742,000 for an increase of $344,520.

Rental Payments to GSA 0 1

GSA rates are projected to increase 1.7 percent in FY 2013. This percentage was applied to the FY 2012 estimate of $53,000 to arrive at an increase of $901.

Communications, utilities, and miscellaneous charges 0 1,949

Electricity rate increase.....	1,761
Natural Gas rate increase.....	189
HCHB Electricity.....	(1)

The electricity ATB amount was derived using a year to year comparison of the cost per kilowatt hour. In analyzing the 12 months ended March 2011 and 2010, the per kilowatt hour rate increased 18.1 percent (from .094 to .111) for Gaithersburg, Maryland; increased 17.2 percent (from .303 to .355) for Kauai, Hawaii; increased 7.6 percent (from .066 to .071) for Boulder, Colorado; and decreased 2.2 percent (from .091 to .089) for Ft. Collins, Colorado for a net increase of $1,761,000.

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 March 2011 and 2010, the per therm rate increased 4.7 percent (from .851 to .891) and increased 4.7 percent (from 5.637 to 5.902) for Gaithersburg and Boulder respectively resulting in a net increase of $189,000.

The average decrease for HCHB PEPCO electricity is projected to be 25%. This percentage was applied to the 2012 electricity estimate of $4,000 for a decrease of $1,000.

Other Services		0	162
Working Capital Fund (Departmental Management)	24		
Commerce Business Systems (CBS)	137		
National Archives and Records Administration (NARA) storage costs	1		

Working Capital Fund (Departmental Management) ($24,000) – An additional $24,000 is required to fund cost increases in the Departmental Management Working Capital Fund.

Commerce Business Systems (CBS) ($137,000) – An increase of $137,000 is required in FY 2013 consistent with the CBS Capital Asset Plan.

National Archives and Records Administration (NARA) storage costs ($1,000) - NARA estimates reflect an increase of $1,000 in FY 2013 for records storage and maintenance costs.

Supplies and Materials		0	185
Scientific journal subscriptions	$156		
Helium	29		

Scientific journal subscriptions ($156,000) - This adjustment to base addresses the FY 2010 to FY 2011 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 7.3 percent deflator results in an increase of $156,366 when applied to the FY 2012 estimate of $2,142,000.

Helium ($29,000) – This adjustment to base was derived using a year to year comparison of the average cost per liter of helium. In analyzing the 12 months ended February 2011 and 2010, the per liter rate increased 7.5 percent (from 8.402 to 9.034) resulting in an increase of $28,875 when applied to the FY 2012 estimate of $385,000.

General pricing level adjustment	0	2,373

This request applies the OMB economic assumption of 1.5 percent for FY 2013 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 $19,905; rental payments to others $34,470 communications, utilities, and miscellaneous charges $68,415; printing and reproduction $4,830; other services $1,180,685; supplies and materials $367,200; and equipment $697,980.

Subtotal, Other changes	27	7,788
Amount absorbed	0	(7,788)
Total adjustments to base	27	0

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STRS

APPROPRIATION ACCOUNT: SCIENTIFIC AND TECHNICAL RESEARCH AND SERVICES

BUDGET ACTIVITY: MEASUREMENT SCIENCE, SERVICES, AND PROGRAMS

For FY 2013, the NIST budget request is an increase of $81.0 million from the FY 2012 enacted appropriations for a total of $648.0 million. The request provides a 117 FTE increase, including 27 FTE from the annualization of increases provided in FY 2012 appropriations.

BASE JUSTIFICATION FOR FY 2013:

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 more competitive ways to manufacture current generation products and that enable 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 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 interoperate and exchange information seamlessly across systems.

The Measurement Science, Services, and Programs budget is organized into three subactivities under the Scientific and Technical Research and Services (STRS) appropriation account.

- The Laboratory Programs subactivity ($572.6 million, 2,159 FTE) includes two user facilities (NIST Center for Neutron Research and Center for Nanoscale Science and Technology), two measurement laboratories (Physical Measurement Laboratory and Material Measurement Laboratory) and two technology laboratories (Engineering Laboratory and Information Technology Laboratory). It also includes The Strategic and Emerging Research Initiative (SERI), Innovations in Measurement Science (IMS), and the Postdoctoral Research Associateship Program.

- The Corporate Services subactivity ($18.6 million, 48 FTE) contains Computer Support and Business Systems in support of NIST's Laboratories.

- The Standards Coordination and Special Programs subactivity ($56.8 million, 85 FTE) manages the organization's programs and resources to meet specific mission objectives. Current activities include management of the Office of Law Enforcement Standards and NIST's responsibilities related to Greenhouse Gases and National Security Standards, among others.

Laboratory Programs

Exhibit 10

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

Activity: Measurement science, services, and programs
Subactivity: Laboratory programs

Line Item		2011 Actual Personnel	2011 Actual Amount	2012 Currently Available Personnel	2012 Currently Available Amount	2013 Base Personnel	2013 Base Amount	2013 Estimate Personnel	2013 Estimate Amount	Increase/ (Decrease) over 2013 Base Personnel	Increase/ (Decrease) over 2013 Base Amount
Strategic and emerging research initiative fund	Pos./Approp	25	$9,743	25	$9,668	25	$9,668	25	$9,668	0	0
	FTE/Obl.	23	9,120	24	10,313	24	9,668	24	9,668	0	0
National measurement and standards laboratories	Pos./Approp	1,590	372,862	1,702	420,736	1,702	420,736	1,778	468,909	76	$48,173
	FTE/Obl.	1,544	384,673	1,684	432,472	1,706	421,384	1,762	470,807	56	49,423
User Facilities	Pos./Approp	260	69,575	260	74,557	260	74,557	275	81,055	15	6,498
	FTE/Obl.	250	70,306	259	75,273	259	74,755	270	81,253	11	6,498
Postdoctoral research associateship program	Pos./Approp	85	11,008	105	13,008	105	13,008	105	13,008	0	0
	FTE/Obl.	81	9,860	99	14,212	103	13,022	103	13,022	0	0
Total	Pos./Approp	1,960	463,188	2,092	517,969	2,092	517,969	2,183	572,640	91	54,671 [1/]
	FTE/Obl.	1,898	473,959	2,066	532,270	2,092	518,829	2,159	574,750	67	55,921 [2/]

[1/] The increase of $54.671 million consists of $39 million for Advanced Manufacturing (components of the $45 million initiative), $8 million for Advanced Communications (component of the $10 million initiative), $5 million for Disaster Resilience, $8 million for NSTIC, and a decrease of $5.329 million in grants (component of the $12 million extramural grants reduction).

[2/] The difference between obligation and appropriation is due to EAC transfer of $2.75 million and transfer out of $1.5 million to NIST WCF.

SUBACTIVITY: LABORATORY PROGRAMS

The objectives of the Laboratory Programs subactivity 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 by NIST include advanced manufacturing, cybersecurity, Smart Grid, Healthcare IT, alternative energies, and improved sustainability. 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 Budget Line Items under NIST's Laboratory Programs are described below.

1. NIST Center for Neutron Research (NCNR)

Program Description:

NIST safely and reliably operates a national user facility providing neutron-based measurement capabilities to U.S. researchers from industry, academia, NIST, and other government agencies in support of materials research, neutron imaging, chemical analysis, neutron standards, dosimetry, and radiation metrology. The NCNR, the Nation's premier neutron research facility, serves the majority of all neutron scattering users in the United States. 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 technology, 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 dynamics, neutron trace analysis, neutron chemical spectroscopy, neutron imaging, and neutron spectroscopy. In FY 2012 NIST will restart reactor operations following an extended shutdown period used to enhance and increase neutron measurement capabilities as part of the ongoing NCNR expansion initiative.

Examples of Accomplishments:

Research and Facility Performance:

- National Research Facility/Neutrons: Even with the long FY 2011 shutdown, NCNR successfully operated the reactor to support scientific research on 142 days out of as many scheduled days. During FY 2010, the last previous year of full NCNR operations, nearly 2,300 researchers directly benefited from access to NCNR capabilities, which accounted for over one-half of all neutron research done in the United States. Researchers from 42 States, Puerto Rico, and the District of Columbia are included in this total. These researchers also represent 146 U.S. universities, 45 U.S. corporations, and 32 U.S. government organizations and laboratories.

- High Impact Research: Research performed at the NCNR resulted in 328 publications in FY 2011. 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 2013:

In FY 2013 the NCNR will have completed construction and new instrumentation work performed during the shutdown allowing 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. In the case of energy, nanoscale phenomena lie at the heart of a great many energy production, storage, and transmission processes. Research aimed at optimizing the nanoscale structure of photovoltaic or thermoelectric devices can, for example, 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 uniquely satisfy these demands. Offering many unique measurement capabilities, the CNST provides an open, collaborative, multi-disciplinary research environment that focuses on national nanoscale measurement needs in such areas as nanomanufacturing, next-generation energy systems, future electronics, and nanofabrication. 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, offers open, convenient and economical access to expensive state-of-the-commercial-art fabrication tools, measurement tools and processes in an environment designed to support both new ventures seeking assistance and training, and experienced practitioners needing access to a research "fab" with a broad selection of advanced tools. Quick access is available through a simple, merit-based application process. 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 is continuing 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.

Examples of Accomplishments:

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

- National Research Facility: In FY 2011, the CNST's third full year of operation, the number of researchers benefitting from access to the CNST totaled over 1,300, and continued to grow rapidly. These 1,300 researchers participating in CNST-supported projects were employed by 74 companies, 25 government institutions, and 166 universities, including institutions in 41 states and the District of Columbia.

- Energy Conversion, Storage, and Transport: The CNST has developed a new approach to evaluating future rechargeable batteries being developed based on nanowires, fabricating complete, functional single-nanowire lithium-ion batteries optimized for characterization in a transmission electron microscope. Using these nanodevices, the CNST has observed the nanoscale structural changes that occur inside an individual nanowire battery during charging and discharging, providing valuable information for improving the efficiency and performance of this promising technology.

- Future Electronics: The CNST provided world-leading insights into the properties and potential of graphene, considered one of the most promising materials to revolutionize future electronic devices, through collaborations using its unique measurement instruments for probing the quantum electronic structure of nanometer scale systems. The CNST research included collaborators from Georgia Institute of Technology, Columbia University, the University at Albany, University of Texas, Seoul National University, and others.

- Nanoscale imaging and fabrication: CNST researchers created a prototype of a novel hybrid nanomechanical-nanophotonic chip designed for rapid, compact, and low-cost nanoscale metrology in a wide range of applications. The integrated sensor chip combined a nanomechanical cantilever probe with a high-sensitivity nanophotonic interferometer. Replacing the traditional bulky laser detection system with this integrated device allowed the cantilevers to be orders of magnitude smaller than prior displacement sensors. Because each of these smaller structures has an effective mass less than a picogram, the detection bandwidth is dramatically increased, reducing the system response time to a few hundred nanoseconds.

Priority Objectives for FY 2013:

- Metrology for Process Control: In collaboration with a leading U.S. aerospace company, develop a new technique using microwave spectroscopy to monitor the distribution of carbon-based nanostructures in nanocomposite materials on the production line, and thereby assist the U.S. in maintaining leadership in the production of high-performance materials for aerospace, transportation, and energy applications.

- Nanoscale Material Characterization: Expand the use of single-molecule fluorescence microscopy to the imaging of nanostructures and interfaces in advanced materials, enabling the optimization of materials and processes in fields as diverse as integrated circuit fabrication and advanced composites manufacturing.

- New Microscopies for Nanoscale Characterization and Fabrication: Develop innovative ion beam sources to enable a wide range of new imaging and nanofabrication modalities. Work with small businesses to transfer this technology and create opportunities for high tech start-ups, leading to new jobs in an area where the U.S. has an opportunity to become the leader.

- Technology for On-Chip Optical Data Processing: In collaboration with a major U.S. corporation, develop new characterization and measurement tools for future generations of novel optical data processing and transmission compatible with existing technologies necessary to maintain U.S. leadership in advanced computing.

- Electronic Devices for Data Processing and Storage: Apply CNST's strong capabilities in nanomagnetics imaging, nanomagnetics dynamic measurements, and theory and modeling to the problem of developing new ways to process and store data. In collaboration with industrial and academic partners, provide measurements in support of the development of new nanomagnetic devices and storage paradigms needed to maintain U.S. competitiveness in this seven billion dollar industry.

- Solar Energy/Photovoltaics (PV): Develop measurements essential to fully characterize and optimize existing and emerging thin-film photovoltaic materials and devices to achieve three-dimensional, high resolution, correlated mapping across a wide range of lengths scales of chemical composition, structure, and electric field. Asses the role of imperfections, including grain boundaries, distribution of domains, defects, chemical segregation, impurities, and density variations, on carrier transport and recombination defining the device performance.

- Battery technology: Develop methods to characterize *in-situ* changes in the composition, structure, and electrostatic potential in lithium-ion batteries during recharging cycles with spatial resolution ranging from the nanometer to the millimeter scale, and thereby determine the effects of working conditions, protective coatings, and electrolyte additives on performance and aging, and identify the origins of performance limiting impedance at the interfaces. Use the experimental input to construct and validate circuit level, finite element, and molecular dynamics models for battery operation and degradation under a range of operating conditions

- Efficiency of energy usage: Develop metrology for simultaneous, high-throughput and precise assessment of multiple parameters determining the conversion efficiency of thermoelectric materials and devices compatible with manufacturing processes of emerging high-efficiency nanostructured thermoelectric.

- New Capabilities in the NanoFab: Add new capabilities in the NanoFab for automated, reproducible lithography, wet chemical processing, and nanoscale patterning and chemical analysis of metals and other hard materials in order to maintain the cutting edge research environment required to meet the needs of industry and other stakeholders.

- 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, 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 through 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 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 3 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[1] and nearly 37 million

[1] *All therapeutic radiation procedures performed in the United States must be traceable to NIST standards. According to the American Cancer Society (http://www.cancer.org), there will be nearly 1.6 million newly diagnosed cancers in the United States in 2011. Approximately 60 percent of cancer patients are treated with radiation therapy during the course of the disease. An estimate of the number of cancer patients treated annually using radiation therapy is, therefore, about 900,000. Each patient will have a total of between 25 and 30 fractionated dose procedures (between 22 million and 27 million individual procedures performed annually). Therapeutic radiation procedures are also used for diseases other than cancers. However, statistics on these are not available.*

x-ray mammograms[2] 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 is highly dependent on measurements enabled by NIST programs. The U.S. electronics and electrical equipment industries (including computer, communications, semiconductor component and equipment manufacturing) employed almost 3 million people at the end of 2007,[3] and the products of these industries, representing over $830 billion in U.S. shipments annually, support other major manufacturing and service industries, such as the automotive, aerospace, and health-care industries. 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.

- 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.

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[2] *All mammograms performed in the United States must be traceable to NIST standards. As of December 1, 2011, over 39 million mammograms were being performed annually. See See* http://www.fda.gov/Radiation-EmittingProducts/ MammographyQualityStandardsActandProgram/FacilityScorecard/ucm113858.htm.

[3] *http://www.bls.gov/news.release/empsit.t14.htm*

Examples of Accomplishments:

- Time and Frequency: NIST built the world's most precise atomic clock, which was based on a single aluminum atom and more than twice as precise as any previous clock. It would neither gain nor lose one second in 3.7 billion years. Ultra-precise timekeeping enables continued improvements in GPS technology and fundamental scientific inquiry.

- Medical Imaging Technology: NIST developed improved measurement methods and materials, including the first standard "phantom" to mimic the human body for the calibration of magnetic resonance imaging (MRI) machines, and pioneering the use of quantum dots to illuminate cell interiors. NIST advances are helping make medical imaging more accurate and consistent, and giving doctors new tools to visualize the body's internal structures, diagnose diseases, plan medical treatment, and measure the efficacy of therapies.

- 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 2013:

- Dimensional Metrology: In support of the National Nanotechnology Initiative, develop a new class of fundamental, traceable nanoscale dimensional measurements for pitch, height, and width for features smaller than 20 nm in dimension with uncertainties at the atomic scale in direct support of nanoelectronics and nanotechnology manufacturing.

- Medical Imaging Technology: Develop a positron emission tomography – computed tomography (PET-CT) imaging testbed and user facility to determine the sources of error associated with medical imaging procedures and to measure the properties of potential imaging standards, biomimetic phantoms, and novel imaging agents.

- Electronics Technology: Advance solar energy technology by developing measurement methods that improve the understanding of the fundamental processes in which light generates electrical current in next-generation solar cells. Establish a world-class electronics reliability research center at NIST to ensure that next-generation and environmentally friendly devices perform predictably and reliably.

- Neutron Imaging: Apply and further develop expertise in neutron imaging to provide real-time diagnostics of lithium dynamics in next-generation lithium-ion batteries, being developed for advanced vehicle technologies. This will provide the U.S. battery industry with means to better engineer innovative technologies in support of a clean energy future.

- Optical Technology: Improve satellite and ground-based measurement methods for determining CO_2 emissions. Help develop new field able techniques for atmospheric monitoring using innovative laser spectroscopy, correlated with independent measurements of CO_2 mass flow rate.

- Public Health and Safety: Further develop NIST's state-of-the-art gamma ray spectrometer for application in verifying nuclear non-proliferation. This ultra-precise technology can distinguish between naturally occurring and weapons-related isotopes, quickly and non-destructively during cargo inspections.

- 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. Additionally, we will refresh NIST's aging time and synchronization measurement and distribution systems to meet contemporary demands.

4. Material Measurement Laboratory (MML)

Program Description:

The MML serves as the national reference laboratory for measurements in the chemical, biological, and material 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:

- Analytical Chemistry to provide the measurement science for reference methods and Standard Reference Materials to support traceability and comparability of chemical measurements both within the U.S. and globally;

- Biochemical Science to provide biochemically- and biologically- based measurement methods, data, reference materials, and predictive models to advance innovation and support the commercialization of biotechnology-based discoveries;

- Ceramics to provide measurement science and provide measurement methods, reference materials, Standard Reference Data, and software tools pertaining to the structure, properties, and performance of advanced inorganic and hybrid materials and structures in support of technology development by U.S. industry;

- Chemical and Biochemical Reference Data to provide measurement science and computational approaches for Reference Data, protocols, and databases to support the identification of chemical and biochemical species and for the determination, estimation, and prediction of chemical and physical properties and reactivities for mixtures and for species such as small molecules, aerosols, proteins, nanoparticles and biomolecules to support accurate identification

of species and to support prediction of success for design and commercialization of materials with desired characteristics;

- Surface and Microanalysis Science to provide measurement science and development of methods for provision of reference materials and reference data to support quantitative chemical characterization and imaging at high spatial resolution, ranging from atomic to macroscopic length scales, on systems and processes to support traceability of these measurements nationally and internationally;

- Materials Reliability to provide measurement methods, Standard Reference Materials and data to enable the prediction of the reliability of materials, in applications ranging from bridges to biology in support of assessing and improving the safety of physical infrastructures in the U.S. as well as the innovation, evaluation of the reliability (in varied environments), and commercialization of a wide range of material components including biomaterials;

- Metallurgy to provide the measurement methods, Standard References Materials, and Reference Data for the measurement and prediction of performance and reliability of metallic materials that support innovation and lowering of costs of metals producers and users by enabling informed predictions of the performance, manufacturability, and long-term reliability of materials;

- Polymers for the measurement science to provide the measurement methods, reference materials and data in support of the determination of the physical/chemical/functional properties, and structure, and processing of polymers and complex fluids to advance the manufacture and use of these "soft" materials (polymers and complex fluids in industry);

- Process Measurements to develop standards, reference data, models, and sensing technologies to support the improvement and monitoring of industrial processes and for addressing measurement problems for applications in biomanufacturing, health care, and industrial processes;

- Thermal Properties and Science to provide critically-evaluated thermophysical property data on a wide range of gases, liquids, and solids (including mixtures and supercritical fluids) to support the availability of critical reliable data for development, design, and manufacture of wide-ranging materials such as alternative/sustainable fuels, explosives, refrigerants, cryocooler and power cycle fluids.

MML is also responsible for coordinating the NIST-wide Standard Reference Materials and Standard Reference Data 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 (and Continuing Activities):

Research and measurement service delivery focus on industry and government priorities, as described below:

- Advanced Materials: Establish quantitative processing-structure-property relationships of 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. New, advanced materials define the state of technology in manufactured products, and MML provides the tools for accurate measurements of these cutting edge materials needed to enable the efficient manufacture of innovative products ranging from nanoscale next-generation microelectronics to energy efficient automobiles, and required for assessing the safety, toxicity and environmental impact of advanced engineered nanomaterials.

- Biomedical and Healthcare: Increase the accuracy, comparability, and efficacy of measurements used in medical diagnostics and advanced therapeutics in ways that enable 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 now provides needed measurements and standards to support: measurement of health status markers in serum, urine, and tissue; the development of personalized medicine and cell-based regenerative medicine; the development of advanced dental materials, tissue engineering scaffolds, nanoparticle-based therapies for cancer, preservation strategies for protein therapeutics, and safe and reliable implanted medical devices.

- Electronics: Quantify the composition, structure, properties and dimensions of current and emerging electronic materials and devices, and to assess electronics fabrication routes in ways that enable 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: Support 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 enable 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: Verify assessments of soil, air, and water, as well as environmental threats, and to support environmental remediation strategies, in ways that enable 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, animals and humans.

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

- Manufacturing: Support the industrial production of finished goods from raw chemicals, raw materials and biological sources, and that accelerate 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 pharmaceuticals.

- Physical Infrastructure: 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 enable 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.

- Security, Safety, and Forensics: Advance threat detection, improve the accuracy of forensics measurements and 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 2013:

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

- 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, basic chemical formulations, petroleum based products, consumer products, and pharmaceuticals;

- measurement methods and instruments capable of determining the composition and structure of materials with the unprecedented resolution and accuracy needed by industry to advance the development of products including semiconductors, engineered nanomaterials and catalysts. This includes microscopy and spectroscopic methods to image materials at the atomic and molecular scales, and a suite of NIST-developed synchrotron spectroscopy instrumentation at the world's premiere synchrotron user facility, NSLS-II (Brookhaven National Laboratory);

- reference materials and data needed by industry to calibrate nanoscale measurements of nanomaterials and other advanced materials. These include reference flexural cantilever arrays for calibration of force measurement in scanning probe microscopes, which are ubiquitous in industry laboratories;

- measurement methods and standards for assessing and managing the environmental, health and safety risks of engineered nanomaterials and products containing engineered nanomaterials, with a focus on industry-relevant species, such as titanium dioxide, silver and silicon dioxide nanoparticles; and

- length dispersion carbon nanotube reference materials needed to gauge the performance and potential NanoEHS risks of single wall carbon nanotubes, and databases of critically evaluated crystal structure and phase equilibrium data.

Biomedical and Healthcare: MML will develop and disseminate reference methods, Standard Reference Materials, and measurement quality assurance programs, needed to support increased accuracy and comparability in 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);

- genetics analysis, as well as DNA and RNA expression measurements methods that support early detection of cancers and that guide cancer therapy decisions; and genetics-based diagnostics (such as those used for detection of Huntington's Disease and Fragile X Syndrome);

- measurement protocols and reference data and reference materials that enable detailed structural analysis of glycoproteins, needed to assess the identity, safety and effectiveness of many protein-based pharmaceuticals;

- documentary standards and best-practice protocols for measuring stem cells, requested by the cell therapy industry and the FDA to improve the quality of cell-based biological assays;

- 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 in active medical devices like pacemakers; and

- 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; and

- 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 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;

- 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 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; and

- 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.

Environment and Climate: MML will develop and disseminate:

- measurement methods, data, 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;

- 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 data and thermophysical property values requested by the DOE to evaluate the effectiveness and safety of more environmentally benign refrigeration fluids;

- 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; and

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

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:

- the isotopic ratio of 87Sr/86Sr in food to support the identification of counterfeit food products or for customs investigations of food origin;

- 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 in baby foods, breakfast cereals and table salt, in partnership with the NIH Office of Dietary Supplements; and

- Indicators of food spoilage in priority systems such as poultry.

Manufacturing: Enabled by new funding provided in FY 2012 and the reprioritizing of current resources, MML will substantially grow 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, real-time measurement of biologic products during manufacturing. In particular, MML research products will support the manufacture of biotechnology drugs, currently dominated by protein therapeutics, which are the fastest-growing class of pharmaceuticals as well as the fastest growing category of health care spending. Specific efforts include measurement research in protein structure including post-translational modifications that can affect the efficacy of a drug, such as glycosylation. Much needed protein aggregation and immunogenicity standards will also be developed under this program. Through this program, MML will work with industry and Federal regulatory agencies to understand emerging measurement problems, develop innovative measurement solutions to address these issues, and achieve consensus in standards development in the area of biomanufacturing.

- Materials Genome Initiative (MGI): MML expertise in materials measurements and modeling will be an essential component to this interagency effort aimed at accelerating industrial innovation by significantly reducing the timeline 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 will strengthen and extend its expertise in the development and use of multi-scale materials modeling and simulation, with a focus on areas such as standard reference databases, data assessment and validation, and the development and implementation of standard protocols needed to connect the results of simulations enacted on the atomic, molecular, microstructural and macroscopic scales.

- NanoEHS for Nanomanufacturing: In collaboration with other NIST laboratories, MML will develop measurement science and standards needed to support assessments of

nanotechnology-related environmental health and safety (nanoEHS). These research and standards products 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 High-Volume Manufacturing with Advanced Materials: In partnership with industry, MML will develop a suite of measurement tools capable of monitoring advanced high-volume manufacturing processes. These measurements will enable manufacturers to assess and optimize, in real time, the processing and properties of the complex materials incorporated into technologies such as flexible electronics, thin film and organic photovoltaics, and advanced composites. The work will focus on measurement techniques for monitoring processes such as interface formation, film formation, deposition distribution and structure formation at the speeds needed for roll-to-roll manufacturing, and often with nanometer-level resolution.

- Sustainable Manufacturing: MML will develop and deploy measurement techniques and standards needed to support industrial substitution of toxic, resource intensive, energy intensive, and rare or expensive materials in their manufacturing processes. MML efforts will include: the development of measurement protocols and standard reference materials that improve the quality and performance of plastics and composites fabricated from bio-based feedstocks and fundamental measurement science that will accelerate the manufacture of high-power magnets and electronics that reduce or eliminate the use of critical rare earth metals or toxic materials like lead. In addition, the NIST Automotive Light-weighting center will deploy data, measurement protocols and models that will enable the automotive industry to more rapidly design and manufacture vehicle components from light-weight alloys, which promise to significantly improve the fuel efficiency of automobiles.

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; and

- 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.

Security, Safety, 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; and
- 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. The Laboratory 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. It 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.

The Laboratory'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 Grid Interoperability: To support the modernization of the U.S. electrical power grid by (1) accelerating the development and adoption of Smart Grid interoperability and cyber security standards; (2) promoting a testing and certification framework to ensure the

interoperability and security of Smart Grid devices and systems; and (3) developing the measurement science that will support the next generation of Smart Grid technologies.

- 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 and cyber-physical systems applications.

- Smart Manufacturing, Construction and Cyber-physical Systems: To enable real-time monitoring, control, and performance optimization of smart manufacturing systems in the factory.

- 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.

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

  - Sustainable Manufacturing: To develop and deploy advances in measurement science to achieve sustainability across manufacturing processes enabling efficient resource utilization and resilient production networks.

  - Sustainable, High-performance Infrastructure Materials: To develop and deploy advances in measurement science for sustainable materials used 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 develop and deploy advances in measurement science to enhance the resilience of buildings and infrastructure to natural and manmade hazards.

Examples of Accomplishments:

- Smart Manufacturing, Construction, and Cyber-Physical Systems

  - Smart Grid Interoperability: Expedited the development and adoption of interoperability standards through an open, consensus-based process that emphasizes public participation via the Smart Grid Interoperability Panel (SGIP), which was established by NIST. Results of this process already include key publications such as the *NIST Framework and Roadmap for Smart Grid Interoperability* and the *Guidelines for Smart Grid Cyber Security.*

  - 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: Contributed critical technical content to new ISO 10218 robot safety standards that were balloted in 2011 and have now been approved, and drafted key parts of the ISO guidelines for implementing the standards. The new standards resolve differences between robot safety requirements for the U.S., Canada, and around the world, and provide for speed and separation monitoring features that enable new modes of safe human-robot collaboration, and are expected to result in increased productivity and reduced floor space and cost requirements for robot installations.

  - Smart Manufacturing and Construction Systems: Completed the development of a conformance testing tool for the DMIS 5.2 programming language for coordinate measuring machines. This software-based testing tool is used by the Dimensional Measurement Standards Consortium to certify compliance of programming software for coordinate measuring machines and help assure that these critical quality control instruments make measurements correctly.

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

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

  - Sustainable Manufacturing: Completed a comprehensive analysis of existing standards and directives related to sustainable manufacturing and broadly disseminated the results through a newly developed web-accessible tool. This NIST-developed tool allows diverse stakeholders – software vendors, industry end users, industrial consortia, academia, and government agencies – to understand and apply standards for products, processes and services and to comply with applicable standards.

  - Sustainable, High-performance Infrastructural Materials: Developed hardware and measurement protocols for capturing and characterizing nanoparticles released from

weathered nanocomposite building materials. Quantifying the release of nanoparticles during service and disposal is critical to assessing the potential environmental, health, and safety threats of these materials, a key attribute of sustainability.

- Net-Zero Energy, High-Performance Buildings: Developed new simulation techniques and a database of airtightness values in U.S. commercial buildings, which have been used to support energy savings estimates from improving building airtightness. This work led directly to the addition of a building airtightness requirement in ASHRAE Standard 90.1, the Nation's premier building energy standard, as well the adoption of similar requirements by the Army Corps of Engineers, the General Services Administration, and several state building codes.

- Disaster-Resilient Buildings, Infrastructure, and Communities

  - Fire Risk Reduction in Communities: A final report was completed on the study of the June 18, 2007, fire at the Sofa Super Store in Charleston, S.C., that trapped and killed nine firefighters, the highest number of firefighter deaths in a single event since 9/11. NIST is working with various public and private groups toward implementing changes to practices, standards, and building and fire codes based on the findings from this study.

  - Fire Risk Reduction in Buildings: Developed new innovative measurement capabilities to reduce material flammability, including the ability to use carbon nanotubes and nanofibers in a Layer-by-Layer Assembly process for coating materials, and a foam smoldering assessment device and protocol that quantifies material smoldering performance.

  - Earthquake Risk Reduction in Buildings and Infrastructure: Developed improved procedures for selecting and scaling ground motions for use in nonlinear analysis of the response of structures to earthquakes. This capability will lead to higher accuracy performance-based seismic design of buildings.

  - Structural Performance Under Multi-hazards: A NIST team was deployed to Joplin, Missouri, and has assembled its initial observations and preliminary findings on the tornado which killed over 160 people. The team focused on the patterns, locations and causes of fatalities and injuries; the warning system, evacuation, emergency response and occupant behavior; responses of buildings, shelters and safe areas; and damage to lifelines.

Priority Objectives for FY 2013:

- Smart Grid Interoperability: Publish new releases of both the NIST Framework and Roadmap for Smart Grid Interoperability and the NIST Smart Grid Cyber Security Guidelines, which will help ensure efficient, secure, and reliable operation of Smart Grid devices and systems. Continue oversight of the Smart Grid Interoperability Panel (SGIP) and support its goal of developing an additional twelve Smart Grid standards, completing eighteen Priority Action Plans, and finalizing a framework for testing and certifying Smart Grid products.

- Smart Manufacturing Processes and Equipment: Complete design of a new test artifact for metal-based additive manufacturing, and propose for standardization by the ASTM F42 committee. The standard test artifact will provide a critical common point of reference for defining, evaluating, and improving the performance of additive manufacturing equipment.

- Next Generation Robotics and Automation: Develop and implement a "ground truth" system for assessing the performance of sensors that identify and locate objects. This capability will

underpin ASTM E57.02 standards for measuring—and spurring improvement of—the performance of perception systems that provide robots with information about objects in their environment. Such perception systems are needed to enable robots to perform more complex tasks with greater robustness to part placement variability.

- Sustainable Manufacturing: Complete characterization of high-energy manufacturing processes and develop energy consumption simulation models for selected processes. Identify measurement science gaps in carbon footprint and hazardous material information standards. New measurement science for modeling manufacturing processes will enable manufacturers to optimize energy consumption and reduce emissions.

- Net-Zero Energy, High-Performance Buildings: Commission the newly constructed Net-Zero Energy Test Facility and conduct extensive monitoring measurements to capture overall energy performance and the performance of subsystems within the facility. Develop a commissioning tool for guiding installation of residential and light commercial air-conditioning and heat pump systems to set 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.

- Fire Risk Reduction in Buildings: Commission the newly built National Fire Research Laboratory infrastructure and conduct shakedown experiments. The experiments will demonstrate the capabilities of the new facilities, which will enable the development of measurement science needed for performance-based design methodologies for fire resistance of structures.

- Earthquake Risk Reduction in Buildings and Infrastructure: Complete study to determine if building code provisions for structural systems achieve sufficient lateral load capacity from wind design requirements so that the required lateral load resistance for earthquake is achieved. If verified, this could enable relaxation of expensive seismic detailing requirements for buildings in the central and eastern U.S., resulting in cost savings in construction with no reduction in performance and safety.

6. Information Technology Laboratory (ITL)

Program Description:

The ITL develops and disseminates standards, measurements, and testing for interoperability, security, usability, and reliability of information systems, including cybersecurity standards and guidelines for Federal agencies and U.S. industry, supporting these and measurement science at NIST through fundamental and applied research in computer science, mathematics and statistics.

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, usable, and reliable; 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 several 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 within government and industry by providing technical guidance and promoting standards.

- 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 enable prediction and control of their behavior. Initially focused on the Internet and Grid Computing, this Program will facilitate 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 pushed, 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 organizational enterprises to fully implement a threat-vulnerability-asset based cybersecurity continuous monitoring program.

- Cybersecurity Center of Excellence: The U.S. Department of Commerce, through NIST, has been charged with establishing a public-private partnership to operate a Cybersecurity Center of Excellence based at a facility shared by NIST and the State of Maryland. This activity is being undertaken in cooperation with the State of Maryland. Both Federal and State partners will mutually benefit from the public-private partnership operating from a common pre-competitive research center. The mission of the Cybersecurity Center of Excellence is to foster development and rapid adoption of comprehensive cybersecurity platforms that support automated and trustworthy government and industry business operations and e-commerce.

- Health Information Technology: NIST's laboratories are contributing to the healthcare industry by providing its standards, measurement science and testing expertise. NIST collaborates with major standards development organizations, professional societies and the public sector in fostering interoperable, secure, usable, and reliable standards-based solutions for the exchange of health information. NIST focuses on advancing healthcare information standards that are complete and testable and by 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 information technology.

- Materials Genome Initiative: The Materials Genome Initiative (MGI) at NIST will develop the measurement science, tools and standards necessary to enable greatly improved efficiency in the Nation's development and manufacture of new products and services based on innovative materials. In conjunction with materials measurement efforts within MML, NIST's ITL will extend its expertise in the development and use of materials modeling and simulation directed at

manufacturing, and initiate the creation of a national measurement and standards infrastructure that will substantially lower the cost of both design and manufacturing for industries seeking to realize the benefits of computer-based materials discovery and optimization.

- 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 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 and the NSTIC Grant Program will conduct research into existing identity management schemes and publish gap analysis and recommendations; establish a privately led steering group 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 services providers. It will 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 NPO will work closely with the Executive Office of the President (EOP), the Federal CIO Council, the Information & Communications Infrastructure 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.

- 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 Administration 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. The NICE will be represented by 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 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 the Department of Homeland Security (DHS).

- Quantum Information Program: 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. The aim of the NIST Quantum Information Program is 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 of the NIST Quantum Information Program 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, measurement methods, and standards. ITL is leading NIST Smart Grid activity in cybersecurity and the use of wireless communications and Internet protocols in the Smart Grid, as well as the harmonization of power line carrier standards for appliance communications in the home.

- Virtual Measurement Systems: A virtual measurement is a quantitative result and its uncertainty, obtained primarily by a nontrivial computer simulation or computer-assisted measurements. Examples of virtual measurements include computational models of physical systems and visualizations of the results. The Virtual Measurement Systems Program introduces metrology constructs - standard references, uncertainty characterization and propagation, and traceability - into scientific computation and computer-assisted measurement technologies. As with physical measurement systems, development of a virtual metrology infrastructure will result in predictive computing with quantified reliability. In turn, this will enable improved decision making contingent on virtual measurement systems.

- 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; and
  - 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: As wireless communications become ubiquitous and used in many different environments for very different mission critical applications, it is imperative to develop standards and metrics that improve wireless communications resilience and interoperability. This program is focused on developing standards and metrics to support critical wireless communication requirements including reliability, capacity and dynamic network coverage.

Examples of Accomplishments:

- Cloud Computing: NIST met a major milestone in support of the U.S. CIO Federal Cloud Computing Strategy – release of the draft Special Publication 500-293 "USG Cloud Computing Technology Roadmap" for public comment. This occurred in parallel with the NIST public outreach Cloud Computing Forum and Workshop IV, attended by more than 450 individuals. The roadmap reflects work NIST led and completed collaboratively with 30 Federal agencies and hundreds of private sector stakeholders to identify and make progress against the highest priority interoperability, security, and portability requirements that must be met to accelerate U.S. government adoption of Cloud Computing. The technical foundation for the roadmap is publicly available on the NIST Cloud Computing website. Examples include: technical projects (Koala and SAJACC,) special publications (500-291 "USG Cloud Computing Standards Roadmap" and 500-292 "NIST Cloud Computing Reference Architecture") and 3) working documents ("Technical Considerations for USG Cloud Computing Deployment Decisions" and "Challenging Security Requirements for US Government Cloud Computing Adoption.") Much work was completed through the NIST public working groups and collaboration web site, partnering with academia, industry, standards organizations, government, and the international community.

- Measurement Science for Complex Information Systems: NIST identified a vulnerability to strategic attack on a class of network packet routing algorithms and showed that even a weak attacker can inflict serious damage (as measured by degradation in system performance) in routing algorithms characterized by selfish user behavior.

- Cybersecurity Automation: In FY 2011 the Cybersecurity Automation Program standardized metadata and provided metrics to 4,089 new Cybersecurity Vulnerabilities. It provided all cybersecurity vulnerability reference data in standardized format with multiple media presentations used by U.S. Government, industry, academia and multiple foreign governments in the NIST National Vulnerability Database (NVD). The Program validated 16 Commercial Tool Sets for compliance in meeting NIST cybersecurity automation standards supporting configuration management, vulnerability identification and automated remediation. The Program hosted a multi-agency workshop on IT Security Automation with DoD, NSA, and industry. It developed and deployed the NIST Security Automation Content Validation Tool designed to validate correctness of standardized data streams to latest NIST versions. NIST developed Cybersecurity Automated Configurations for multiple commercial products with Industry and Government involving multiple industry representatives and DISA, DoD, and NSA. NIST published NIST SP 800-126,Rev. 1 "The Technical Specification for the Security Content Automation Protocol (SCAP): SCAP Version 1.1", NIST IR 7831, "Common Remediation Enumeration", NIST IR 7802 "Trust Model for Security Automation Data", NIST IR 7756 "Draft CAESARS Framework Extension: An Enterprise Continuous Monitoring Technical Reference Architecture", NIST IR 7698 "Common Platform Enumeration: Dictionary Specification Version", and NIST IR 7696 "Common Platform Enumeration: Name Matching Specification", NIST IR 7694 "Specification for the Asset Reporting Format", and NIST IR 7692 "Specification for the Open Checklist Interactive Language." This extensive body of deliverables and reference

materials allow for automated, metrics-based, near real time and continuous monitoring and management of cybersecurity risk.

- Cybersecurity Center of Excellence: NIST drafted a Joint Project Agreement with the State of Maryland to establish the 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.

- Health Information Technology: NIST developed the conformance test method (test procedures, test data, and test tools) to ensure compliance with the Stage 1 Meaningful Use technical requirements and standards and in support of the Nationwide Health Information Network (NwHIN) testing.

- Identity Management Systems: NIST published "Electronic Authentication Guideline" (NIST Special Publication 800-63-1) which expands the options for government agencies that need to verify the identity of users of their Web-based services. The Guideline is an extensive revision and update of the original document, released in 2006 and is the official implementation guidance for the Office of Management and Budget (OMB) Memorandum 04-04, "E-Authentication Guidance for Federal Agencies."

- 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 and initiated the NSTIC Pilots Grant Program, which will award more than $10 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. In addition, NIST released the government's recommendations for the private sector-led NSTIC Steering Group to craft policies and standards for the Identity Ecosystem, and will provide a grant to catalyze the Steering Group's formation. NIST also published the NSTIC Federal Implementation Roadmap, identifying key milestones and agency leads for the complete set of Federal activities related to implementing the NSTIC.

- Materials Genome Initiative: Released version 2.1 of NIST's Object Oriented Finite element software (OOF), a specialized tool to help materials designers understand how stress and other factors act on a material with a complex internal structure, as is the case with many alloys and ceramics. OOF starts with micrographs—images of a material taken by a microscope—of real or simulated materials, allows users to assign material properties to the components, and then performs an analysis to determine the effect of, for example, external stresses or temperatures. Version 2.1 incorporates some dramatic improvements, including the ability to simulate nonlinear and time-dependent behavior.

- National Initiative for Cybersecurity Education: In FY2011, NIST issued the draft National Initiative for Cybersecurity Education (NICE) Strategic Plan, "Building a Digital Nation." This plan was developed from separate drafts that expressed the views of the four component areas into a comprehensive document that will be submitted for Cyber IPC approval. NIST organized and hosted the second annual NICE Workshop, "Shaping the Future of Cybersecurity Education," held on September 20-22, 2011. The workshop served as a forum for the community to openly discuss progress, solutions, challenges, and proposals relating to the goals of the NICE program. Over 500 attendees from academia, government, and industry joined in the workshop, either in person or virtually through webinars/webcasts. Participants included universities, community colleges, high schools, and other training associations, including international groups from Canada, Japan, Brazil and Italy. As part of its outreach role, the NIST NICE Leadership Team (NNLT) members also attended more than 100 events, symposia, forums, competitions, educational outreach meetings, and workshops to promote the initiative.

- Quantum Information Program: Many physical systems have been suggested for implementing quantum computers. To compare the different platforms in a standardized way, we have developed benchmark procedures to evaluate the quality of basic quantum computing operations. In particular, we have developed a standard method for determining an error per gate (EPG) for one-qubit computations that is being implemented on an increasing number of platforms, ranging from nuclear magnetic resonance (NMR) spectrometers to ion traps. This year we participated in a new implementation of this benchmark in a NIST ion trap where the qubits are manipulated with microwaves instead of laser light. This implementation successfully demonstrated EPGs below the critical value of 0.0001, which is believed to be necessary for practical scalable quantum computing.

- Smart Grid: NIST led the development of the "Guidelines for assessing wireless communications for Smart Grid Applications, V1.0" which was approved by the Smart Grid Interoperability Panel (SGIP) and the SGIP's Governing Board. It was published and included in the SGIP's catalog of standards in July 2011. The Priority Action Plan on Wireless Communications group was awarded an SGIP team recognition award in March 2011. In April 2011 NIST assumed co-leadership of the effort to develop a migration path between Zigbee Smart Energy Profile 1.X and 2.0. The group has completed a draft white paper on the requirements for coexistence and interoperability between SEP 1.X and 2.0 and the draft is currently available for public comment. The SGIP's Cybersecurity Working Group (CSWG) and NIST partnered with DOE and NERC to develop a Draft Risk Management Guide for the Electricity Sector, which utilizes the risk management approach defined in NIST SP 800-39. The CSWG Standards sub-group completed a cybersecurity review of 24 identified standards against the NISTIR 7628 high-level security requirements, earning the sub-group an SGIP Certificate of Appreciation in July 2011. In addition, the CSWG Privacy sub-group recently developed a privacy training briefing intended for electric utilities and public utility commissions (PUCs).

- Virtual Measurement Systems: NIST conducted initial development of a numerical simulation for bone-mineral density measurements – critical for diagnosis and treatment of bone-fragility diseases such as osteoporosis – and extended its analyses of sources of uncertainty in widely-used waveform-measurement devices such as oscilloscopes and photodiodes. NIST hosted and co-organized with the International Federation for Information Processing (IFIP) the Working Conference on Uncertainty Quantification in Scientific Computing, held in August 2011 in Boulder Colorado. The conference was attended by 76 mathematicians, statisticians, computer scientists, and application scientists and managers from 10 countries across the globe.

- Voting Systems Standards and Research: NIST continued to develop a set of 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 was a key contributor to 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: NIST created and successfully validated a reference behavior model for the various protocols described in the TIA-102 Trunking Common Air Interface (CAI) standards using Specification and Description Language (SDL).

Priority Objectives for FY 2013:

- Cloud Computing: NIST plans to work on the high priority interoperability, security and portability requirements identified in the USG Cloud Computing Technology Roadmap (early FY 2012) to accelerate USG adoption of cloud computing. This includes working with the cloud computing stakeholder community to recommend and identify initiatives that match USG cloud computing priorities (Priority Action Plans (PAP)). One PAP example is working with industry consortia and suppliers to encourage use of the Cloud Computing Reference Architecture to categorize their products and services. This makes it easier for U.S. government agencies and others to compare "apples to apples" when evaluating the different cloud service offerings. NIST led development of the Cloud Computing Reference Architecture in partnership with private sector volunteers in 2011, and worked with vendors to validate the reference architecture in early FY 2012. Another example is supporting international standards organizations in their development of consensus based international standards. A final example is working with public and private sector organizations to refine security requirements and solutions, including continuous monitoring and conformity assessment systems. USG high priority requirements and recommended PAPs are identified in the roadmap document.

- Measurement Science for Complex Information Systems: NIST will develop metrics that enable the characterization of key structural properties of abstract networks and computational strategies for their efficient computation relating these metrics to the reliability and security of information networks.

- Cybersecurity Automation: NIST will develop a public data model to standardize the expression of software vulnerabilities.

- Cybersecurity Center of Excellence: NIST will expand its development of multi-institutional, collaborative research 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.

- Health Information Technology: NIST will advance the interoperability, security, usability, reliability and adoption of health IT by collaborating with stakeholders to develop health information standards and technologies that are complete and testable and by providing the necessary conformance tests and tools. We will accelerate development of key standards, measurements and technologies for emerging health IT priorities: clinical decision support; medical records

discovery and sharing; retrieval and analysis of free-text healthcare data; integrated clinical environment and medical device interoperability; image quality; long-term preservation and management of electronic health records; semantic interoperability; genomics data; and, wireless medical wearable sensors.

- Identity Management Systems: NIST will develop metrics for multi-techology identity management solutions.
- National Strategy for Trusted Identities in Cyberspace: NIST will continue to facilitate implementation of the NSTIC. We 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. We will build a focused strategy to support the development of international standards. NIST's primary focus will be supporting governance and pilot activities, and accelerating Federal adoption of commercial identity solutions where individuals and organizations can complete online transactions with confidence, trusting the identities of each other and the identities within the infrastructure. NIST will also focus on providing the research and standards development needed for development of an online environment (the Identity Ecosystem) called for in the NSTIC.

- Materials Genome Initiative: NIST will develop semantic-based approaches and tools for the representation, identification, and exchange of materials property data.

- National Initiative for Cybersecurity Education: NIST will provide collaboration and coordination for NICE program threads. We will host quarterly coordination meetings for thread leads and host an annual public/private sector NICE workshop. We will maintain the NICE website as a news and collaboration site. We will encourage the private sector to fund public-private partnership events.

- Quantum Information Program: NIST will develop novel theoretical techniques to assess the true nature of the improvement in processing power obtainable through the use of quantum resources. We will apply these techniques to the assessment of algorithms that may provide the basis for future quantum-resistant public key cryptography.

- Smart Grid: NIST will 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 reviewing NIST publication 7761 "Guidelines for Assessing Wireless Standards for Smart Grid Applications" to identify necessary updates. In addition, NIST will continue to collaborate with the Department of Energy on risk management guidance for the electric power industry to help improve cybersecurity of the evolving smart grid. We will publish the revised NISTIR 7628, "Guidelines for Smart Grid Cyber Security" and complete the AMI upgradeability test project which will include development and implementation of specific test criteria, publishing of the criteria and updating of NISTIR 7823: "Advanced Metering Infrastructure Smart Meter Upgradeability Test Framework."

- Virtual Measurement Systems: NIST will research and develop metrology constructs – standard reference computations, uncertainty quantification, and traceability – into 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 such as those being undertaken under the Materials Genome Initiative. This measurement infrastructure will result in predictive

computing with quantified reliability. In turn, this will enable risk-informed decision-making for problems in which the results of computational models provide critical inputs.

- 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 event logs and voter registration databases. We will conduct research on methods for achieving auditability of voting systems that support both security and accessibility requirements. This will result in more trustworthy voting systems for Federal, state, and local elections in the U.S.

- Wireless Interoperability: NIST will develop and document metrics and methods for assessing the performance characteristics of wireless communication technologies.

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 contribute effectively to future national needs and goals by investing in high-risk, high-payoff research to enable innovation. 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 to solve problems in selected national need areas. The SERI program gives NIST the flexibility to respond quickly to developing capabilities to solve new measurement problems for emerging national needs. Examples of recent 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:

Climate Research/GHG Monitoring

SERI funding is being utilized to support cross NIST efforts to develop and validate novel methodologies and procedures remote monitoring and measurement of greenhouse gas emissions. Specifically SERI funds have accomplished the following:

- Dense Networks - In collaboration with leading universities, NIST initiated a feasibility study of the performance of spatially-dense, surface observing networks for the greenhouse gases, carbon dioxide and methane, and the anthropogenic tracer, carbon monoxide, as a potential measurement methodology capable of identification and

quantification of emission sources and sinks as a first step toward validation of greenhouse gas inventories locally and regionally.

- Microwave Standards - NIST scientist have recently completed the world's first free-field microwave brightness-temperature (T_B) measurements, with full measurement uncertainty analysis, on commercial microwave black-body calibration targets that are traceable to the International System of Units, and have demonstrated improved black-body target free-field reflectivity measurements on three candidate targets. These accomplishments are important steps towards realizing a full microwave emissivity measurement capability, essential to NIST's efforts to develop a full, SI-traceable T_B standard that will fill an important gap in microwave remote sensing instrument performance evaluation for use by both the airborne and satellite observing communities.

- Frequency Combs - IR Spectroscopic Source Development – Demonstrated an advanced dual frequency-comb spectrometer capable of simultaneously detecting the greenhouse gases carbon dioxide, methane, water vapor, associated atmospheric tracer gases, e.g., carbon monoxide, and many hydrocarbon pollutant gases. In addition significant advances toward combining dual frequency-comb spectroscopy with conventional laser spectroscopy as a basis for future measurement approaches useful for development of high accuracy spectral reference data have been made.

Biomanufacturing

SERI funding is being 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. To date SERI funding has been utilized to accomplish the following:

- Procured two types of instruments commonly used by the biopharmaceutical industry for characterizing protein particulates and developed competence in these measurements.

- Procured state-of-the-art ion trap mass spectrometer, developed liquid chromatographic and mass spectral expertise and new methodologies for characterizing glycosylation of therapeutic proteins, a post-translational modification found in ~3/4 of all protein products and a critical quality attribute that affects both product safety and efficacy.

- Completed procurement of an ARRA funded, ultra-high field 900 MHz Nuclear Magnetic Resonances (NMR) spectrometer. This NMR will be used to develop measurements and standards to support quantitative analysis of protein structure, function and post-translational modification that will support commercial development of protein biologics.

- Procured a SERI funded, state-of-the-art medium pressure chromatography system that will be used in conjunction with protein expression equipment/systems, rapid dialysis, and other purification equipment to increase the speed, reproducibly, and quality of in house protein (biologics) purification. This system is part of instrumentation being procured and two FTE positions being filled to establish a protein production and isotope labeling facility that will form a core capability to further development of standardized NMR and Neutron methods for analysis of protein (biologics) 3D structure.

- Procured a SERI funded, state-of-the-art temperature controlled Aqua spec infrared spectroscopy transmission cell, cell accessories, rapid scan capabilities and controlling software to upgrade our Bruker Optics Vertex 80 Fourier transform infrared spectrometer to measure and compare protein 2D and 3D structure using standardized methods to support biomanufacturing.

- Consulted with industry, FDA, other standards organizations, and biomedical community regarding the need for higher-order (3D) protein structure methods and standards to support protein biologics development and biomanufacturing.

- Established a simple phosphorus (31P) NMR based method for the detection of trace host cell protein enzyme contaminants in biologic samples that is based on the detection of dephosphorylation activity. This method has been used to detect and tentatively identify trace host cell protein contaminants in human protein biologic samples produced in transgenic plants.

- Collected and began culture and expansion of 3 cell lines from different biomanufacturers lines that represent different protein expression capabilities in order to characterize the performance of the lines and better understand the mechanisms that lead to more productive biomanufacturing processes.

Nano-EHS

Recent SERI funds were used to develop measurement tools relevant to the three most widely used engineered nanomaterials (ENMs) in consumer and biomedical products—titanium dioxide and silver nanoparticles, and single-wall carbon nanotubes (SWCNT). Work focused on the development of methods to measure the structure (atomic to nanometer length scales) and chemistry (concentration and elemental composition) of ENMs. Specific accomplishments include:

- Release of titanium dioxide nanoparticle reference material and related measurement and dispersion protocols;

- Release of the first SWCNT reference materials, including raw soot, length-sorted populations, and "bucky paper," and development of two ISO technical specifications on SWCNT spectroscopy measurements;

- Identification of the parameters determining the stability of silver and gold nanoparticles in biological and environmental media;

- Development and demonstration of a technique to map structural and chemical changes in ENMs at atomic resolution using an ultra-high resolution electron microscope; and

- Identification of the effect of various processes, such as bio-accumulation and bio-adsorption, on the leaching of silver from consumer products in various environmental media.

Physical Infrastructure

SERI funding is supporting NIST efforts to accelerate work directed at assessing the condition of aging physical infrastructure and guide cost-effective strategies for its maintenance, repair, and replacement. Specifically NIST is developing advanced sensor technologies for high-resolution

strain sensing, including microscale and full-field macroscale approaches that can be integrated with minimal impact into existing structures for real-time inspection and monitoring. These sensors, combined with NIST reference artifacts and calibration services, will provide a gold standard by which other inspection methodologies will be cross-compared. We envision a future user facility in which sensor manufacturers can perform calibration and validation testing of their products, increasing the portfolio of inspection tools available to the structural community.

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. Three NIST Nobel Prize winners in Physics (Dr. William Phillips, 1997, Dr. Eric Cornell, 2001, and Dr. Jan Hall, 2005) 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 technology. 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:

- Investigations of trace detection of explosives;
- Development of micro-pattern electrodeposition platinum alloy thin films and their use as catalysts;
- Analysis and evaluation of high-efficiency polymer solar cell materials;
- Investigation of fundamental mechanics of tooth enamel as related to fabricating biomimetic composites;
- Development of a technique for evaluating nanomaterial purity composition; and
- Investigations on the effects of ethanol fuel on fatigue crack growth in pipeline steels.

Priority Objectives for FY 2013:

The priority objectives for FY 2013 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 will be 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 FOR FY 2013:

1. Measurement Science for Advanced Manufacturing (Base Funding: $90.8 million and 98 FTE; Program Change: + 58 FTE and + $45.0 million):

NIST requests an increase of $45.0 million and 58 FTE for a total of $135.8 million to catalyze the development of measurement science, tools and standards that will enable the next generation of advanced manufacturing technologies.

The Administration recognizes that we must do more to enhance innovation in the manufacturing sector and invest in crosscutting technologies that can improve the competitiveness of U.S. manufacturing. Under this initiative, NIST will develop the underpinning measurements and standards to support cutting edge research in transformational manufacturing technologies. Efforts include focus on enhancing high technology manufacturing innovation in products and processes, particularly in the emerging game-changing fields of biomanufacturing, nanomanufacturing, and advanced materials. NIST's efforts support the development of increased intelligence throughout the manufacturing enterprise to enable higher agility and flexibility in products and processes, with higher quality, and greater reliability and robustness. To ensure strong ties to industry and to promote technology transfer, the new Manufacturing Fellowships Program will bring engineers and scientists from industry and academia to NIST to work on measurement science research for manufacturing innovations.

Proposed Actions:

This initiative will enable NIST to strengthen capabilities in multiple areas that impact manufacturing from cutting edge research in the technologies that are needed to underpin transformational manufacturing capabilities in high-technology industries like communications, biotechnology, and energy production to the development of measurement technologies and standards that will enable U.S. manufacturers to adopt technology advances that lower cost, reduce processing times, and improve overall quality.

This initiative targets emerging revolutionary processes and products, such as biomanufacturing, nanomanufacturing, and "materials by design" as well as the underlying smart manufacturing framework needed to accelerate the agility and quality of our Nation's manufacturing sector. The Manufacturing Fellowships Program will foster manufacturing technology transfer from the NIST Laboratories to industry.

With its FY 2013 budget request NIST is expanding its laboratory efforts in the following areas to address critical measurement and technology needs critical to advanced manufacturing:

- $10.0 million for metrology infrastructure and standards to support biomanufacturing.
  The initiative would provide the support needed to build upon the efforts begun in FY2012, focused on manufacturing issues pertaining to biologic drugs. When fully developed, these tools are expected to help provide the scientific basis for regulatory decisions and facilitate the development of lower cost generic versions of protein medicines, so-called biosimilars. NIST will develop measurement science, process monitoring tools, and standards for the biotechnology industry to enable more cost efficient manufacturing of a range of biologic products. This suite of metrology tools will also be generators of manufacturing knowledge that will allow rational process improvements leading to higher quality, lower cost biologic products. To accomplish these goals, the program will target three primary objectives:

- Protein Structure Metrology: Develop the measurement services and tools to aid in the characterization of the safety and efficacy of biologic drugs including standards and references to measure critical factors such as immunogenicity, 3-D protein structure, and post-translational modifications such as glycosylation that can affect the efficacy and reactivity of a biological drug.

- Test-bed bioreactor: Develop a test-bed bioreactor facility to benchmark and validate the performance of models and measurement tools used for in-line and at-line bioprocess monitoring. The facility will be used to develop protocols, standards and measurement science underpinning the use of these tools so they provide robust, accurate results. The test-bed bioreactor will also be used as a platform for research aimed at achieving a higher level of process understanding and control capability.

- Bioprocess measurements and standards: Benchmark and develop measurement science, protocols, and standards for sensors or instruments used in bioprocess monitoring. Metrology will be developed for both current generation sensor technologies and next-generation sensor technologies. Current generation tools are sensors that are currently used by the industry and they typically measure global properties such as temperature, pH, dissolved gases, nutrient molecules, or small molecules metabolites. These sensors also tend to be used in conjunction with multivariate data analysis (MVDA) models that are correlated with product trajectory during manufacturing. Next generation tools are advanced sensors that will directly measure critical quality attributes of biologic products or biomolecular signatures of bioprocesses that are direct indicators of product quality. NIST has held several workshops with industry to assess future measurement needs for bioprocess monitoring. One example of a need voiced by industry is technology for online monitoring of cell metabolism where the ability to monitor cell-distress and communication signals in real time would provide direct, real-time feedback on the cell culture process.

- $10.0 million for measurement science and standards to support nanomanufacturing:
NIST requests this increase for nanomanufacturing innovations and for nanotechnology-related environmental health and safety (nano-EHS) measurement science and standards. Nanotechnology offers exceptionally broad possibilities for manufacturing processes and consumer products across a spectrum of applications in electronics, energy, and other fields. These funds are requested for the development of measurement methods that will enable manufacturers to overcome a number of technical barriers to high-volume nanomanufacturing. Innovative, cost-effective, rapid methods are needed to ensure product quality by reporting on the nanoscale structure/properties of materials, nanostructures, or device arrays as they are processed at high speed.

  Nanomaterials can range from multi-functional, precisely engineered nanoparticles used in milligram quantities for therapeutic and/or diagnostic applications, to carefully controlled nanoscale systems employed in kilogram amounts for tasks such as catalysis, flexible electronics and energy storage, to bulk nanostructures produced in tons for high-performance nanocomposite materials for aerospace and defense applications. In each case, it is necessary to develop manufacturing techniques that yield the desired performance attributes at an economically viable cost of production.

  In order to optimize the manufacture of a nanomaterial system, measurement methods are needed that can help identify and measure what aspects of the material system are critical to

performance and functionality and as such must be monitored and controlled during production. For example, in an ink for flexible electronics, the critical parameter may be size, shape, surface chemistry, carrier transport, or some combination of these properties. Likewise, in a nanocomposite, the critical features of nanostructure morphology, distribution, and particle-matrix interaction must be identified in order to optimize the material composition. Manufacturing process control may involve the use of novel, detailed in situ measurements, as well as theoretical insight, to understand the critical process parameters necessary for optimal nanomaterial manufacture. Moreover, metrologies are needed to ensure that a safe and robust manufacturing process can be carried out under closed-loop control on the manufacturing floor. The extent of economic feasibility and the nature of the associated high-throughput measurement science will depend on criteria such as whether the nanotechnology-enabled product requires high purity, as in the case of nanomedicine therapies which must meet rigorous regulatory approval, or if the primary requirements are low-cost and high volume production, such as for nanoparticles used in coatings and paints.

Furthermore, measurement science and standards development in nanotechnology-related environmental health and safety (nano-EHS) will support innovations in nanomanufacturing by helping ensure safe workplace environments for manufacturers and by providing a scientific underpinning for regulatory decision-makers. The nano-EHS program will include efforts to develop new reference materials, measurement protocols, and documentary standards as well as new methodologies to evaluate the release of nanoparticles during manufacture and from consumer products.

- $10.0 million to support measurement science and standards in advanced materials for industry, as related to the national Materials Genome Initiative (MGI).
  The generation and evaluation of physical reference data and the development of databases that can be widely used by industry is part of NIST's mission. NIST has expertise in data generation, collection, assessment, and dissemination, as well as model design and validation from atomic scale to the device scale. The proposed initiative seeks to significantly expand these efforts with a focus on data needed for materials R&D:

  - Standard Reference Database Development - NIST will assemble databases of evaluated data on physical, chemical and mechanical properties of materials generated through both computational models and experiments, including data describing thermodynamic properties; multi-component diffusion; thermal conductivities (temperature sensitivity); lattice parameters (density); chemical reactivity of surfaces; thermophysical properties of fluids; composition and functional properties of semiconductor, insulator, composite, and metallic alloys; interatomic potentials to describe atomic interactions; microstructure formation models; and other, as identified by partners in government, industry and academia.

  - Data Assessment Techniques and Tools - NIST will develop a measurement science infrastructure for models and simulations that is on par with that of physical experimentation. Not only will this ensure the quality of NIST data, but the techniques and tools developed will also be usable by industry to increase confidence in predictions of the models and simulations they use in materials discovery and optimization.

  - Standards Determination, Implementation and Dissemination - This includes standards for documenting data, software standards, the mathematical descriptions of calculated quantities, associated experimental data, manuscripts, and other relevant materials. This standards development process will necessarily engage much of the materials modeling

community (public-private partnerships). Community consensus will be developed through workshops, planning grants and roadmapping exercises enabling the scope of needed data standards to be determined.

- Standard Reference Materials (SRM) Development – NIST will develop a new paradigm for the Standard Reference Materials Program, distributing materials data and models along with the physical sample, allowing for an enormous value-add to the customers using SRMS in their manufacturing processes. This effort would also allow others to validate their models against NIST-developed models and associated SRMs.

- Model Development, Integration and Standard Reference Simulations - NIST will develop and integrate materials models in order to benchmark and maintain depth of competence in state-of-the-art materials modeling. Such an approach is necessary to support the manufacturing community, which has specific materials performance criteria but often limited capability to perform materials by design. Additionally, NIST will develop powerful abstraction methods to enable multiscale integration and discovery of new macroscopic physical properties derived from models at shorter length and time scales.

- $10.0 million for measurement science and standards to support smart manufacturing:
  Smart Manufacturing refers to production systems at the equipment, factory, and enterprise levels that integrate cyber and physical systems to enable innovative production, products, and systems of products. They do so by combining smart operating systems to monitor, control, and optimize performance, systems engineering-based open architectures and standards, and embedded and/or distributed sensing, computing, communications, actuation, and control technologies. This initiative will address two key challenges in making smart manufacturing a reality. NIST will develop the measurements and standards for a quality measurement system focusing on automated in-process quality monitoring and control for factory-level production systems. NIST will also build a testbed integrating a systems architecture framework and an open standards platform for facilitating the simultaneous engineering of the computational (cyber) and physical elements of manufacturing systems, with predictive modeling and simulation for automated control and performance optimization.

- $5.0 million for the NIST Manufacturing Fellowships Program:
  NIST manufacturing fellowships will provide opportunities for engineers and scientists to work with NIST staff on the measurement and standards required to create cutting-edge tools for manufacturers. Fellowships will be available to qualified candidates who are currently employed in industry and non-profit organizations, as well as to recent recipients of bachelors or masters degrees in relevant fields. NIST Manufacturing Fellowships Program awardees will work jointly with NIST to publicize NIST advanced manufacturing research opportunities. The program will be administered by a third party that will recruit and identify viable candidates.

Statement of Need and Economic Benefits:

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 quality jobs.

A robust and vibrant manufacturing sector is critical to the overall health of the U.S. economy. Today the manufacturing sector accounts for 12 percent of GDP, which amounts to a substantial

$1.6 trillion, and employs 14.3 million workers. Manufacturing generates an additional $1.43 in economic activity in the rest of the economy for each $1 in merchandise sales (more than all other sectors) and the manufacturing sector is the primary source of U.S. trade revenues, accounting for almost two-thirds of the Nation's total exports. Equally critical for future U.S. economic health is the integral role of the manufacturing sector in leveraging technological innovation in the rest of the economy, especially in the large and rapidly growing service sector. It is widely acknowledged that R&D is the fundamental basis of innovation, but the fact that the manufacturing sector drives the majority of U.S. R&D efforts is often overlooked. The manufacturing sector accounts for more than 70 percent of U.S. industrial R&D, with more and more of the research effort and production coming from the high-technology portion of the manufacturing sector, which has tripled its output over the past 25 years.[4]

Globalization has placed new pressures upon the manufacturing sector. Today global markets are becoming increasingly technology-based. The U.S. manufacturing sector must adopt new technologies and processes to compete effectively in the future. Working with industry NIST has identified biomanufacturing, nanomanufacturing, advanced materials, and smart manufacturing as key areas where increased measurement and standards would facilitate and accelerate the adoption of these new technologies and processes. These technology areas were also highlighted as salient examples of important technology areas for advanced manufacturing in a 2011 report by the President's Council of Advisors on Science and Technology.[5]

Biomanufacturing

The high cost of biotechnology medicines is adversely impacting the U.S. healthcare system. Biotechnology drugs, currently dominated by protein therapeutics, are the fastest-growing class of pharmaceuticals and the fastest growing (~20 percent/year) category of health care spending.[6] 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 characterize these complex protein products with sufficient precision and accuracy. Manufacturing costs also contribute significantly to the high cost of these drugs. Some have estimated that the biotech industry wastes approximately $15.0 billion each year due to inefficient manufacturing, as much as it spends on R&D for discovery and development of new drugs.[7] There are several factors that are responsible for the high manufacturing costs of biologic products. These therapeutics are produced by living cells that are highly sensitive to external conditions such as temperature, pH, and the composition of the complex surrounding medium. As a result, manufacturing processes can be highly variable and are typically poorly understood. Under the current paradigm, manufacturing of biologic drugs is a slow (1-3 weeks), highly empirical, recipe driven, batch mode process where product quality is ensured by end-product testing. Production processes are frozen for the fear that manufacturing changes will alter the safety and efficacy of products in an unknown, immeasurable way. NIST is ideally positioned to work with industry and the FDA to understand measurement problems, develop innovative solutions, and help achieve consensus in standards development.

Biotechnology products comprise the fastest-growing sector in drug development, and they are expected to account for more than 50 percent of all new product approvals by 2015 and around 70

[4] Gregory Tassey, Rationales and Mechanisms for Revitalizing U.S. Manufacturing R&D Strategies, 2009 (http://www.nist.gov/director/planning/manufacturing_strategy_paper.pdf).
[5] PCAST, "Report to the President on Ensuring American Leadership in Advanced Manufacturing", June, 2011
[6] Biotech 2008-Life Sciences: A 20/20 Vision to 2020, Burrill and Company, 2008.
[7] Pharmaceutical Manufacturing Research Project, J. Macher and J. Nickerson, Sept. 2006.

percent by 2025.[8] A NIST measurement program focused on improved manufacturing of biologic drugs will not only support the manufacturing of current products, but also next-generation products including the manufacture of cost-saving biosimilars, generic verisons (though not identical copies) of biotech drugs, and personalized medicines and manufacturing of biologic therapies tailored to individuals' genetic makeup.

Nanomanufacturing

The future of U.S. manufacturing will rely on innovative, complex, high value-added products manufactured with materials and processes that are similarly advanced in nature, such as those based on nanotechnology. Remarkable discoveries of nanoscale materials with unique properties, along with laboratory demonstrations of a range of innovative nanoscale devices, provide a broad and deep potential foundation for future U.S. manufacturing competitiveness. However, for these early discoveries to become the basis for new industries and to drive future productivity and market growth, measurement science and methods are needed to support the new manufacturing technologies, quality assurance, and environmental health and safety needs that accompany higher volumes of production.

Advanced Materials

Today, the discovery and optimization of new materials for innovative products is a time-consuming and laborious process, as much a craft practiced by skilled artisans as a science. Expensive trial and-error-based experimentation results in a highly inefficient exploration of the potential candidates for a desired new system. As a result, the product design and development cycle now outpaces the materials development cycle, and the insertion of new materials technologies has become much more difficult and less frequent, with materials themselves increasingly becoming a constraint on the design process. This potentially threatens U.S. competitiveness in powerhouse industries such as electronics, automotive, and aerospace, in which the synergy among product design, materials, and manufacturing has given our Nation a competitive advantage.

However, a powerful new paradigm for materials discovery and optimization - materials by design - has begun to emerge. In contrast to an empirical trial-and-error-based approach that may take decades to implement, computational approaches based on physics-based material models can lead to hugely reduced development time, materials of higher performance, and far more effective and cheaper products. In much the same way that silicon in the 1970s led to the modern information technology industry, NIST programs in advanced materials could fuel emerging multi-billion-dollar industries aimed at addressing challenges in energy, national security, and human welfare.

The proposed NIST program in this area is a critical link needed to realize the vision of the recently launched, multi-agency Materials Genome Initiative (MGI). The MGI is aimed at accelerating industrial innovation by significantly reducing the timeline from discovery to commercial deployment for new materials. This initiative will further the promise of the MGI, enabling NIST to strengthen and extend its expertise in the development, use and integration of materials modeling and simulation, with a focus on areas such as standard reference databases, data assessment and validation, and standards development and implementation. These capabilities will provide the interoperability, validity and confidence levels necessary to ensure industrial adoption of modeling and simulation for materials.

[8] "The Billion-Plus Blockbusters: The Top 25 Biotech Drugs" BioWorld, M. Harris, 2009.

Smart Manufacturing

A broad consensus has emerged that smart manufacturing—the dramatically intensified application of *manufacturing intelligence* via advanced data analytics, modeling, and simulation throughout the manufacturing and supply chain enterprise—provides a comprehensive approach to addressing global competitiveness, skilled job retention and growth, and improving energy, environment, and health and safety (EH&S) performance.[9] The importance of smart manufacturing is also reflected in the findings of the National Science and Technology Council (NSTC) Interagency Working Group on Manufacturing R&D in their report on Manufacturing the Future: Federal Priorities for Manufacturing R&D, which identified Intelligent and Integrated Manufacturing (smart manufacturing) as one of three opportunity areas for Federal manufacturing R&D.[10]

A broad consensus has also emerged that although there is already a trend toward smart manufacturing and some progress is being made, "needed systemic infrastructural capabilities are yet to be delivered to mobilize a knowledge- and model-enabled process industry environment over the entire product and process lifecycle."[11] Many challenges and barriers currently exist throughout the product realization lifecycle – from design to fabrication to logistics and distribution – that prevent the realization of smart manufacturing.

Manufacturers lack the ability to:

- Adapt automated production equipment and systems rapidly, reliably, safely, and cost-effectively to meet changing needs and requirements;
- Take full advantage of advanced, non-traditional manufacturing processes that can dramatically improve manufacturing responsiveness and flexibility in producing a dynamic variety of products and make entirely new types of products possible;
- Fully explore production options and possibilities through high-fidelity modeling and simulation rather than time-consuming physical prototypes and pilot production lines;
- Quickly and effectively make design and production decisions based on a comprehensive scientific understanding of underlying production processes and systems;
- Obtain, seamlessly integrate, and optimally use the full spectrum of real-time, actionable process information; and
- Easily and efficiently assemble enterprise networks of manufacturing services to access modeling and analysis capabilities and expertise, and reduce transaction, processing, and fabrication costs to unleash the full potential of small- and medium-sized manufacturers

Overcoming these challenges to realize smart manufacturing offers the opportunity to reverse the trend of transferring both product and production technologies, and associated creative knowhow,

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[9] Smart Manufacturing Leadership Coalition (SMLC) Public-Private Partnership Program Recommendations, Oct. 10, 2010.

[10] Manufacturing the Future: Federal Priorities for Manufacturing R&D, http://www.manufacturing.gov/pdf/NSTCIWGMFGRD_March2008_Report.pdf

[11] Smart Process Manufacturing: An Operations and Technology Roadmap, 2009 http://oit.ucla.edu/nsf-evo-2008/documents/SmartProcessManufaturingAnOperationsandTechnologyRoadmapFullReport.pdf

overseas to lower-wage regions. It can enable U.S. companies to move from an economies-of-scale focus to an economies-of-scope focus,[12] and revitalize the industrial base of small and medium manufacturers. These changes are essential if the US is to compete successfully as global mass-customization becomes the rule rather than the exception.

Manufacturing Fellowship

Federal laboratories have been a source of innovation in the United States since the establishment of the first laboratory, the Smithsonian Institution, in 1846. The Stevenson-Wydler Technology Innovation Act of 1980 (P.L. 96-480) stated, "technology transfer, consistent with mission responsibilities, is a responsibility of each laboratory science and engineering professional." In addition, the act mandated the creation of an Office of Research and Technology Applications (ORTA) at major laboratories to facilitate transfers of technology from the laboratories. A study of Federal technology transfer conducted in 2011 found that personnel exchange agreements was a viable form of achieving technology transfer.[13] According to one of the study authors, "the ability to transfer technology from the Federal laboratories is essential to the nation's innovation strategy—using science and technology to drive economic competitiveness." NIST proposes to expand its technology transfer pathways through the Manufacturing Fellowships Program, to ensure that engineers and scientists from industry can work at NIST on cutting-edge research essential for enabling advances in manufacturing and diffuse their new knowledge through the manufacturing sector to accelerate the innovation cycle.

Base Resource Assessment:

NIST currently has exploratory program efforts related to biomanufacturing, nanomanufacturing, advanced materials, and smart manufacturing, as follows:

Biomanufacturing

To date, NIST's efforts in the area of healthcare have targeted the measurement and standards needs associated with clinical diagnostics and medical imaging. This initiative is an outgrowth of work initiated in FY12 focused on developing 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. This new initiative will further expand NIST's ability to address inefficiencies and stimulate innovation in healthcare by addressing challenges associated with the development and manufacture of biologic drugs.

Nanomanufacturing

This initiative builds upon multiple program areas across NIST in measurement science and standards related to nanomanufacturing technology developments and nano-EHS. NIST's multidisciplinary research staff and the NanoFab shared-use facility enable continued achievements in critical measurement technologies and services that will support advanced nanomanufacturing

[12] Economies-of-scale occur when the per-unit production cost decreases as the volume of each good produced increases. Economies-of-scope occur when the per-unit production cost decreases through the production of a wider variety of goods.

[13] M.E. Hughes, S.V. Howieson, G. Walejko, N. Gupta, S. Jonas, A.T. Brenner, D. Holmes, E. Shyu, S. Shipp. Technology Transfer and Commercialization Landscape of the Federal Laboratories. IDA Science and Technology Policy Institute, 174 pp. Published June 2011.

innovations. Working closely with other Federal agencies, the NIST nano-EHS program has been designed to address the high-priority measurement infrastructure needs that are supported by industry and U.S. regulatory agencies.

Advanced Materials

A base program in advanced materials, initiated in FY 2012, is focused on the development of an enhanced materials innovation infrastructure to enable the integration of modeling and simulation tools with experimentally-derived data and digital data/informatics.

Smart manufacturing

The objectives of the Smart Manufacturing base program are to develop the underpinning measurement science, performance metrics, reference test methods, and reference artifacts and data for robots working closely with humans and for metal-based additive manufacturing. In the area of robotics, NIST is developing the measurement science needed to increase the versatility, agility, and ability of robots and automation equipment to work safely in collaboration with and in close proximity to humans, and work in less structured environments. NIST is developing measurement science for metal-based additive manufacturing to enable the rapid manufacture of innovative complex, custom products and replacement parts that are either required to be produced in low volumes with very quick turnaround, or have geometries that are impossible to make by more traditional manufacturing technologies.

In support of the proposed activities it is noted that NIST has deep technical expertise in measurement science for manufacturing processes, equipment, and systems, and in intelligent systems theory, architectures, performance metrics, and standards. It has unique manufacturing process measurement capabilities and laboratory facilities—including state-of-the-art manufacturing equipment and control systems—that are required to develop the needed measurement science and standards for new manufacturing processes and products. The program has several unique features that distinguish it from manufacturing research in industry and academia: 1) emphasis on infrastructural performance metrics, metrology, and standards that can be applied to a broad class of measurement and manufacturing technology challenges, 2) emphasis on development of rigorous and generic procedures to characterize measurement uncertainty that comply with international standards, and 3) long-term commitment, expertise, and neutrality essential for the development of harmonized and unbiased national and international standards. NIST has the necessary expertise, program focus, and government mandate to address the high-priority infrastructural measurement and standards challenges most needed by U.S. industry.

Schedule, Milestones, and Deliverables:

Biomanufacturing:

Protein Structure:

- Develop new protein therapeutic reference materials for ensuring accurate and quantitative physicochemical characterization of protein therapeutics (FY 2014)

- Develop mass spectral and NMR databases of approved protein therapeutics to support development of biosimilars and new protein therapeutics (FY 2015)

- Validate new protein structure methods such as mass spectral HD exchange for determining comparability of protein therapeutics (FY 2016)

Test-bed bioreactor:

- Develop test-bed bioreactor with uniquely flexible instrumentation and control capabilities (FY 2014)
- Implement and compare performance of multiple process sensors in the testbed reactor and in a laboratory setting (FY 2015)
- Implement software for process control of test-bed bioreactor (FY 2016)

Bioprocess measurements and standards:

- Develop data sets for validation of multivariate data analysis (MVDA) implementations for bioreactor control (FY 2014)
- Develop and validate new bioprocess tools for real-time measurement of monoclonal antibody product concentration (FY 2014)
- Develop reference materials for common biomanufacturing feedstocks (FY 2015)
- Develop and validate new bioprocess tools for early detection of protein aggregation (FY 2015)
- Develop reference data and reference materials for validating host cell protein assays (FY 2016)
- Develop new MVDA models that are integrated with latest bioreactor process models (FY 2016)
- Develop and validate new bioprocess tools for rapid glycosylation analysis (FY 2016)
- Develop microfluidic platforms for rapid identification of high-producing, stable clones, and culture conditions for optimizing protein production. (FY 2017)
- Develop and validate new tools for real time imaging of production cells and cell therapy products to assess the productivity, viability, and function of production cells and cell therapies (FY 2017)

Nanomanufacturing:

- Develop In-line metrology tools for nanomaterial synthesis and nanocomposite fabrication (FY 2013-2017):
  - Metrology techniques to efficiently monitor the uniformity (e.g. size, shape) of nanostructures manufactured in high volumes for incorporation into nanocomposites and other nanoenabled products
  - Metrology techniques to monitor the distribution of nanomaterials within composites at high throughput and low cost for closed-loop process control for integration into realistic manufacturing process scenarios (e.g. roll-to-roll)

- Enable accurate, precise, and reproducible measurements of engineered nanomaterials and nanotechnology-enabled products (FY 2013-2016):
  - Establish measurement science to identify and quantify relevant characteristics (e.g. electronic, optical, magnetic) for desirable properties in manufactured nanomaterial systems
  - Develop reference materials, validated measurement protocols, and documentary standards relating to manufactured nanomaterials, e.g. those manufactured in large volume such as titanium dioxide nanoparticles, carbon nanotubes, and nanoclays
- Develop methodologies to evaluate the release of nanoparticles during manufacture and from consumer products (FY 2013-2016):
  - Develop new and improve existing methodologies to evaluate the release of nanomaterials from products in realistic release scenarios by using available instrumentation
  - Develop new and improve existing methodologies to sample air in manufacturing plants and the surrounding environment and to measure the properties of the collected nanomaterials by using available instrumentation
- Provide validated data and models pertaining to the release of nanomaterials throughout the lifecycle, including manufacturing, use, and disposal of nanotechnology-enabled products (FY 2015-2017):
  - Generate validated data and models pertaining to the release of nanomaterials from products using methodologies developed at NIST
  - Generate validated data pertaining to airborne nanomaterials (sampled using methodologies developed by NIST) and the properties of the collected nanomaterials

Advanced Materials:

- Standard Reference Database (SRD) Development
  - Develop an archive capability for digital materials data (FY 2012-2014)
  - Develop and implement a common interface to all relevant NIST SRDs (FY 2012-2016)
  - Develop novel search, retrieval, and analysis tools for materials data (FY 2012-2016)
  - Implement emerging standards and protocols for access to NIST SRDs (FY 2013-2017)
  - Develop federated database technology enabling integrated search across materials data maintained by multiple parties (FY 2012-2017)
  - Develop thermodynamic databases of multi-component alloys (FY 2012-2017)
  - Develop databases of multi-component diffusion coefficients and atomic mobilities (FY 2012-2017)
  - Develop databases of thermo-electric conductivities (FY 2013-2017)

- Develop databases of crystal lattice parameters (density/molar volume) (FY 2014-2017)

- Broaden the scope of the interatomic potential repository to include reference data and property evaluations for a wide range of materials (FY 2012-2017)

- Develop quantum/ab-initio database (FY 2012-2017)

- Develop a reference chemical kinetic database for vapor-phase reactions used in material growth using thermochemical deposition processes (FY 2013-2017)

- Develop a quantum chemistry database with thermochemical, electrical, magnetic and optical properties data of small nanostructures (< 1,000 atoms) (FY 2013-2017)

Data Assessment Techniques and Tools

- Reference standards for quantified verification of the numerical accuracy of computational models: benchmark problems and solutions, *a posteriori* error estimators, convergence analysis, and the method of manufactured solutions (FY 2012-2016)

- Tools and analyses to assess the error propagation that occurs as a result of multi-model chaining-i.e., outputs of one model are used as inputs for another model (FY 2012-2016)

- Develop standardized methods for uncertainty analysis in property calculations, reference data, materials informatics, and connections between scales (FY 2012-2016)

- Develop standardized protocols for evaluating properties in molecular simulation (automated property evaluations) (FY 2012-2016)

- Develop database of materials reference data with full pedigree (similar to Chemistry WebBook) (FY 2012-2016)

- Standards Determination and Implementation
  - Facilitate the community-based development of standardized terminologies and taxonomies for materials data (FY 2012-2017)

  - Facilitate the community-based development of standardized representations for materials data and associated meta-data (FY 2012-2017)

  - Facilitate the community-based development of standardized protocols for the interchange of materials data among databases, simulation systems, and analysis tools (FY 2013-2017)

  - Develop reference implementations and conformance tests for emerging community standards for materials data representation and interchange (FY 2013-2017)

  - Develop comprehensive and flexible taxonomies for classifying materials information (FY 2013-2017)

- Standard reference states for thermodynamic and diffusion data and models (FY 2013-2017)

- Standardized formats for representing interatomic potentials (FY 2013-2017)

- Standard Reference Materials Development
  - Experimental effort aimed at providing key, yet sparse, data sets for selected materials against which the databases in the Standard Reference Database (SRD) Development section above can be validated. New Standard Reference Materials will be identified that can be used for inter-laboratory agreement on selected data sets (FY 2013-2016)

- Model Development and Integration
  - Development of standard reference simulations, including challenge problems, software, and associated results, that can be used as benchmarks for development and application of modeling software (FY 2012-2018)

  - Development of open hardware/software platforms that enable integration of models representing multiple physical processes, time, and length scales (FY 2012-2018)

  - Development of software repositories to provide wide community access to state-of-the-art tools (FY 2012-2018)

  - Formulation of advanced predictive microstructure evolution models using sharp interface and phase field methods. Both full scale and approximate semi-analytical models will be employed. Models will utilize data from the thermodynamic and diffusion databases (FY 2012-2016)

  - Formulation of models to predict bulk mechanical properties of metallic materials as a function of microstructure (FY 2012-2016)

Smart Manufacturing

- Measurement science for quality measurement systems for smart manufacturing
  - at the manufacturing cell level. (FY 2013-2016)

  - at the manufacturing factory level. (FY 2013-2016)

  - at the production network level. (FY 2013-2017)

- Measurement Science and Standards for Cyber-Physical Manufacturing Systems
  - Develop and deploy a generic, cyber-physical manufacturing systems architecture framework built on layers of computational (logical), physical, and human actions. (FY 2013-2016)

  - Develop and deploy an open standards platform for CPS on which flexible systems architectures for manufacturing equipment and systems can be built and CPS components integrated (FY 2013-2016)

- Develop and deploy measurement science for predictive modeling and simulation needed for CPS development (FY 2013-2016)

- Develop and deploy measurement science for a CPS integration and evaluation testbed for new production systems and systems of products (FY 2013-2017)

Manufacturing Fellowships

- Conduct open competition to award cooperative agreement to institution to administer fellowship program (FY 2013)

- Identify salient qualification requirements and targeted manufacturing technology areas for competition annually (FY 2013-on)

- Conduct Manufacturing Fellowships Program to achieve effective knowledge transfer between NIST and U.S. manufacturing base (FY 2013-on)

Deliverables:

Biomanufacturing:

- Validated protocols, standards, the benchmarking of existing methods, and the development of new metrology tools that will result in greater confidence in bioprocess measurements

- Improved bioprocess understanding, and increased biomanufacturing efficiency due to less waste and fewer product rejections.

Nanomanufacturing:

- High-throughput robust metrology tools to enable closed-loop process control in high volume manufacturing environments

- Determination of structure – property process relationships as they relate to the manufacture of nanomaterials and nanocomposite materials

- Establishment of a consortium of industry and government stakeholders to identify and prioritize relevant fabrication and characterization modules and to transfer technology developments

- Completion of standard reference materials and reference materials for nanoparticles and nanotubes certified for relevant physico-chemical parameters (e.g., positive toxicity controls, nanomaterials in complex media)

- Development and broad dissemination of measurement protocols and documentary standards relating to nanomaterials (e.g., freeze-drying of silver nanoparticles, measuring chirality of carbon nanotubes, and assays to measure indicators of toxicity)

- Publications containing data sets and methodologies relating to the measure of the extent and rate of release of nanomaterials during production, use, and disposal, and to the effectiveness of air sampling methods and measurement of the properties of the collected airborne nanomaterials.

Advanced Materials:

- Standard Reference Database (SRD) Development
  - Open access to our stakeholders of the above developed databases
  - Roll out these changes to the public, in conjunction with quality control issues discussed below
  - Code repositories
- Data Assessment Techniques and Tools
  - Understanding the limits of numerical accuracy obtained from non-linear computations of materials data at the atomic level and continuum models of microstructure - properties prediction performed on different hardware and software platforms
  - Methods to evaluate error propagation from linked models
  - Recommended practice guides for property calculations and uncertainty analysis
- Standards Determination and Implementation
  - Recommendations for common ways to transfer information between programs and scales
- Standard Reference Materials Development
  - Standard reference materials for validating models
- Model Development and Integration
  - Model of how precipitate size/morphology and density affect the strength, fatigue, fracture resistance, creep and other mechanical properties of alloys
  - Methods for error propagation
  - Comparisons of models with reference data (particularly experimental)

Smart Manufacturing:

- Measurement science for quality measurement systems for smart manufacturing
  - Measurement science to reduce the uncertainty associated with machining process parameters for new, high-performance materials. Completion in FY 2015.
  - Measurement science for accurate complex motion of manufacturing equipments to produce complex parts. Completion in FY 2015.
  - Measurement science and standards to achieve real-time, on-machine (in-situ) part measurement and certification. Completion in FY 2016.

- A measurement science testbed to support a light-weight, reference architecture development for factory-wide wireless, real-time control networks. Completion in FY 2016.

- Standard test methods and performance metrics to evaluate and predict the quality of control networks in factory floor environments. Completion in FY 2015.

- Standardized methods for communicating quality metrics across manufacturing cells in a factory floor. Completion in FY 2015.

- Measurement science testbed for a service-oriented manufacturing architecture and integration infrastructure for high quality production networks. Completion by FY 2018.

- Methods and tools to model production network performance in the presence of uncertainties, and their validations. Completion by FY 2017.

- Metrics and tools for quality assurance of complex, dynamic production networks. Completion by FY 2017.

- Measurement Science and Standards for Cyber-Physical Manufacturing Systems
  - A reference manufacturing control architecture consisting of three layers: (1) a real-time, context aware logics, (2) an abstraction of the real-time physical world, and (3) a model of the physical world. Completed in FY 2016.

  - Measurement science and standards for the messaging protocols to securely publish sensor events, actuator events, and their information content to support CPS architecture. Completed in FY 2015.

  - Measurement science and standards for user-defined semantics and computations for select CPS units. Completed in FY 2015.

  - Measurement science for open, cross-domain standards platforms with fundamental services (communications, networking, interoperability) and architectures. Completed in FY 2015.

  - Measurement science for standards in specific application fields and environments (aerospace and automotives) with vertical experimental platforms and correspondingly integrated interdisciplinary efforts. Completed in FY 2016.
  - Testing tools for select interoperability standards for use in a systems integration and evaluation testbed. Completed in FY 2015.

  - A model-based systems engineering (MBSE) hub to enable disciple-specific teams to work with mathematical abstractions convenient to their needs, and at the same time, allow for the capture of cross-disciplinary system capabilities and resources for the CPS integrators. Completed in FY 2016.

  - Methods and tools to explore CPS design space to optimize the CPS performance, and to test the sensitivities of the CPS subsystem/component parameters and specifications. Completed in FY 2017.

- Methods and tools for validation and verification of CPS models and simulations to ensure that the systems requirements are captured and tested correctly. Completed in FY 2016.

- Demonstration of integration of the CPS architecture, standards, and predictive models with key applications (aerospace and automotive). Completed in FY 2016.

- Evaluation of open standards-based integration of CPS in specific application areas to establish its efficacy over current, ad hoc engineering processes. Completed in FY 2017.

Manufacturing Fellowships Program:

- Active cooperative manufacturing fellowship program with non-profit or academic institution in place. (FY 2013)

- Qualified candidates perform research at NIST on advanced manufacturing measurement science (FY 2013-on)

Performance Goals and Measurement Data:

Biomanufacturing:

Performance Goal: Develop and validate new tools for bioreactor processing	FY 2012 Target	FY 2013 Target	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target
With Increase	-	20%	40%	60%	80%	100%
Without Increase	-	0%	5%	5%	5%	5%
Description: Percentage of proposed measurement tools and services delivered						

Nanomanufacturing:

Performance Goal: Number of published data sets and methodologies relating to nanomaterial release	FY 2012 Target	FY 2013 Target	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target
With Increase	1	3	6	8	10	10
Without Increase	1	0	0	0	0	0
Description: Publications will provide validated data and models pertaining to the extent and rate of release of nanomaterials during production, use, and disposal.						

Advanced Materials:

Performance Goal: Formulation of models to predict bulk mechanical properties of metallic materials as a function of microstructure	FY 2012 Target	FY 2013 Target	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target
With Increase	10%	20%	40%	60%	80%	100%
Without Increase	-	6%	13%	20%	25%	30%
Description: Percentage of milestones completed leading to the formulation of models to predict bulk mechanical properties of metallic materials as a function of microstructure						

Smart Manufacturing:

Performance Goal: Number of standard test methods and performance metrics for control networks in factory floor environments.	FY 2012 Target	FY 2013 Target	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target
With Increase	-	2	2	2	2	-
Without Increase	-	0	0	0	0	-
Description: A total of 8 standard test methods and performance metrics to evaluate and predict the quality of control networks in factory floor environments.						

Manufacturing Fellowships:

Performance Goal: Number of participating qualified fellows	FY 2012 Target	FY 2013 Target	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target
With Increase	-	20	20	20	20	20
Without Increase	-	0	0	0	0	0
Description: Total number of fellowships granted to qualified applicants to reside at NIST for an extended period of time and work on cutting-edge research for advanced manufacturing.						

PROGRAM CHANGE PERSONNEL DETAIL
(Dollar amounts in thousands)

Activity: Measurement Science, Services, and Programs
Subactivity: Laboratory Programs
Program Change: Advanced Manufacturing

Title:	Location	Grade	Number of Positions	Annual Salary	Total Salaries
Biophysicist	Gaithersburg, MD	ZP V	1	$123,758	$123,758
Electrical engineer	Gaithersburg, MD	ZP V	3	123,758	371,274
Industrial engineer	Gaithersburg, MD	ZP V	3	123,758	371,274
Mass spectrometrist	Gaithersburg, MD	ZP V	1	123,758	123,758
Mathematician	Gaithersburg, MD	ZP V	1	123,758	123,758
Mechanical engineer	Gaithersburg, MD	ZP V	3	123,758	371,274
Physicist	Gaithersburg, MD	ZP V	1	123,758	123,758
Program manager	Gaithersburg, MD	ZP V	2	123,758	247,516
Project manager	Gaithersburg, MD	ZP V	1	123,758	123,758
Research chemist	Gaithersburg, MD	ZP V	3	123,758	371,274
Research physicist	Gaithersburg, MD	ZP V	2	123,758	247,516
Analytical chemist	Gaithersburg, MD	ZP IV	1	105,211	105,211
Analytical mass spectrometrist	Gaithersburg, MD	ZP IV	1	105,211	105,211
Applied geneticist	Gaithersburg, MD	ZP IV	1	105,211	105,211
Bioanalytical chemist	Gaithersburg, MD	ZP IV	1	105,211	105,211
Bioinformaticist	Gaithersburg, MD	ZP IV	1	105,211	105,211
Biomedical engineer	Gaithersburg, MD	ZP IV	1	105,211	105,211
Bioprocess engineer	Gaithersburg, MD	ZP IV	1	105,211	105,211
Cell biologist	Gaithersburg, MD	ZP IV	1	105,211	105,211
Chemical engineer	Gaithersburg, MD	ZP IV	1	105,211	105,211
Chemist	Gaithersburg, MD	ZP IV	1	105,211	105,211
Computer engineer	Gaithersburg, MD	ZP IV	2	105,211	210,422
Computer scientist	Gaithersburg, MD	ZP IV	5	105,211	526,055
Electronics engineer	Gaithersburg, MD	ZP IV	4	105,211	420,844
Electrical engineer	Gaithersburg, MD	ZP IV	1	105,211	105,211
Environmental engineer	Gaithersburg, MD	ZP IV	1	105,211	105,211
Fire research engineer	Gaithersburg, MD	ZP IV	1	105,211	105,211
Immunologist	Gaithersburg, MD	ZP IV	1	105,211	105,211
Materials engineer	Gaithersburg, MD	ZP IV	1	105,211	105,211
Materials scientist	Gaithersburg, MD	ZP IV	2	105,211	210,422
Mathematician	Gaithersburg, MD	ZP IV	2	105,211	210,422
Mechanical engineer	Gaithersburg, MD	ZP IV	4	105,211	420,844
Molecular biologist	Gaithersburg, MD	ZP IV	1	105,211	105,211
Neutron biophysicist	Gaithersburg, MD	ZP IV	1	105,211	105,211

Physical scientist	Gaithersburg, MD	ZP IV	3	105,211	315,633
Physicist	Gaithersburg, MD	ZP IV	1	105,211	105,211
Program manager	Gaithersburg, MD	ZP IV	2	105,211	210,422
Protein biochemist	Gaithersburg, MD	ZP IV	1	105,211	105,211
Protein nmr spectrometrist	Gaithersburg, MD	ZP IV	1	105,211	105,211
Research chemist	Gaithersburg, MD	ZP IV	1	105,211	105,211
Research physicist	Gaithersburg, MD	ZP IV	1	105,211	105,211
Research statistician	Gaithersburg, MD	ZP IV	1	105,211	105,211
Systems architect	Gaithersburg, MD	ZP IV	2	105,211	210,422
Analytical chemist	Gaithersburg, MD	ZP III	1	74,872	74,872
Engineering technician	Gaithersburg, MD	ZT III	1	56,857	56,857
Administrative/technical support	Gaithersburg, MD	ZA II	7	51,630	361,410
Subtotal			79		8,247,396
Less lapse 25 %			(21)		(2,059,850)
Total full-time permanent (FTE)			58		6,187,546
2013 Pay Adjustment (0.5%)					30,927
Total					6,218,473

Personnel Data

Full-Time Equivalent Employment	
Full-time permanent	58
Authorized Positions:	
Full-time permanent	79

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

Activity: Measurement Science, Services, and Programs
Subactivity: Laboratory Programs
Program Change: Advanced Manufacturing

	Object Class	2013 Increase
11	Personnel compensation	
11.1	Full-time permanent	$6,218
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	6,218
12	Civilian personnel benefits	1,720
13	Benefits for former personnel	0
21	Travel and transportation of persons	638
22	Transportation of things	181
23.1	Rental payments to GSA	0
23.2	Rental Payments to others	0
23.3	Communications, utilities and miscellaneous charges	1,587
24	Printing and reproduction	84
25.1	Advisory and assistance services	0
25.2	Other services	3,629
25.3	Purchases of goods & services from Gov't accounts	3,625
25.4	Operation and maintenance of facilities	0
25.5	Research and development contracts	7,335
25.6	Medical care	0
25.7	Operation and maintenance of equipment	479
25.8	Subsistence and support of persons	0
26	Supplies and materials	2,285
31	Equipment	4,032
32	Lands and structures	0
33	Investments and loans	0
41	Grants, subsidies and contributions	11,687
42	Insurance claims and indemnities	0
43	Interest and dividends	0
44	Refunds	0
99	Direct obligations	43,500
	Transfer to working capital fund	1,500
	Total obligations	45,000

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

NIST requests an increase of $5.0 million and 4 FTE for a total of $6.0 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 ($3.0 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 $55.0 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 do not exist to enable communities to recover 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, standards developing organizations (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, underinvestment, 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 ($2.0 million)

Improving and protecting our Nation's buildings and infrastructure and enhancing the resiliency of our communities are key to mitigating the impacts from disasters. As part of the Administration's efforts to promote disaster resiliency, this initiative will help address the R&D gaps (in both magnitude and scope) to realize the full potential of national resilience, and 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 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 solutions demanded by 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. NIST's measurement science and standards work in this area can help inform decision-making and maintenance of current and future physical infrastructure. The Congressional Budget Office (CBO) estimates that the direct investment by the U.S. economy is $400 billion/year for physical infrastructure. Additionally, the opportunity cost and subsequent required investment in the wake of a failure of any single event such as a bridge collapse, water main break, or major windstorm is not included and are estimated to be in the tens to hundreds of billions of dollars.

Base Resource Assessment:

In the areas of disaster resilience NIST invested a total of $1.0 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 ($3.0 million)

- Establish National Model Resilience Standards Panel (NMRSP) (FY 2013).
- Develop a framework to enhance community resilience (FY 2013).
- Develop guidelines for the assessment and development of community and regional resilience goals and criteria for the built environment (FY 2014-2018).

Action 2: Research and Development for Critical Building and Lifeline Resilience ($2.0 million)

- Develop guidelines for the assessment of disaster resilience of critical buildings. (FY 2014)
- Develop initial set of protocols and model standards to enhance community resilience. (FY 2015)
- Develop design guidance for disaster resilience of new and existing critical buildings. (FY 2015)
- Develop guidelines for the assessment of disaster resilience of lifeline systems. (FY 2017)
- Develop design guidelines for disaster resilience of lifeline systems. (FY 2018)
- Develop expanded set of protocols and model standards to enhance community resilience. (FY 2018)

Deliverables:

Action 1: Convene private-sector group to develop resilience framework and model resilience standards and policies ($3.0 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 ($2.0 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 ($3.0 million)

Performance Goal: Development and adoption of critical performance metrics, tools, and standards to achieve building, infrastructure and community resilience	FY 2012 Target	FY 2013 Target	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 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 ($2.0 million)

Performance Goal: Development of design guidelines and protocols for disaster resilience of new and existing critical buildings subject to extreme weather events	FY 2012 Target	FY 2013 Target	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 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 amount in thousands)

Activity: Measurement science, services, and programs
Subactivity: Laboratory programs
Program Change: Disaster Resilience

Title:	Location	Grade	Number of Positions	Annual Salary	Total Salaries
Research engineer	Gaithersburg, MD	ZP V	2	$123,758	$247,516
Research structural engineer	Gaithersburg, MD	ZP V	4	123,758	495,032
Total			6		742,548
less Lapse		25%	2		185,637
Total full-time permanent (FTE)			4		556,911
2013 Pay Adjustment (.5%)					2,785
TOTAL					559,696

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)

Activity: Measurement science, services, and programs
Subactivity: Laboratory programs
Program Change: Disaster Resilience

	Object Class	2013 Increase
11	Personnel compensation	
11.1	Full-time permanent	$560
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	560
12	Civilian personnel benefits	155
13	Benefits for former personnel	0
21	Travel and transportation of persons	27
22	Transportation of things	15
23.1	Rental payments to GSA	0
23.2	Rental Payments to others	0
23.3	Communications, utilities and miscellaneous charges	160
24	Printing and reproduction	6
25.1	Advisory and assistance services	0
25.2	Other services	2,426
25.3	Purchases of goods & services from Gov't accounts	146
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	67
25.8	Subsistence and support of persons	0
26	Supplies and materials	319
31	Equipment	519
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

3. Measurement Science to Support Advanced Communications Networks (Base Funding: $10.6 million and 23.2 FTE; Program Change: +10 FTE and +$10.0 million).

NIST requests an increase of $10.0 million and 10 FTE to develop the measurement science and tools required to increase the security, robustness, and capabilities of the Nation's communications infrastructure.

Proposed Actions:

U.S. citizens will need access to unlimited information, at any time and at any location, in order to compete in a future global business environment where communication networks will be as critical as the distributed electrical grid was to the industrial revolution. Today, the U.S. lacks the technology to ensure adequate capacity to achieve a large-scale, hyper-connected network capable of this vision. This network will have to seamlessly integrate fixed and wireless communication hardware and will rely on revolutionary advances in network architecture. Signs of strain are already evident as current broadband services strive to meet the rapid increase in demand due to the fast-paced growth in the number of portable broadband devices and the data-rich applications they employ. Add to this the many relatively new areas where reliable, efficient, secure and low-cost networks are critical, such as medicine (e.g. Health IT, telemedicine), sensor/control networks (e.g. Smart Grid, environmental monitoring), and information systems (e.g. cloud computing), and it is clear that incremental advances in broadband technology or network capacity will be not be sufficient to meet the future needs of a hyper-connected world. This program focuses on addressing three key areas that can enable significant innovation in communications, both in the commercial and public safety communication sectors, through the development and adoption of NIST measurement science and tools. These key areas are (1) Robust Next Generation Network Technologies, (2) Signal Metrology for 21st Century Communications, and (3) the 700 MHz Public Safety Broadband Demonstration Network.

Action 1: Robust Next Generation Network Technologies ($4.0 million)

The request would provide funds to significantly extend NIST's work with industry to test, measure and improve designs for forward-looking Internet protocol 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 Internet architectures 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 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 information systems, such as the Internet, 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 large information

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.

Action 2: Signal Metrology for 21st Century Communications ($4.0 million)

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 imposed by 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/s 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, can be used as a fundamental source of traceability for the millimeter wave wireless industry, enabling multi-gigabit/s 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.

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 3: 700 MHz Public Safety Broadband Demonstration Network ($2.0 million)

The request would provide funds to support the continued development 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 what else needs to be done 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 incompatible 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. 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 and 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 see that those requirements are met.

The Advanced Communications Initiative will help support continued operations of the 700 MHz PSBD Network and to make modifications to allow additional use as a platform for addressing interoperability and performance questions of non-PS next generation communications technologies. This funding will sustain necessary infrastructure that will be leveraged in the future by WIN-funded research.

Statement of Need and Economic Benefits:

Demand for capacity in aggregated traffic for fixed broadband is expected to grow exponentially for the foreseeable future, between 30 percent and 50 percent. 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 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 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 a decade 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, will 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 is primarily adapting 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 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: Robust Next Generation Network Technologies

- FY 2013-FY 2014: Develop a measurement basis for Internet scale modeling, including a measurement infrastructure capable of collecting data from which to derive accurate models of Internet connectivity and routing policies. Develop algorithms and techniques to derive realistic models of current and future Internets from these data sets.

- FY 2013-FY 2015: Using these models, 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 2015-FY 2016: Test and evaluate emerging proposals for software-defined networks based upon customized forwarding algorithms. Work with industry to define and promulgate open standards for programmable networks and to ensure that the introduction of such technologies into commercial networks can be achieved in a robust and secure manner.

- FY 2016-FY 2018: Identify clean-slate Internet architectures (e.g., content centric networking) with potential commercial viability and work with academia and industry to further define and enhance their designs. NIST's focus will be on evaluating the robustness and scalability of proposed architectures and working with industry to foster their adoption in commercial networking standards.

- FY 2013-FY 2015: Identify challenges and alternatives for the realization of secure and seamless wireless/wireline networks and publish gap analyses and recommendations.

- FY 2013-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 2013-FY 2014: Develop theoretical framework by creating algorithms, determining what measurement data are required and where and how to make the measurements in networks, and defining criteria and procedures to evaluate the algorithms.

- FY 2014-FY 2015: Conduct theoretical evaluations in the context of simulation models and phase transitions created during the first phase of the initiative. File for patents on the most successful algorithms, as appropriate.
- 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 on the NSF GENI test bed. Third, establish a consortium to test the algorithms in commercial systems and industrial laboratories.

- 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.

Action 2: Signal Metrology for 21st Century Communications

- 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 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: Develop critical Error Vector Magnitude (EVM) formalism consistent with existing RF industry practice for multi-level/multi-phase RF signals.

- 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 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: Demonstrate network performance monitoring on a 100 Gbps test-bed with complex data formats using EVM formalism.

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

Action 3: 700 MHz Public Safety Broadband Demonstration Network

- FY 2013-FY 2014: Test proposed architecture(s) for possible nationwide public safety broadband network.
- FY 2013-FY 2015: Develop capability and test public safety mission critical voice service over an LTE network.

- FY 2013-FY 2015: Demonstrate and test available mission critical public safety devices over the demonstration network.

- FY 2013-FY 2015: Perform multi-vendor interoperability testing within the demonstrate network for LTE network components.

- FY 2013-FY 2016: Develop public safety specific standards contributions based on demo network findings and lessons learned.

Deliverables:

Action 1: Robust Next Generation Network Technologies

- 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 next generation routing techniques for today's Internet.

- Published analyses and improved standard specifications for emerging specifications for software-defined networks.

- Published analyses for promising clean-slate approaches to global scale Internetworking focused on the commercial viability of such approaches.

- 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 patented suite of algorithms that can be applied to measure global network dynamics; the software that implements the required computations.

- A set of network simulation models capable of generating phase transitions of interest and of collecting data required for algorithmic analysis.

- Criteria, metrics and procedures to evaluate algorithms for monitoring and predicting shifts in global behavior in large networks and distributed systems.

- A set of robust and successful detection algorithms suitable for implementation in commercial products, networks and systems.

Action 2: Signal Metrology for 21st Century Communications

- 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 3: 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.

Performance Goals and Measurement Data:

Action 1: Robust Next Generation Network Technologies ($4.0 million)

Performance Goal: Publications	FY 2013 Target	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target	FY 2018 Target
With increase	10	20	20	20	20	20
Without increase	5	5	5	5	5	5
Description:	Number of new NIST Special Publications, Internal Reports, Professional conference and journal articles, standard technical contributions annually.					

Performance Goal: Test & Measurement Tools	FY 2013 Target	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target	FY 2018 Target
With increase	3	5	5	8	8	10
Without increase	2	2	2	2	2	2
Description:	Number of models, test and measurement tools released to public use annually.					

Action 2: Signal Metrology for 21st Century Communications Technology ($4.0 Million)

Performance Goal: Publications	FY 2013 Target	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target	FY 2018 Target
With increase	8	10	10	10	10	10
Without increase	4	4	4	5	5	5
Description:	Number of new Internal Reports, Professional conference and journal articles, standard technical contributions annually.					

Performance Goal: Test & Measurement Tools	FY 2013 Target	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target	FY 2018 Target
With increase	6	6	6	7	7	9
Without increase	2	2	2	2	2	2
Description:	Number of models, test and measurement tools released to public use annually.					

Action 3: 700 MHz Public Safety Broadband Demonstration Network ($2.0 million)

Performance Goal: Publications	FY 2013 Target	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target	FY 2018 Target
With increase	10	10	10	10	10	10
Without increase	2	2	2	2	2	2
Description:	Number of new Internal Reports, Professional conference and journal articles, standard technical contributions annually.					

Performance Goal: Test & Measurement Tools	FY 2013 Target	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target	FY 2018 Target
With increase	5	5	5	5	5	5
Without increase	2	2	2	2	2	2
Description:	Number of models, test and measurement tools released to public use annually.					

PROGRAM CHANGE PERSONNEL DETAIL

(Dollar amount in thousands)

Activity: Measurement science, services, and programs
Subactivity: Laboratory programs
Program Change: Advanced Communications

Title:	Location	Grade	Number of Positions	Annual Salary	Total Salaries
Electrical Engineer	Gaithersburg	ZP V	2	$123,758	$247,516
Physicist	Gaithersburg	ZP V	1	123,758	123,758
Electronics Engineer	Gaithersburg	ZP IV	2	105,211	210,422
Statistician	Gaithersburg	ZP IV	1	105,211	105,211
Electronics Technician	Gaithersburg	ZT IV	1	74,872	74,872
Electronics Engineer	Gaithersburg	ZP III	1	74,872	74,872
Computer Scientist	Gaithersburg	ZP V	2	123,758	247,516
Mathematician	Gaithersburg	ZP V	1	123,758	123,758
Computer Scientist	Gaithersburg	ZP IV	2	105,211	210,422
Administrative/technical support	Gaithersburg	ZA II	1	51,630	51,630
Subtotal			14		1,469,977
Less lapse 25%			(4)		(367,494)
Total full-time permanent (FTE)			10		1,102,483
2013 Pay Adjustment (0.5%)					5,512
TOTAL					1,107,995

Personnel Data	Number
Full-Time Equivalent Employment	
Full-time permanent	10
Other than full-time permanent	0
Total	10
Authorized Positions:	
Full-time permanent	14
Other than full-time permanent	0
Total	14

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

Activity: Measurement science, services, and programs
Subactivity: Laboratory programs
Program Change: Advanced Communications

	Object Class	2013 Increase
11	Personnel compensation	
11.1	Full-time permanent	$1,108
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	1,108
12	Civilian personnel benefits	306
13	Benefits for former personnel	0
21	Travel and transportation of persons	62
22	Transportation of things	25
23.1	Rental payments to GSA	0
23.2	Rental Payments to others	0
23.3	Communications, utilities and miscellaneous charges	274
24	Printing and reproduction	3
25.1	Advisory and assistance services	0
25.2	Other services	5,611
25.3	Purchases of goods & services from Gov't accounts	356
25.4	Operation and maintenance of facilities	0
25.5	Research and development contracts	807
25.6	Medical care	0
25.7	Operation and maintenance of equipment	81
25.8	Subsistence and support of persons	0
26	Supplies and materials	334
31	Equipment	1,033
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	10,000

4. National Strategy for Trusted Identities in Cyberspace (Base Funding: 13 FTE, $16.5 million; Program Change: +0 FTE and + $8.0 million).

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 2009 *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 non-government 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.

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 2012-FY 2014: 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 2013-FY 2014: 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 2011 Actual # of Awards	FY 2012 Target # of Awards	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
With Increase	0	5-8	9-13	9-13	5-8	*	*
Without Increase	0	5-8	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. There is a ramp down of the NSTIC program starting in FY 2015, as the program is transitioned to the private sector.

* No new awards will be made in FY 2016 and FY 2017; however, prior year awards may continue into FY 2016 and FY 2017.

PROGRAM CHANGE PERSONNEL DETAIL

(Dollar amount in thousands)

Activity: Measurement Science, Services, and Programs
Subactivity: Laboratory Programs
Program Change: NSTIC

Title:	Location	Grade	Number of Positions	Annual Salary	Total Salaries
Total			0		0
less Lapse		25%	0		0
Total full-time permanent (FTE)			0		0
2013 Pay Adjustment (0.5%)					
TOTAL					0

Personnel Data	Number
Full-Time Equivalent Employment	
Full-time permanent	0
Other than full-time permanent	0
Total	0

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

Activity: Measurement Science, Services, and Programs
Subactivity: Laboratory Programs
Program Change: NSTIC

	Object Class	2013 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	$234
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	0
33	Investments and loans	0
41	Grants, subsidies and contributions	7,766
42	Insurance claims and indemnities	0
43	Interest and dividends	0
44	Refunds	0
99	Direct obligations	8,000
	Transfer to the Working Capital Fund	0
	Total obligations	8,000
	Less administrative savings	0
	Total request	8,000

5. Reduction to NIST's STRS Extramural grants (Base Funding: $34.2 million; Program Change: 0 FTE and -$12.0 million).

NIST requests a $12.0 million decrease to its extramural STRS grant program to redirect funding to higher priority activities within the STRS. The reduction includes $6.0 million from one-time external grants to support industry-led consortia in the development of technology roadmaps. NIST will identify an additional $6.0 million from low priority research areas and areas where intramural efforts are sufficient to meet research requirements.

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

Activity: Measurement Science, Services, and Programs
Subactivity: Laboratory Programs
Program Change: STRS Extramural Grants

	Object Class	2013 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	0
33	Investments and loans	0
41	Grants, subsidies and contributions	($12,000)
42	Insurance claims and indemnities	0
43	Interest and dividends	0
44	Refunds	0
99	Total obligations	(12,000)

Department of Commerce
National Institute of Standards and Technology
Laboratory Programs
REIMBURSABLE PROGRAM AND WORKING CAPITAL FUND INVESTMENTS
(Dollar amounts in thousands)

	FY 2011 Actual	FY 2012 Currently Available	FY 2013 Estimate
Department of Defense			
Air Force	$10,001	$9,843	$9,335
Army	1,429	2,962	1,663
Navy	1,761	1,331	1,361
Other, Department of Defense	16,101	18,067	15,254
Subtotal, Department of Defense	29,292	32,203	27,613
Department of Agriculture	175	60	60
Department of Commerce	13,877	15,204	15,365
Department of Energy	6,959	7,484	6,588
Dept. of Health & Human Services	3,946	4,462	4,389
Dept. of Homeland Security	11,196	19,308	17,487
Department of the Interior	146	20	20
Department of Justice	5,916	12,663	10,850
Department of Transportation	34	266	0
Department of the Treasury	110	0	0
Department of Veterans Affairs	165	0	0
Environmental Protection Agency	0	105	100
General Services Administration	206	0	0
National Aeronautics & Space Admin.	3,655	4,884	4,400
National Science Foundation	2,926	2,861	2,940
Nuclear Regulatory Commission	1,141	2,033	500
Other	7,341	8,754	5,525
Subtotal, Other Agency	87,085	110,307	95,837
Calibrations & Testing	8,914	7,457	7,791
Technical & Advisory Services	25,742	38,663	27,826
Standard Reference Materials	17,332	16,505	16,630
Subtotal, Other Reimbursables	51,988	62,625	52,247
Total, Reimbursable Program	139,073	172,932	148,084
Equipment Transfers	0	1,535	1,500
SRM Transfers	0	160	0
Subtotal, WCF transfer	0	1,695	1,500
Equipment Investments	18,310	28,383	17,891
IE Amortization	(21,835)	(18,852)	(17,891)
Excess Amortizations over Equipment Investments	3,526	0	0
WCF Operating Adjustments	(155)	0	0
Total, WCF Investments	(154)	9,531	0
Total, Reimbursable Program and WCF Investments	138,919	184,158	149,584

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)

Activity: Measurement science, services, and programs
Subactivity: Corporate services

Line Item		2011 Actual Personnel	2011 Actual Amount	2012 Currently Available Personnel	2012 Currently Available Amount	2013 Base Personnel	2013 Base Amount	2013 Estimate Personnel	2013 Estimate Amount	Increase/ (Decrease) over 2013 Base Personnel	Increase/ (Decrease) over 2013 Base Amount
Computer support	Pos./Approp	13	$8,236	13	$8,124	13	$8,124 *	13	$8,124 *	0	0
	FTE/Obl.	12	8,549	12	8,169	12	8,169	12	8,169	0	0
Business systems	Pos./Approp	36	10,606	36	10,423	36	10,423	36	10,423	0	0
	FTE/Obl.	35	10,725	36	10,481	36	10,481	36	10,481	0	0
Total	Pos./Approp	49	18,842	49	18,547	49	18,547	49	18,547	0	0
	FTE/Obl.	47	19,274	48	18,650	48	18,650	48	18,650	0	0

* Includes activities previously reported within the Research Support Services line item.

SUBACTIVITY: CORPORATE SERVICES

This subactivity 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 subactivity 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

Program Description:

The scope of this program 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:

- Upgraded the Central Computer Facility to reduce and improve the management of power usage
- Piloted support for mobile devices and the use of cloud collaboration services
- Incorporated the Risk Management Framework and continuous monitoring into NIST's IT Security practices

Priority Objectives for FY 2013:

- Manage the IT infrastructure including computing systems, software, data storage, networking, and security capabilities to support all NIST programs
- Optimize the portfolio of computing platforms, data storage, backup storage, network interconnects, system security mechanisms, 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

2. Business Systems

Program Description:

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 2013:

- 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 2011 Actual	FY 2012 Currently Available	FY 2013 Estimate
Department of Commerce	$2,260	$2,422	$2,422
General Services Administration	13	0	0
Subtotal, Other Agency	2,273	2,422	2,422
Total, Reimbursable Program	2,273	2,422	2,422
Equipment Investments	2,746	5,176	2,506
IE Amortization	(1,689)	(2,570)	(2,506)
Excess Amortizations over Equipment Investments	(1,058)	0	0
Total, WCF Investments	(1)	2,606	0
Total, Reimbursable Program and WCF Investments	2,272	5,028	2,422

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)

Activity: Measurement science, services, and programs
Subactivity: Standards coordination and special programs

Line Item		2011 Actual Personnel	2011 Actual Amount	2012 Currently Available Personnel	2012 Currently Available Amount	2013 Base Personnel	2013 Base Amount	2013 Estimate Personnel	2013 Estimate Amount	Increase/ (Decrease) over 2013 Base Personnel	Increase/ (Decrease) over 2013 Base Amount
Standards coordination and special programs	Pos./Approp	58	$15,346	62	$30,484	62	$30,484	95	$56,813	33	$26,329
	FTE/Obl.	56	16,354	61	38,959	62	30,521	85	56,850	23	26,329
Total	Pos./Approp	58	15,346	62	30,484	62	30,484	95	56,813	33	26,329 *
	FTE/Obl.	56	16,354	61	38,959	62	30,521	85	56,850	23	26,329

* The increase of $26.329 million consists of $6 million for Advanced Manufacturing (components of the $45 million initiative to include $5 million for the NIST Manufacturing Fellowships Program and $1 million for Smart Manufacturing), $2 million for Advanced Communications (component of the $10 million initiative), $20 million for NIST Centers of Excellence, $5 million for Forensic Science, and a decrease of $6.671 million in grants (component of the $12 million extramural grants reduction).

SUBACTIVITY: STANDARDS COORDINATION AND SPECIAL PROGRAMS

Program Description:

Special Programs Office (SPO)/Standards Coordination Office (SCO): The SPO 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 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 SPO currently consists of the following three programs:

- Law Enforcement Standards: 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, computer forensics, DNA analysis, 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.

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:

- 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 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.

- 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. 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 2013:

- Law Enforcement Standards: 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 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: Establish the first 25 percent of 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.

- 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.

- Standards Guidance: Strengthen conduits for information related to external standards needs and priorities, including the establishment of mechanisms to further understand customer needs. Mechanisms include the establishment of external steering committees to examine 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.

- 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 CHANGES FOR FY 2013:

1. NIST Centers of Excellence (Base Funding: $0 million; Program Change: +2 FTE and +$20.0 million).

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. The intent is to provide continuing support to Centers for several years. 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 2012 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. 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 2013)
- Selection of identification of emerging areas of national need in measurement science (FY 2013, FY 2017)
- Competitive process to select NIST Centers of Excellence (FY 2013, FY 2017)
- Four new NIST Centers of Excellence in Advanced Technology (FY 2013)

Deliverables:

Funding for the NIST Centers of Excellence in Advanced Technology 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: Number of companies utilizing or collaborating with COEs Number of NIST Centers of Excellence	FY 2012 Actual	FY 2013 Target	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target
With increase	-	20	40	40	40	40
Without increase	-	-	-	-	-	-

Performance Goal Performance Measure: Number of doctoral candidates and post-docs Number of NIST Centers of Excellence	FY 2012 Actual	FY 2013 Target	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target
With increase	-	30	60	60	60	60
Without increase	-	-	-	-	-	-

Performance Goal Performance Measure: Number of patents, copyrights (software), licenses Number of NIST Centers of Excellence	FY 2012 Actual	FY 2013 Target	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target
With increase	-	0	4	8	8	8
Without increase	-	-	-	-	-	-

PROGRAM CHANGE PERSONNEL DETAIL

(Dollar amount in thousands)

Activity: Measurement Science, Services, and Programs
Subactivity: Laboratory Programs
Program Change: NIST Centers of Excellence

Title:	Location	Grade	Number of Positions	Annual Salary	Total Salaries
Program Manager	Gaithersburg	ZP V	1	$123,758	$123,758
Assistant Program Manager	Gaithersburg	ZP IV	2	105,211	210,422
Total			3		334,180
less Lapse		25%	1		83,545
Total full-time permanent (FTE)			2		250,635
2013 Pay Adjustment (0.5%)					1,253
TOTAL					251,888

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)

Activity: Measurement Science, Services, and Programs
Subactivity: Laboratory Programs
Program Change: NIST Centers of Excellence

	Object Class	2013 Increase
11	Personnel compensation	
11.1	Full-time permanent	$252
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	252
12	Civilian personnel benefits	70
13	Benefits for former personnel	0
21	Travel and transportation of persons	13
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	72
24	Printing and reproduction	1
25.1	Advisory and assistance services	0
25.2	Other services	50
25.3	Purchases of goods & services from Gov't accounts	98
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	8
25.8	Subsistence and support of persons	0
26	Supplies and materials	10
31	Equipment	17
32	Lands and structures	0
33	Investments and loans	0
41	Grants, subsidies and contributions	19,409
42	Insurance claims and indemnities	0
43	Interest and dividends	0
44	Refunds	0
99	Total obligations	20,000

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

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 will 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. 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.

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

- Create rigorous training programs to facilitate basic understanding of underlying metrology in applied forensic procedures and methods for various levels of teachers, forensic science analysts, and crime laboratory managerial staff. Further create a continuing education process for the participants to assist in the implementation of lessons learned

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 responded with 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.

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] has a good program of research targeted at forensic science and law enforcement, but the program is modest. NIST also has strong ties to industry and academia, and it has an eminent history in standard setting and method development." - *Strengthening Forensic Science in the United States: A Path Forward, 2009, Page 17.*

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 court room 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 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 enhancing the accuracy and utility of 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 $214 billion in 2006[14]. 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[15]). 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[16]. 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[17].

Base Resources Assessment:

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 established core capabilities 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.

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

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

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

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

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 $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[18].

Schedule & Milestones:

- Identify and develop senior level researchers who will communicate and coordinate across NIST and with members of the forensic science community (FY 2013)
- Develop NIST expertise in forensic measurement science specialty areas (FY 2013-2017)
- Develop new innovative approaches to aid forensic community (FY 2014-2017)
- 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)
- Create opportunities for on-site training, research, and distance learning (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
- Enhanced ability to understand crime scenes, identify suspects, and prosecute and convict criminals while exonerating the innocent
- Greater confidence in the forensic science aspect of the U.S. criminal justice system

[18] See www.innocenceproject.org

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

Performance Goal Performance Measure: Reference materials and databases	FY 2012 Actual	FY 2013 Target	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target
With increase	-	1	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 2012 Actual	FY 2013 Target	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target
With increase	-	1	2	2	2	2
Without increase	-	-	-	-	-	-
Description: Number of protocol validation studies completed and published.						

Performance Goal Performance Measure: Forensic standards	FY 2012 Actual	FY 2013 Target	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)

Activity: Measurement Science, Services, and Programs
Subactivity: Laboratory Programs
Program Change: Forensic Science

Title:	Location	Grade	Number of Positions	Annual Salary	Total Salaries
Program Manager	Gaithersburg	ZP V	1	$123,758	$123,758
Assistant Program Manager	Gaithersburg	ZP IV	4	105,211	420,844
Physical scientist	Gaithersburg	ZA III	10	74,872	748,720
Students/graduate students	Gaithersburg	ZP III	5	74,872	374,360
Administrative/technical support	Gaithersburg	ZA II	2	51,630	103,260
Total			22		1,770,942
less Lapse		25%	6		442,736
Total full-time permanent (FTE)			16		1,328,207
2013 Pay Adjustment (0.5%)					6,641
TOTAL					1,334,848

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)

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

	Object Class	2013 Increase
11	Personnel compensation	
11.1	Full-time permanent	$1,335
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	1,335
12	Civilian personnel benefits	369
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	320
24	Printing and reproduction	6
25.1	Advisory and assistance services	0
25.2	Other services	1,722
25.3	Purchases of goods & services from Gov't accounts	213
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	179
25.8	Subsistence and support of persons	0
26	Supplies and materials	58
31	Equipment	105
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

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 2011 Actual	FY 2012 Currently Available	FY 2013 Estimate
Department of Agriculture	$12	0	0
Dept. of Homeland Security	14,587	$10,350	$9,000
Department of Justice	10,120	2,500	3,000
Subtotal, Other Agency	24,719	12,850	12,000
Technical & Advisory Services	469	33	34
Subtotal, Other Reimbursables	469	33	34
Total, Reimbursable Program	25,188	12,883	12,034
Equipment Investments	9	14	14
IE Amortization	(25)	(36)	(14)
Excess Amortizations over Equipment Investments	16	0	0
Total, WCF Investments	0	(22)	0
Total, Reimbursable Program and WCF Investments	25,188	12,861	12,034

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	2011 Actual	2012 Currently Available	2013 Base	2013 Estimate	Increase/ (Decrease) Over 2013 Base
11	Personnel compensation					
11.1	Full-time permanent	$189,052	$198,978	$202,256	$211,720	$9,464
11.3	Other than full-time permanent	14,764	14,764	14,764	14,764	0
11.5	Other personnel compensation	7,471	7,471	7,471	7,471	0
11.9	Total personnel compensation	211,287	221,213	224,491	233,955	9,464
12.1	Civilian personnel benefits	59,542	62,221	63,099	65,716	2,617
13	Benefits for former personnel	14	14	14	14	0
21	Travel and transportation of persons	11,322	12,164	10,543	9,539	(1,004)
22	Transportation of things	1,144	1,327	1,327	1,588	261
23.1	Rental payments to GSA	56	35	40	40	0
23.2	Rental payments to others	1,766	2,298	2,479	2,479	0
23.3	Communications, utilities, and miscellaneous charges	19,339	22,054	22,054	24,466	2,412
24	Printing and reproduction	223	322	212	312	100
25.1	Advisory and assistance services	1,450	1,024	930	930	0
25.2	Other services	57,837	74,466	50,070	69,076	19,006
25.3	Purchases of goods and services from Government accounts	22,110	25,005	25,005	29,587	4,582
25.5	Research and development contracts	2,201	9,186	9,186	18,428	9,242
25.7	Operation and maintenance of equipment	10,291	11,082	11,082	11,861	779
26	Supplies and materials	25,262	27,007	27,007	30,013	3,006
31	Equipment	38,748	46,532	46,532	51,455	4,923
32	Land and structures	172	1,672	1,672	1,672	0
41	Grants, subsidies, and contributions	46,817	72,257	72,257	99,119	26,862
42	Insurance claims and indemnities	1	0	0	0	0
43	Interest and dividends	5	0	0	0	0
99	Total Obligations	509,587	589,879	568,000	650,250	82,250

	Object Class	2011 Actual	2012 Currently Available	2013 Base	2013 Estimate	Increase/ (Decrease) Over 2013 Base
99	Total Obligations	509,587	589,879	568,000	650,250	82,250
	Less Prior Year Recoveries	(4,678)	(1,000)	(1,000)	(1,000)	0
	Less Prior Year Refunds	(46)	0			
	Less Prior Year Unobligated Balance	(18,931)	(15,924)	0	0	0
	Plus Unobligated Balance, End of Year	15,924	0			
	Plus Unobligated Balance, Expired	7	0			
	Unobligated Balance Transfer to ITS		1,600			
	Total Budget Authority	501,863	574,555	567,000	649,250	82,250
	Transfer to NIST Working Capital Fund	0	1,695	0	1,500	1,500
	Transfer from Election Assistance Commission	(3,244)	(2,750)	0	(2,750)	(2,750)
	Transfers from DoJ for Office of Law Enforcement Standar	(1,243)	(6,500)	0	0	0
	Transfers to ITS, Reorganization	9,608				
	Appropriation	506,984	567,000	567,000	648,000	81,000
	Personnel Data					
	Full-time equivalent employment:					
	Full-time permanent	1,771	1,945	1,972	2,062	90
	Other than full-time permanent	230	230	230	230	0
	Total	2,001	2,175	2,202	2,292	90
	Authorized Positions:					
	Full-time permanent	2,019	2,155	2,155	2,279	124
	Other than full-time permanent	48	48	48	48	0
	Total	2,067	2,203	2,203	2,327	124

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. $648,000,000, 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 2011 Actual	FY 2012 Estimate	FY 2013 Estimate
Management and professional support services	$773	$779	$779
Studies, analyses, and evaluations	674	245	151
Engineering and technical services	3	0	0
Total	1,450	1,024	930

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.

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
2012 Currently Available	130	133	$128,443	$141,260	$128,443
less: Unobligated balance from prior year			0	(8,117)	0
less: Unobligated balance from STRS transfer			0	(1,600)	0
2013 Adjustments to base:					
Adjustments:					
TIP Shutdown/BPEP transition	(52)	(50)			
Other Changes:					
plus: Restoration of 2012 deobligation offset	0	0		(3,100)	0
plus: Restoration of prior year unobligated balance rescission	0	0			
plus: Uncontrollable cost changes	0	0	624	624	624
less: ATBs absorbed	0	0	(624)	(624)	(624)
less: Estimated recoveries 2013	0	0	0		0
2013 Base Request	78	83	128,443	128,443	128,443
plus: 2013 Program changes	5	4	20,557	20,557	20,557
2013 Estimate	83	87	149,000	149,000	149,000

		2011 Actual		2012 Currently Available		2013 Base		2013 Estimate		Increase/ (Decrease) Over 2013 Base	
Comparison by activity/subactivity:		Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount
Technology innovation program											
Technology innovation program	Pos./Approp	78	$44,810	41	0	0	0	0	0	0	0
	FTE/Obl.	76	74,170	39	$8,384	0	0	0	0	0	0
Advanced manufacturing technology consortia											
Advanced manufacturing technology consortia	Pos./Approp	0	0	0	0	0	0	5	$21,000	5	$21,000
	FTE/Obl.	0	0	0	0	0	0	4	21,000	4	21,000
Hollings manufacturing extension partnership											
Hollings manufacturing extension partnership	Pos./Approp	73	128,443	78	128,443	78	$128,443	78	128,000	0	(443)
	FTE/Obl.	83	128,593	83	130,826	83	128,443	83	128,000	0	(443)
Baldrige performance excellence program											
Baldrige performance excellence program	Pos./Approp	51	9,608 [1/]	11	0	0	0	0	0	0	0
	FTE/Obl.	47	8,558	11	2,050	0	0	0	0	0	0
TOTALS	Pos./Approp	202	182,861 [1/]	130	128,443	78	128,443	83	149,000	5	20,557
	FTE/Obl.	206	211,321	133	141,260	83	128,443	87	149,000	4	20,557

[1/] The Baldrige Performance Excellence Program transferred from the STRS appropriation to the ITS appropriation consistent with the approved NIST reorganization.

Comparison by activity/subactivity:	2011 Actual Per-sonnel	2011 Actual Amount	2012 Currently Available Per-sonnel	2012 Currently Available Amount	2013 Base Per-sonnel	2013 Base Amount	2013 Estimate Per-sonnel	2013 Estimate Amount	Increase/ (Decrease) Over 2013 Base Per-sonnel	Increase/ (Decrease) Over 2013 Base Amount
Adjustments for:										
Recoveries		(4,228)		(3,100)		0		0		0
Refunds		(601)		0		0		0		0
Unobligated balance, start of year		(31,748)		(8,117)		0		0		0
Unobligated balance, end of year		8,117		0		0		0		0
Unobligated balance, transfer from STRS		0		(1,600)		0		0		0
Budget Authority		182,861		128,443		128,443		149,000		20,557
Unobligated balance rescission		0		0		0		0		0
Financing from transfers:										
Reorganization		(9,608) [1/]		0		0		0		0
Appropriation		173,253		128,443		128,443		149,000		20,557

1/ The Baldrige Performance Excellence Program transferred from the STRS appropriation to the ITS appropriation consistent with the approved NIST reorganization.

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 Shutdown/BPEP transition	(50)	0

In FY 2012, NIST's Technology Innovation Program (TIP) and the Baldrige Performance Excellence Program (BPEP) did not receive congressional funding. These are the resultant FTE base adjustments required in FY 2013 (-39 TIP) and (-11 BPEP).

Other Changes:		
2013 Pay increase and related costs	0	37

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

Total cost in FY 2013 of pay increase	$37,000
Less amount absorbed in FY 2013	0
Amount requested for FY 2013 pay increase	37,000
Payment to Departmental Management Working Capital Fund	0
Total adjustment for FY 2013 pay increase	37,000

Personnel benefits	0	74
Civil Service Retirement System (CSRS)	(8)	
Federal Employees' Retirement System (FERS)	14	
Thrift Savings Plan (TSP)	4	
Federal Insurance Contribution Act (FICA) – OASDI	11	
Health Insurance	47	
Employees' Compensation Fund	6	

Civil Service Retirement System (-$8,000) – 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 10.2 percent in FY 2012 to 8.7 percent in FY 2013. The contribution rate will remain at 7.0 percent in FY 2013.

Payroll subject to retirement systems ($7,936,096)	
Cost of CSRS contributions in FY 2013 ($7,936,096 x .087 x .07)	$48,331
Cost of CSRS contributions in FY 2012 ($7,936,096 x .102 x .07)	56,664
Total adjustment to base	(8,333)

Federal Employees' Retirement System ($14,000) – 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 89.8 percent in FY 2012 to 91.3 percent in FY 2013. The contribution rate remained at 11.7 percent in FY 2013.

Payroll subject to retirement systems ($7,936,096)	
Basic benefit cost in FY 2013 ($7,936,096 x .913 x .117)	$847,742
Basic benefit cost in FY 2012 ($7,936,096 x .898 x .117)	833,814
Total adjustment to base	13,928

Thrift Savings Plan ($4,000) – The cost of agency contributions to the Thrift Savings Plan will also rise as FERS participation increases. The contribution rate decreased from 4.56 percent in FY 2012 to 4.54 percent in FY 2013.

Thrift plan cost in FY 2013 ($7,936,096 x .913 x .0454)	$328,953
Thrift plan cost in FY 2012 ($7,936,096 x .898 x .0456)	324,974
Total adjustment to base	3,979

Federal Insurance Contributions Act (FICA) - OASDI (11,000) – As the percentage of payroll covered by FERS increases, the cost of OASDI contributions will increase. In FY 2013, the maximum salary subject to OASDI tax increased from $110,175 in FY 2012 to $113,100 in FY 2013. The OASDI tax rate will remain 6.2 percent in FY 2013.

FERS payroll subject to FICA tax in 2013 ($7,936,096 x .913 x .882 x .062)	$396,221
FERS payroll subject to FICA tax in 2012 ($7,936,096 x .898 x .873 x .062)	385,735
Increase (FY 2012-FY 2013)	10,486
OTP payroll subject to FICA tax in 2013 ($254,904 x .913 x .882 x .062)	12,726
OTP payroll subject to FICA tax in 2012 ($254,904 x .898 x .873 x .062)	12,390
Increase (FY 2012-013)	336
Total adjustment to base	10,822

Health insurance ($47,000) – Effective January 2011, NIST's contribution to Federal employees' health insurance premiums increased by 8.8 percent. Applied against the FY 2012 estimate of $539,000, the additional amount required is $47,432.

Employees' Compensation Fund ($6,000) – The Employees' Compensation Fund bill for the year ending June 30, 2011 is a net $13,015 lower than for the year ending June 30, 2010. ITS had a small increase of $6,030.

Travel and transportation of persons		0	19

The GSA standard per diem rate increased from $116 to $123. The percentage increase of 6.0% for destinations within the Continental United States (CONUS) was applied to the FY 2012 estimate of $314,000 for an increase of $18,840.

Communications, utilities, and miscellaneous charges		0	272
Electricity rate increase	247		
Natural Gas rate increase	25		

The electricity ATB amount was derived using a year to year comparison of the cost per kilowatt hour. In analyzing the 12 months ended March 2011 and 2010, the per kilowatt hour rate increased 18.1 percent (from .094 to .111) for Gaithersburg, Maryland; increased 17.2 percent (from .303 to .355) for Kauai, Hawaii; increased 7.6 percent (from .066 to .071) for Boulder, Colorado; and decreased 2.2 percent (from .091 to .089) for Ft. Collins, Colorado for a net increase of $247,000.

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 March 2011 and 2010, the per therm rate increased 4.7 percent (from .851 to .891) and also increased 4.7 percent (from 5.637 to 5.902) for Gaithersburg and Boulder respectively resulting in a net increase of $25,000.

General pricing level adjustment		0	222

This request applies the OMB economic assumptions of 1.5 percent for FY 2013 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: rental payments to others $5,415 communications, utilities, and miscellaneous charges $2,790; other services $202,890; supplies $5,685; and equipment $5,040.

Subtotal Other changes		(50)	624
Amount absorbed		0	(624)
Total Adjustments to base		(50)	0

ITS

APPROPRIATION ACCOUNT: INDUSTRIAL TECHNOLOGY SERVICES (ITS)

The ITS appropriation funds the Hollings Manufacturing Extension Partnership (MEP) program. The request proposes to fund an initiative, the Advanced Manufacturing Technology Consortia (AMTech), under this appropriation. The ITS request totals $ 149.0 million and 87 FTE, a $20.6 million increase and 46 FTE decrease below the FY 2012 enacted level. This increase includes no adjustments to base for inflationary adjustments. The Consolidated Appropriations Act of FY 2012 did not include funding for the Technology Innovation Program (TIP) or the Baldrige Performance Excellence Program (BPEP). TIP began to implement a shutdown of operations in FY 2012. Through funds NIST received from the Malcolm Baldrige National Quality Award Foundation, BPEP will continue to meet its objectives.

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Technology Innovation Program

Exhibit 10

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

Activity: Technology innovation program
Subactivity: Technology innovation program

Line Item		2011 Actual		2012 Currently Available		2013 Base		2013 Estimate		Increase/ (Decrease) Over 2013 Base	
		Personnel	Amount	Personnel	Amount	Personnel	Amount	Personnel	Amount	Personnel	Amount
Technology innovation program	Pos./Approp	78	$44,810	41	0	0	0	0	0	0	0
	FTE/Obl.	76	74,170	39	$8,384	0	0	0	0	0	0

Department of Commerce
National Institute of Standards and Technology
Technology Innovation Program
REIMBURSABLE PROGRAM AND WORKING CAPITAL FUND INVESTMENTS
(Dollar amounts in thousands)

	FY 2011 Actual	FY 2012 Currently Available	FY 2013 Estimate
Equipment Investments	$14	0	0
IE Amortization	(1)	0	0
Excess Amortizations over Equipment Investments	(13)	0	0
Total, WCF Investments	0	0	0
Total, Reimbursable Program and WCF Investments	-	-	-

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)

Activity: Advanced manufacturing technology consortia
Subactivity: Advanced manufacturing technology consortia

Line Item		2011 Actual		2012 Currently Available		2013 Base		2013 Estimate		Increase/ (Decrease) Over 2013 Base	
		Personnel	Amount	Personnel	Amount	Personnel	Amount	Personnel	Amount	Personnel	Amount
Advanced manufacturing technology consortia	Pos./Approp	0	0	0	0	0	0	5	$21,000	5	$21,000
	FTE/Obl.	0	0	0	0	0	0	4	21,000	4	21,000

BUDGET ACTIVITY AND SUBACTIVITY: ADVANCED MANUFACTURING TECHNOLOGY CONSORTIA (AMTech)

BASE JUSTIFICATION FOR FY 2013:

The Advanced Manufacturing Technology Consortia (AMTech) is an initiative proposed for FY 2013.

PROGRAM CHANGES FOR FY 2013:

Advanced Manufacturing Technology Consortia (AMTech) (Base Funding: 0 FTE and $0 million; Program Change: +4 FTE and +$21.0 million)

An Advanced Manufacturing Technology Consortia (AMTech) program is proposed for FY 2013 to establish industry-led consortia to 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 invest in emerging technologies 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, to accelerate the pace of innovation throughout various industrial sectors.

The AMTech funding would be distributed in three categories as follows:

(1) Planning Awards: Any organization seeking to establish multi-partner consortia to develop a shared vision of industry's research needs via a technology roadmap is eligible for a planning award. These awards create the incentive for the private sector to form industry-led consortia and roadmap critical long-term research needs.

(2) Implementation Awards: Larger awards to established consortia are intended to facilitate the realization of clearly stated long-term industry research needs. NIST and consortia partners will fund university-based research and effectively evaluate the technical outputs to ensure that they do meet industry need, creating the incentive for private and non-Federal funding agencies to fully develop and commercialize the innovations developed through AMTech.

(3) A minimal staff is needed to initiate and carry out the AMTech program management. This includes the awarding of AMTech awards via a competitive selection process, based on selection criteria such as high technical risk; production of fundamental new knowledge; addresses critical consensus roadblocks to U.S. innovation and competitiveness; potential to create radical new downstream industries; technical plan; and identification of relevant industry stakeholders.

The AMTech model demonstrates how the Federal government may leverage resources for a greater societal and commercial outcome by producing research that fits into 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.

Schedule & Milestones:

- In FY 2013 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. Implementation awards will be allocated for a duration of three to five years each.

- In FY 2014 - FY 2017, 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 2013, 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 amount in thousands)

Activity: Advanced Manufacuring Technology Consortia
Subactivity: Advanced Manufacuring Technology Consortia

Title:	Location	Grade	Number of Positions	Annual Salary	Total Salaries
Assesment Panel Member	Gaithersburg	ZP IV	3	$105,211	$315,633
Technical Project Manager	Gaithersburg	ZP IV	2	105,211	210,422
Total			5		526,055
less Lapse		25%	1		131,514
Total full-time permanent (FTE)			4		394,541
2013 Pay Adjustment (0.5%)					3,156
TOTAL					397,697

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)

Activity: Advanced Manufacturing Technology Consortia
Subactivity: Advanced Manufacturing Technology Consortia

	Object Class	2013 Increase
11	Personnel compensation	
11.1	Full-time permanent	$397
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	397
12	Civilian personnel benefits	109
13	Benefits for former personnel	0
21	Travel and transportation of persons	0
22	Transportation of things	12
23.1	Rental payments to GSA	0
23.2	Rental Payments to others	0
23.3	Communications, utilities and miscellaneous charges	107
24	Printing and reproduction	3
25.1	Advisory and assistance services	0
25.2	Other services	77
25.3	Purchases of goods & services from Gov't accounts	188
25.4	Operation and maintenance of facilities	0
25.5	Research and development contracts	489
25.6	Medical care	0
25.7	Operation and maintenance of equipment	12
25.8	Subsistence and support of persons	0
26	Supplies and materials	19
31	Equipment	19
32	Lands and structures	0
33	Investments and loans	0
41	Grants, subsidies and contributions	19,568
42	Insurance claims and indemnities	0
43	Interest and dividends	0
44	Refunds	0
99	Total obligations	21,000

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Hollings Manufacturing Extension Partnership

Exhibit 10

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

Activity: Hollings manufacturing extension partnership
Subactivity: Hollings manufacturing extension partnership

Line Item		2011 Actual		2012 Currently Available		2013 Base		2013 Estimate		Increase/ (Decrease) Over 2013 Base	
		Personnel	Amount	Personnel	Amount	Personnel	Amount	Personnel	Amount	Personnel	Amount
Hollings manufacturing extension partnership	Pos./Approp	73	$128,443	78	$128,443	78	$128,443	78	$128,000	0	($443)
	FTE/Obl.	83	128,593	83	130,826	83	128,443	83	128,000	0	(443)

BUDGET ACTIVITY AND SUBACTIVITY: HOLLINGS MANUFACTURING EXTENSION PARTNERSHIP (MEP)

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 60 Manufacturing Extension Partnership Centers 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.

BASE JUSTIFICATION FOR FY 2013:

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. Now more than ever, we need strong manufacturing businesses to create good jobs and help the U.S. economy regain its momentum. 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 2013 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 and market expansion. MEP will leverage the knowledge, information and deliverables achieved from the strategic programmatic competitions that began in FY 2010 as a critical mechanism for further implementation of the MEP Next Generation Strategy. Technology acceleration, supplier development and environmental sustainability strategies represent the next logical steps toward generating increased profit, creating jobs, and bolstering 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 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 2010 have MEP clients reporting significant impacts, including:

• New Sales	$3.6 billion
• Retained Sales	$4.6 billion
• Cost Savings	$1.3 billion
• New Client Investment	$1.9 billion
• Jobs Created	19,170
• Jobs Retained	41,327

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 program has the support of the Administration and Congress as evidenced in the various advanced manufacturing and "Buy American" initiatives.

Priority Objectives for FY 2013:

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 has a connection and reach to the U.S. manufacturing community that is unmatched by any other government program. 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 to lay the foundation for a clean energy economy that would keep jobs in the U.S., strengthen national security, and revitalize American communities.

- Environmental Sustainability: MEP will continue to support its partnership with the Department of Energy and the Environmental Protection Agency in addressing the Secretary of Commerce's High Priority Performance Goals 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). Both E3 and GSN support the Administration and Secretarial priority for interagency cooperation.

- 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. It is anticipated that these efforts will expand to the Smart Grid and the work being done to enable interoperability among Smart Grid devices and systems. Given the role of NIST in developing and deploying Smart Grid technology, the MEP network is well positioned to advance this important

Administration priority by working with manufacturing firms to understand, deploy, and continuously innovate Smart Grid technologies.

- 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.

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, investments, and priorities.

PROGRAM CHANGES FOR FY 2013:

Hollings Manufacturing Extension Partnership Program (MEP) (Base Funding: 83 FTE and $128.443 million; Program Change: -0 FTE and -$443 thousand).

The request funds the Hollings Manufacturing Extension Partnership (MEP) at $128.0 million, a decrease of $443 thousand from the FY 2012 enacted appropriations. The funding decrease of $443 thousand to MEP will not affect funding available for MEP Center Renewals in FY 2013.

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

Activity: Hollings Manufacturing Extension Partnership
Subactivity: Hollings Manufacturing Extension Partnership

	Object Class	2013 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	($443)
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	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	(443)

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 2011 Actual	FY 2012 Currently Available	FY 2013 Estimate
Department of Defense			
Army	0	$100	$100
Navy	0	150	0
Other, Department of Defense	$100	0	0
Subtotal, Department of Defense	100	250	100
Department of Commerce	200	1,725	0
Department of Energy	100	0	0
Department of Transportation	0	1,265	550
Environmental Protection Agency	293	75	0
Subtotal, Other Agency	693	3,315	650
Total, Reimbursable Program	693	3,315	650
Equipment Investments	17	26	26
IE Amortization	(1)	(21)	(26)
Excess Amortizations over Equipment Investments	(16)	0	0
Total, WCF Investments	0	5	0
Total, Reimbursable Program and WCF Investments	693	3,320	650

Baldridge 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)

Activity: Baldrige performance excellence program
Subactivity: Baldrige performance excellence program

Line Item		2011 Actual		2012 Currently Available		2013 Base		2013 Estimate		Increase/ (Decrease) Over 2013 Base	
		Personnel	Amount	Personnel	Amount	Personnel	Amount	Personnel	Amount	Personnel	Amount
Baldrige performance	Pos./Approp	51	$9,608	11	0	0	0	0	0	0	0
excellence program	FTE/Obl.	47	8,558	11	$2,050	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 2011 Actual	FY 2012 Currently Available	FY 2013 Estimate
Technical & Advisory Services	$510	0	0
Subtotal, Other Reimbursables	510	0	0
Total, Reimbursable Program	510	-	-
Equipment Investments	5	0	0
Excess Amortizations over Equipment Investments	(5)	0	0
Total, WCF Investments	0	0	0
Total, Reimbursable Program and WCF Investments	510	-	-

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	2011 Actual	2012 Currently Available	2013 Base	2013 Estimate	Increase/ (Decrease) Over 2013 Base
11	Personnel compensation					
11.1	Full-time permanent	$18,992	$12,967	$7,352	$7,749	$397
11.3	Other than full-time permanent	1,575	733	600	600	0
11.5	Other personnel compensation	636	343	239	239	0
11.9	Total personnel compensation	21,203	14,043	8,191	8,588	397
12.1	Civilian personnel benefits	5,916	3,791	2,317	2,426	109
13	Benefits for former personnel	0	2,016	0	0	0
21	Travel and transportation of persons	1,146	882	788	800	12
22	Transportation of things	88	13	12	12	0
23.1	Rental payments to GSA	8	6	6	6	0
23.2	Rental payments to others	227	361	390	390	0
23.3	Communications, utilities, and miscellaneous charges	2,186	1,076	1,076	1,183	107
24	Printing and reproduction	15	24	12	15	3
25.1	Advisory and assistance services	222	240	245	245	0
25.2	Other services	16,755	16,188	12,836	12,470	(366)
25.3	Purchases of goods and services from government accounts	1,311	631	631	819	188
25.5	Research and development contracts	1,454	0	0	489	489
25.7	Operation and maintenance of equipment	1,082	224	224	236	12
26	Supplies and materials	599	429	379	398	19
31	Equipment	678	336	336	355	19
32	Land and structures	0	0	0	0	0
41	Grants, subsidies, and contributions	158,430	101,000	101,000	120,568	19,568
42	Insurance claims and indemnities	0	0	0	0	0
43	Interest and dividends	1	0	0	0	0
99	Total Obligations	211,321	141,260	128,443	149,000	20,557

	Object Class	2011 Actual	2012 Currently Available	2013 Base	2013 Estimate	Increase/ (Decrease) Over 2013 Base
99	Total Obligations	211,321	141,260	128,443	149,000	20,557
	Less Prior Year Recoveries	(4,228)	(3,100)	0	0	0
	Less Prior Year Refunds	(601)	0	0	0	0
	Less Prior Year Unobligated Balance	(31,748)	(8,117)	0	0	0
	Plus Unobligated Balance End of Year	8,117	0	0	0	0
	Less Unobligated Balance, STRS Transfer	0	(1,600)	0	0	0
	Total Budget Authority/Appropriation	182,861	128,443	128,443	149,000	20,557
	Personnel Data					
	Full-time equivalent employment:					
	Full-time permanent	189	125	75	79	4
	Other than full-time permanent	17	8	8	8	0
	Total	206	133	83	87	4
	Authorized Positions:					
	Full-time permanent	190	125	73	78	5
	Other than full-time permanent	12	5	5	5	0
	Total	202	130	78	83	5

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. $128,000,000, is provided for the Hollings Manufacturing Extension Partnership to remain available until expended.

$21,000,000 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).

Exhibit 34

Department of Commerce
National Institute of Standards and Technology
Industrial Technology Services
ADVISORY AND ASSISTANCE SERVICES
(Obligations in thousands of dollars)

	FY 2011 Actual	FY 2012 Estimate	FY 2013 Estimate
Management and professional support services	$191	$231	$236
Studies, analyses, and evaluations	31	9	9
Engineering and technical services	0	0	0
Total	222	240	245

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.

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Construction of
Research Facilities

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
2012 Currently Available	118	121	$55,381	$68,703	$55,381
less: Unobligated balance from prior year	0	0	0	(13,322)	0
2013 Adjustments to base:					
plus: Uncontrollable cost changes	0	0	552	552	552
2013 Base Request	118	121	55,933	55,933	55,933
2013 Program changes	0	0	4,067	4,067	4,067
2013 Estimate	118	121	60,000	60,000	60,000

		2011 Actual		2012 Currently Available		2013 Base		2013 Estimate		Increase/ (Decrease) Over 2013 Base	
Comparison by activity/subactivity:		Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount
Construction and major renovations											
Construction and major	Pos/Approp	114	$69,860	118	$55,381	118	$55,933	118	$60,000	0	$4,067
renovations	FTE/Obl.	121	90,004	121	68,703	121	55,933	121	60,000	0	4,067
Adjustments for:											
Prior year recoveries			(456)		0		0		0		0
Prior year refunds			(6)		0		0		0		0
Unobligated balance, start of year			(33,004)		(13,322)		0		0		0
Unobligated balance, end of year			13,322		0		0		0		0
Financing from transfers:											
Transfers to other accounts (+)			0		0		0		0		0
Appropriation			69,860		55,381		55,933		60,000		4,067

Exhibit 7

Department of Commerce
National Institute of Standards and Technology
Construction of Research Facilities
SUMMARY OF FINANCING
(Dollar amounts in thousands)

	2011 Actual	2012 Currently Available	2013 Base	2013 Estimate	Increase/ (Decrease) Over 2013 Base
Total Obligations	$90,956	$69,633	$55,933	$60,000	$4,067
Financing:					
Offsetting collections from:					
Federal funds	0	0	0	0	0
Non-Federal sources	(929)	0	0	0	0
Total offsetting collections	(929)	0	0	0	0
Adjustments for:					
Prior year recoveries	(456)	0	0	0	0
Prior year refunds	(6)	0	0	0	0
Unobligated balance, start of year (Direct)	(33,004)	(13,322)	0	0	0
Unobligated balance, start of year (Reimbursable)	(953)	(930)	0	0	0
Unobligated balance, end of year (Direct)	13,322	0	0	0	0
Unobligated balance, end of year (Reimbursable)	930	0	0	0	0
Unobligated balance, expired (ARRA)	0	0	0	0	0
Budget Authority	69,860	55,381	55,933	60,000	4,067
Financing:					
Transfer to other accounts	0	0	0	0	0
Transfer from other accounts	0	0	0	0	0
Appropriation	69,860	55,381	55,933	60,000	4,067

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:		
2013 Pay increase and related costs	0	44

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

Total cost in FY 2013 of pay increase	$44,000
Less amount absorbed in FY 2013	0
Amount requested for FY 2013 pay increase	44,000
Payment to Departmental Management Working Capital Fund	0
Total adjustment for FY 2013 pay increase	44,000

Personnel benefits	0	97

Civil Service Retirement System (CSRS)	($10)
Federal Employees' Retirement System (FERS)	17
Thrift Savings Plan (TSP)	5
Federal Insurance Contribution Act (FICA) - OASDI	15
Health Insurance	65
Employees' Compensation Fund	5

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 10.2 percent in FY 2012 to 8.7 percent in FY 2013. The contribution rate will remain at 7.0 percent in FY 2013.

Payroll subject to retirement systems ($9,717,526)	
Cost of CSRS contributions in FY 2013 ($9,717,526 x .087 x .07)	$59,180
Cost of CSRS contributions in FY 2012 ($9,717,526 x .102 x .07)	69,383
Total adjustment to base	(10,203)

Federal Employees' Retirement System ($17,000) – 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 89.8 percent in FY 2012 to 91.3 percent FY 2013. The contribution rate will remain the same at 11.7 percent in FY 2013.

Payroll subject to retirement systems ($9,717,526)	
Basic benefit cost in FY 2013 ($9,717,526 x .913 x .117)	$1,038,036
Basic benefit cost in FY 2012 ($9,717,526 x .898 x .117)	1,020,982
Total adjustment to base	17,054

Thrift Savings Plan ($5,000) – The cost of agency contributions to the Thrift Savings Plan will also rise as FERS participation increases. The contribution rate has decreased from 4.56 in FY 2012 to 4.54 in FY 2013.

Thrift plan cost in FY 2013 ($9,717,526 x .913 x .0454)	$402,793
Thrift plan cost in FY 2012 ($9,717,526 x .898 x .0456)	397,921
Total adjustment to base	4,872

Federal Insurance Contributions Act (FICA) - OASDI ($15,000) – As the percentage of payroll covered by FERS increases, the cost of OASDI contributions will increase. In FY 2013, the maximum salary subject to OASDI tax will increase from $110,175 in FY 2012 to $113,100 in FY 2013. The OASDI tax rate will remain 6.2 percent in FY 2013.

FERS payroll subject to FICA tax in 2013 ($9,717,526 x .913 x .882 x .062).....	$485,162
FERS payroll subject to FICA tax in 2012 ($9,717,526 x .898 x .873 x .062).....	472,322
Increase (FY 2012-FY 2013)	12,840
OTP payroll subject to FICA tax in FY 2013 ($1,296,474 x .913 x .882 x .062)	64,728
OTP payroll subject to FICA tax in FY 2012 ($1,296,474 x .898 x .873 x .062)	63,015
Increase (FY 2012-FY 2013)	1,713
Total adjustment to base	14,553

Health insurance ($65,000) – Effective January 2011, NIST's contribution to Federal employees' health insurance premiums increased by 8.8 percent. Applied against the FY 2012 estimate of $738,000, the additional amount required is $64,944.

Employees' Compensation Fund ($5,000) – The Employees' Compensation Fund bill for the year ending June 30, 2011 is a net $13,015 lower than for the year ending June 30, 2010. CRF had a small increase of $4,592.

Travel and transportation of persons 0 2

The General Services Administration (GSA) increased the standard per diem rate from $116 to $123 resulting in a percentage increase of 6.0% for destinations within the Continental United States (CONUS). This increase was applied to the FY 2012 estimate of $31,000 for an increase of $1,860.

General pricing level adjustment	0	409

This request applies the OMB economic assumptions of 1.5 percent for FY 2013 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: other services $383,430; supplies and materials $24,750; and equipment $915.

Subtotal, Other changes	0	552
Total adjustments to base	0	552

Program and Performance

Exhibit 10

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

Activity: Construction and major renovations
Subactivity: Construction and major renovations

Line Item		2011 Actual		2012 Currently Available		2013 Base		2013 Estimate		(Increase/ Decrease) Over 2013 Base	
		Personnel	Amount	Personnel	Amount	Personnel	Amount	Personnel	Amount	Personnel	Amount
Construction and major renovations	Pos/Approp	7	$11,976	0	$13,900	0	$13,900	0	$11,800	0	($2,100)
	FTE/Obl.	7	26,725	0	19,159	0	13,900	0	11,800	0	(2,100)
Safety, Capacity, Maintenance and Major Repairs	Pos/Approp	104	57,884	118	41,481	118	42,033	118	48,200	0	6,167
	FTE/Obl.	111	62,457	121	46,862	121	42,033	121	48,200	0	6,167
External Projects	Pos/Approp	3	0	0	0	0	0	0	0	0	0
	FTE/Obl.	3	822	0	2,682	0	0	0	0	0	0
Total	Pos/Approp	114	69,860	118	55,381	118	55,933	118	60,000	0	4,067
	FTE/Obl.	121	90,004	121	68,703	121	55,933	121	60,000	0	4,067

APPROPRIATION ACCOUNT: CONSTRUCTION OF RESEARCH FACILITIES

BUDGET ACTIVITY: CONSTRUCTION OF RESEARCH FACILITIES

For FY 2013, NIST requests a net increase of $4.1 million and 0 FTE over the base program for a total of $60.0 million and 121 FTE for Construction of Research Facilities (CRF).

BASE JUSTIFICATION FOR FY 2013:

Construction of Research Facilities Overview

The 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.

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 safety, capacity, maintenance, and major repair projects. If major facilities-related emergency situations arise, previously planned facilities work is reprioritized as appropriate.

Primary activities being conducted with the program's base resources include the following:

- 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 to modify the facilities 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 architectural, structural, and energy conservation related repairs as needed;
- continue site infrastructure, to include roads, docks, pedestrian walk areas, and storm water drainage; and
- enable or maintain building environmental conditions required for meeting scientific requirements.

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.

Significant Adjustments-to-Base (ATBs):

NIST requests a total of $0.552 million of adjustments to the Safety, Capacity, Maintenance, and Major Repair (SCMMR) program within the Construction of Research Facilities budget. The increase will fund the estimated 2013 Federal pay raise of 0.5 percent. The increase will also provide inflationary increases for non-labor activities including service contracts and utilities.

PROGRAM CHANGES FOR FY 2013:

1. Renovation of Building 1 Decrease (Base Funding: 0 FTE and $13.9 million; **Program Change:** 0 FTE and -$13.9 million): NIST requests a decrease in the amount of $13.9 million for the completion of exterior renovations to Building 1 and the interior renovations of Wing 3.

PROGRAM CHANGE PERSONNEL DETAIL
(Dollar amounts in thousands)

Activity: Construction and Major Renovations
Subactivity: 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)

Activity: Construction and Major Renovations
Subactivity: Construction and Major Renovations
Program Change: Building 1 Renovation Decrease

	Object Class	2013 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	($13,900)
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	(13,900)

2. Building 1 Renovation Increase (Base Funding: 0 FTE and $0 million; Program Change: 0 FTE and +$11.8 million): NIST requests an increase of $11.8 million and 0 FTE for a total of $11.8 million and 0 FTE to move forward with the next phase of the multi-year interior renovations of Boulder's Building 1. The increase will fund the interior renovation of Wing 6. The remaining wing renovations will be completed with future funding requests.

Proposed Actions:

With Wing 3 renovation to be completed through FY 2012 funding, NIST requests an increase to fund the next planned phase: renovation of Wing 6. Wing 6 houses the Electromagnetics Division. The conditions are currently insufficient to meet the performance requirements of a Level 3 (L3) General Lab necessary for microwave and wireless calibrations.

Statement of Need and Economic Benefits:

Aging laboratory facilities at NIST Boulder substantially hinder NIST's mission of fostering innovation and ensuring U.S. competitiveness, and impose significant costs to the Nation. 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 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 bring the facility up to 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-range revitalization plan for the NIST laboratories at Boulder following the completion of construction of the high-performance (L4) Precision Measurement Laboratory (PML).

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[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.*

The B1R renovation project would 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 a number of calibration services in the microwave, Radio Frequency, and optical domains. Failures and poor performance of the building infrastructure severely impact that research to the point that calibrations are delayed. Many of the calibration services are currently housed in Wing 6 and are not scheduled to relocate to the PML. 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 Resource 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 2013 – Award the next phase of renovation at Building 1, for the initiation of major mechanical/electrical and architectural work at Wing 6.

Deliverables:

- FY 2013 – Award and construction of interior renovations at Building 1, Wing 6.

Performance Goals and Measurement Data

Performance Goal: Percent of Renovations Complete	FY 2011 Actual	FY 2012 Target	FY 2013 Target	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target
With Increase	5% completion of exterior renovations of Wings 3 and 6, and the limited exterior renovations at the Center Spine; 5% completion of the seismic reinforcing at Wing 5	50% completion of exterior renovations of Wings 3 and 6, and the limited exterior renovations at the Center Spine; 55% completion of the seismic reinforcing at Wing 5; 5% completion of the interior renovation of Wing 3	100% completion of exterior renovations of Wings 3 and 6, and the limited exterior renovations at the Center Spine; 100% completion of the seismic reinforcing at Wing 5; 70% completion of the interior renovation of Wing 3; 5% completion of the interior renovation of Wing 6	100% 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 6	N/A	N/A

Without Increase	5% completion of exterior renovations of Wings 3 and 6, and the limited exterior renovations at the Center Spine; 5% completion of the seismic reinforcing at Wing 5	50% completion of exterior renovations of Wings 3 and 6, and the limited exterior renovations at the Center Spine; 55% completion of the seismic reinforcing at Wing 5; 5% completion of the interior renovation of Wing 3	100% completion of exterior renovations of Wings 3 and 6, and the limited exterior renovations at the Center Spine; 100% completion of the seismic reinforcing at Wing 5; 70% completion of the interior renovation of Wing 3	100% completion of the interior renovation of Wing 3	N/A	N/A	N/A
Description: With funding received in FY 2012, 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 2012 and Prior	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017
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				
*Total:	37,876	11,800	0	0	0	0
FTE's (Initiative)		0				

* *The remaining wing renovations will be completed with future funding requests.*

PROGRAM CHANGE PERSONNEL DETAIL
(Dollar amounts in thousands)

Activity: Construction and Major Renovations
Subactivity: 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)

Activity: Construction and Major Renovations
Subactivity: Construction and Major Renovations
Program Change: Building 1 Renovation Increase

	Object Class	2013 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

3. Safety, Capacity, Maintenance, and Major Repair (SCMMR) (Base Funding: 121 FTE and $42.033 million**; Program Change:** 0 FTE and +$6.167 million**):** NIST requests an increase of $6.167 million and 0 FTE for a total of $48.2 million and 121 FTE 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 renovation projects across NIST facilities.

Statement of Need and Economic Benefits:

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. In this way, NIST research helps foster technological innovation, which is the driving force for about 50 percent of U.S. economic growth. 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 Resource 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 urgent SCMMR projects. Some of NIST's most serious facility deterioration directly affects 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. Each site still suffers from severe 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 2013 – 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 2013 – Reduce the overall facilities backlog annually by approximately three percent.
- FY 2013 – Reduce the FCI annually by approximately three percent.

Performance Goals and Measurement Data

Performance Goal: Percent of facilities backlog reduced	FY 2011 Actual	FY 2012 Target	FY 2013 Target	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target
With Increase	3.0%	2.5%	2.7%	2.7%	2.7%	2.7%	2.7%
Without Increase	3.0%	2.5%	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 2011 Actual	FY 2012 Target	FY 2013 Target	FY 2014 Target	FY 2015 Target	FY 2016 Target	FY 2017 Target
With Increase	3.0%	2.5%	2.7%	2.7%	2.7%	2.7%	2.7%
Without Increase	3.0%	2.5%	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)

Activity: Construction and Major Renovations
Subactivity: 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)

Activity: Construction and Major Renovations
Subactivity: Construction and Major Renovations
Program Change: Safety, Capacity, Maintenance, and Major Repair Increase

	Object Class	2013 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	$6,167
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	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	6,167

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	2011 Actual	2012 Currently Available	2013 Base	2013 Estimate	Increase/ (Decrease) Over 2013 Base
11	Personnel compensation					
11.1	Full-time permanent	$9,737	$9,737	$9,772	$9,772	0
11.3	Other than full-time permanent	0	0	0	0	0
11.5	Other personnel compensation	1,277	1,277	1,277	1,277	0
11.9	Total personnel compensation	11,014	11,014	11,049	11,049	0
12.1	Civilian personnel benefits	3,064	3,086	3,192	3,192	0
13	Benefits for former personnel	1	1	1	1	0
21	Travel and transportation of persons	47	47	49	49	0
22	Transportation of things	22	22	22	22	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	35	35	35	35	0
24	Printing and reproduction	3	3	3	3	0
25.1	Advisory and assistance services	0	0	0	0	0
25.2	Other services	51,491	33,038	24,814	30,981	$6,167
25.3	Purchases of goods and services from government accounts	291	291	295	295	0
25.5	Research and development contracts	0	0	0	0	0
25.7	Operation and maintenance of equipment	824	824	836	836	0
26	Supplies and materials	1,650	1,650	1,675	1,675	0
31	Equipment	61	61	62	62	0
32	Land and structures	21,500	18,112	13,900	11,800	(2,100)
41	Grants, subsidies, and contributions	0	519	0	0	0
43	Interest and dividends	1	0	0	0	0
99	Total Obligations	90,004	68,703	55,933	60,000	4,067

	Object Class	2011 Actual	2012 Currently Available	2013 Base	2013 Estimate	Increase/ (Decrease) Over 2013 Base
99	Total Obligations	90,004	68,703	55,933	60,000	4,067
	Less Prior Year Recoveries	(456)	0	0	0	0
	Less Prior Year Refunds	(6)	0	0	0	0
	Less Prior Year Unobligated Balance	(33,004)	(13,322)	0	0	0
	Plus Unobligated Balance End of Year	13,322	0	0	0	0
	Total Budget Authority	69,860	55,381	55,933	60,000	4,067
	Plus Transfers from Other Accounts	0	0	0	0	0
	Appropriation	69,860	55,381	55,933	60,000	4,067
	Personnel Data					
	Full-time equivalent employment:					
	Full-time permanent	121	121	121	121	0
	Other than full-time permanent	0	0	0	0	0
	Total	121	121	121	121	0
	Authorized Positions:					
	Full-time permanent	114	118	118	118	0
	Other than full-time permanent	0	0	0	0	0
	Total	114	118	118	118	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. $60,000,000, 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.

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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
2012 Currently Available	691	765	1,695	1,695
Reduction in transfers from prior STRS program changes	0	0	(1,695)	(1,695)
2013 Base	691	765	0	0
Reduction of BPEP Positions and FTE supported by reimbursable basis.	(9)	(9)	0	0
Transfer from STRS program changes for equipment investments	0	0	1,500	1,500
2013 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)

	2011 Actual	2012 Currently Available	2013 Base	2013 Estimate	Increase/ (Decrease) Over 2013 Base
Total Obligations	$167,582	$205,367	$163,190	$164,690	$1,500
Offsetting collections from:					
Federal funds	(114,679)	(128,894)	(110,909)	(110,909)	0
Non-Federal sources	(57,545)	(74,778)	(52,281)	(52,281)	0
Total offsetting collections	(172,224)	(203,672)	(163,190)	(163,190)	0
Unobligated balance, start of year	(145,229)	(125,879)	(125,879)	(125,879)	0
Unobligated balance, end of year	125,879	125,879	125,879	125,879	0
Change in uncollected customer payments - Federal	23,992	0	0	0	0
Budget Authority	0	1,695	0	1,500	1,500
Financing:					
Transfer from other accounts	0	(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, and the sale of Standard Reference Materials (SRMs). 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. Through funds NIST received from the Malcolm Baldrige National Quality Award Foundation, the Baldrige Performance Excellence Program will continue to meet its objectives.

The operations of the NIST WCF 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. In addition to its function as a revolving fund, the WCF is also used to handle annual 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 SRMs, and to carry supply inventories until issued for program use. 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.

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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	2011 Actual	2012 Currently Available	2013 Base	2013 Estimate	Increase/ (Decrease) Over 2013 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	0	$160	0	0	0
31	Equipment	0	1,535	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	0	1,695	0	1,500	1,500

Personnel Data	2011 Actual	2012 Currently Available	2013 Base	2013 Estimate	Increase/ (Decrease) Over 2013 Base
Full-time equivalent employment:					
Full-time permanent	643	715	706	706	0
Other than full-time permanent	50	50	50	50	0
Total	693	765	756	756	0
Authorized Positions:					
Full-time permanent	637	661	652	652	0
Other than full-time permanent	30	30	30	30	0
Total	667	691	682	682	0

Exhibit 34

Department of Commerce
National Institute of Standards and Technology
Working Capital Fund
ADVISORY AND ASSISTANCE SERVICES
(Obligations in thousands of dollars)

	FY 2011 Actual	FY 2012 Estimate	FY 2013 Estimate
Management and professional support services	$1,505	$1,730	$1,730
Studies, analyses, and evaluations	153	78	80
Engineering and technical services	0	0	0
Total	1,658	1,808	1,810

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.

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Wireless
Innovation Fund

Exhibit 5

Department of Commerce
National Institute of Standards and Technology
Wireless Innovation Fund
SUMMARY OF RESOURCE REQUIREMENTS - MANDATORY APPROPRIATION
(Dollar amounts in thousands)

	Positions	FTE	Budget Authority	Direct Obligations	Appro-priation
2012 Currently Available	0	0	0	0	0
2013 Adjustments to base	0	0	0	0	0
2013 Base Request	0	0	0	0	0
plus: 2013 Offsetting Collections [1/]	18	13	$300,000	$15,000	0
2013 Estimate	18	13	300,000	15,000	0

Comparison by activity/subactivity:		2011 Actual Per-sonnel	2011 Actual Amount	2012 Currently Available Per-sonnel	2012 Currently Available Amount	2013 Base Per-sonnel	2013 Base Amount	2013 Estimate Per-sonnel	2013 Estimate Amount	Increase/ (Decrease) Over 2013 Base Per-sonnel	Increase/ (Decrease) Over 2013 Base Amount
Wireless Innovation Fund											
Wireless Innovation Fund	Pos/Approp	0	0	0	0	0	0	18	0	18	0
	FTE/Obl.	0	0	0	0	0	0	13	$15,000	13	$15,000
Total: Wireless Innovation Fund	Pos/Approp	0	0	0	0	0	0	18	0	18	0
	FTE/Obl.	0	0	0	0	0	0	13	15,000	13	15,000
Adjustments for:											
Unobligated balance from offsetting collections, end of year			0		0		0		285,000		285,000
Budget Authority - Mandatory Account		0	0	0	0	0	0	13	300,000	13	300,000
Offsetting collections			0		0		0		(300,000)		(300,000)
Net Budget Authority - Mandatory Account		**0**	**0**	**0**	**0**	**0**	**0**	**13**	**0**	**13**	**0**

[1/] WIN Budget Authority of $300 million (from offsetting collections) will obligate over several fiscal years.

Exhibit 7

Department of Commerce
National Institute of Standards and Technology
Wireless Innovation Fund
SUMMARY OF FINANCING - MANDATORY APPROPRIATION
(Dollar amounts in thousands)

	2011 Actual	2012 Currently Available	2013 Base	2013 Estimate	Increase/ (Decrease) Over 2013 Base
Total Obligations	0	0	0	$15,000	$15,000
Adjustments for:					
Unobligated balance from offsetting collections, end of year	0	0	0	285,000	285,000
Budget Authority - Mandatory Account [1/]	0	0	0	300,000	300,000
Financing:					
Offsetting collections from Non-Federal sources	0	0	0	(300,000)	(300,000)
NET Budget Authority - Mandatory Account	0	0	0	0	0

[1/] WIN Mandatory Budget Authority of $300 million (from offsetting collections) will obligate over several fiscal years.

Program and Performance

Department of Commerce
National Institute of Standards and Technology
Wireless Innovation Fund
PROGRAM AND PERFORMANCE: MANDATORY APPROPRIATION
(Dollar amounts in thousands)

Activity: Wireless Innovation Fund
Subactivity: Wireless Innovation Fund

Line Item		2011 Actual		2012 Currently Available		2013 Base		2013 Estimate		(Increase/ Decrease) Over 2013 Base	
		Personnel	Amount	Personnel	Amount	Personnel	Amount	Personnel	Amount	Personnel	Amount
Wireless Innovation Fund	Pos/Approp	0	0	0	0	0	0	18	0	18	0
	FTE/Obl.	0	0	0	0	0	0	13	$15,000	13	$15,000
Total	Pos/Approp	0	0	0	0	0	0	18	0	18	0
	FTE/Obl.	0	0	0	0	0	0	13	15,000	13	15,000

Note: WIN Mandatory Budget Authority of $300 million (from offsetting collections) will obligate over several fiscal years.

MANDATORY ACCOUNT: WIRELESS INNOVATION (WIN) FUND

BUDGET ACTIVITY: WIRELESS INNOVATION (WIN) FUND

This budget activity is new in FY 2013. This new fund is established as part of the Administration's effort to spur wireless innovation.

As part of the National Wireless Initiative included in the American Jobs Act, NIST will create a Wireless Innovation (WIN) Fund to help develop cutting-edge wireless technologies for public safety users. The WIN Fund will provide $300.0 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.

SUBACTIVITY: WIRELESS INNOVATION (WIN) FUND

This budget activity is new in FY 2013.

BASE JUSTIFICATION FOR FY 2013:

The WIN program is a new program and no base funding exists.

PROGRAM CHANGES FOR FY 2013:

Wireless Innovation Fund (Base Funding: 0 FTE and $0 million; Program Change: + 13 FTE and +$300.0 million).

Program Description:

The FY 2013 budget includes a request of $300.0 million in mandatory funds for the Wireless Innovation Fund, which will help spur the development of cutting-edge wireless technologies. As part of this initiative, NIST will work with industry and public safety organizations to conduct research and develop new standards, technologies and applications to advance public safety communications. Core components of this program will include documenting public safety requirements and driving the adoption of those requirements into the appropriate standards; developing the capability for communications between currently deployed public safety narrow band systems and the future nationwide broadband network; and establishing a roadmap that seeks to capture and address public safety's needs beyond what can be provided by the current generation of broadband technology and driving technological progress in that direction. NIST will accomplish these goals through directed research, development, applications, and demonstration projects. Where appropriate, NIST will cooperate with other government research agencies and transfer funding if particular agencies are better suited to sponsor and oversee relevant research, development, or demonstration projects.

FY 2013 activities include setting up the infrastructure to be able to run a competitive grant program in FY 2014 through FY 2016. Grants awarded in these fiscal years will be between $70 and $75 million each year.

Proposed Actions:

NIST will develop the WIN program by building upon and leveraging critical synergies between:

- The Department of Commerce's Public Safety Communications Research (PSCR) program, a partnership of the NIST Office of Law Enforcement Standards (NIST/OLES), NTIA's Institute for Telecommunication Sciences (ITS), and various other NIST laboratories based in Boulder, Colorado.

- NIST and PSCR's strong relationships with public safety practitioners, agencies, and the Public Safety Broadband Licensee, which holds the license to the public safety spectrum.

- NIST's successful partnerships with the Departments of Homeland Security and Justice, the National Telecommunications and Information Administration (NTIA), and the Federal Communications Commission (FCC).

- NIST's experience in research, development, testing, and evaluation of critical public safety communications technologies, including broadband.

The WIN program will support and expand upon the ongoing work of the PSCR program, including:

- The 700MHz Public Safety Broadband Demonstration Network, which will provide public safety practitioners access to information on how advanced communications technologies, such as video, mapping and GPS technologies, will perform over the demonstration network. The network will later be used as a public safety education center, where first responders can run emergency scenarios and develop advanced public safety specific applications. The effort will also result in integration opportunities for a variety of enhanced broadband communication technologies.

- Helping to identify, articulate, and support public safety's requirements in national and international standards bodies, providing insight and direction to IT and wireless standards committees that are developing standards for voice, data, image, and video communications.

PROGRAM CHANGE PERSONNEL DETAIL

(Dollar amount in thousands)

Activity: Wireless Innovation Fund
Subactivity: Wireless Innovation Fund

Title:	Location	Grade	Number of Positions	Annual Salary	Total Salaries
Program manager	Gaithersburg	ZP V	1	$123,758	$123,758
Program lead	Gaithersburg	ZP IV	4	105,211	420,844
Grants specialist	Gaithersburg	ZP IV	10	105,211	1,052,110
Secretary	Gaithersburg	ZA III	1	74,872	74,872
Administrative/tech support	Gaithersburg	ZA II	2	51,630	103,260
Total			18		1,774,844
Less Lapse		25%	(5)		(443,711)
Total full-time permanent (FTE)			13		1,331,133
2013 Pay Adjustment (.5%)					6,656
TOTAL					1,337,789

Personnel Data	Number
Full-Time Equivalent Employment	
Full-time permanent	13
Other than full-time permanent	0
Total	13
Authorized Positions:	
Full-time permanent	18
Other than full-time permanent	0
Total	18

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

Activity: Wireless Innovation Fund
Subactivity: Wireless Innovation Fund

	Object Class	2013 Increase
11	Personnel compensation	
11.1	Full-time permanent	$1,338
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	1,338
12	Civilian personnel benefits	370
13	Benefits for former personnel	0
21	Travel and transportation of persons	134
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	306
24	Printing and reproduction	3
25.1	Advisory and assistance services	0
25.2	Other services	7,943
25.3	Purchases of goods & services from Gov't accounts	4,687
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	45
25.8	Subsistence and support of persons	0
26	Supplies and materials	72
31	Equipment	102
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	15,000

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Object Class

Exhibit 16

Department of Commerce
National Institute of Standards and Technology
Wireless Innovation Fund
SUMMARY OF REQUIREMENTS BY OBJECT CLASS - MANDATORY APPROPRIATION

	Object Class	2011 Actual	2012 Currently Available	2013 Base	2013 Estimate	Increase/ (Decrease) Over 2013 Base
11	Personnel compensation					
11.1	Full-time permanent	0	0	0	$1,338	$1,338
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	1,338	1,338
12.1	Civilian personnel benefits	0	0	0	370	370
13	Benefits for former personnel	0	0	0	0	0
21	Travel and transportation of persons	0	0	0	134	134
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	306	306
24	Printing and reproduction	0	0	0	3	3
25.1	Advisory and assistance services	0	0	0	0	0
25.2	Other services	0	0	0	7,943	7,943
25.3	Purchases of goods and services from government accounts	0	0	0	4,687	4,687
25.5	Research and development contracts	0	0	0	0	0
25.7	Operation and maintenance of equipment	0	0	0	45	45
26	Supplies and materials	0	0	0	72	72
31	Equipment	0	0	0	102	102
32	Land and structures	0	0	0	0	0
41	Grants, subsidies, and contributions	0	0	0	0	0
42	Insurance claims and indemnities	0	0	0	0	0
99	Total Obligations	0	0	0	15,000	15,000

	Object Class	2011 Actual	2012 Currently Available	2013 Base	2013 Estimate	Increase/ (Decrease) Over 2013 Base
99	Total Obligations	0	0	0	$15,000	$15,000
	Unobligated balance from offsetting collections, end of year	0	0	0	285,000	285,000
	Budget Authority - Mandatory Account	0	0	0	300,000	300,000
	Less: Offsetting collections	0	0	0	(300,000)	(300,000)
	Net Budget Authority - Mandatory Account	0	0	0	0	0
	Personnel Data					
	Full-time equivalent employment:					
	Full-time permanent	0	0	0	13	13
	Other than full-time permanent	0	0	0	0	0
	Total	0	0	0	13	13
	Authorized Positions:					
	Full-time permanent	0	0	0	18	18
	Other than full-time permanent	0	0	0	0	0
	Total	0	0	0	18	18

Note: WIN Mandatory Budget Authority of $300 million (from offsetting collections) will obligate over several fiscal years.

Department of Commerce
National Institute of Standards and Technology
Wireless Innovation Fund
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. $300,000,000, no specific authority

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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
2012 Currently Available	0	0	0	0	0
2013 Adjustments to base	0	0	0	0	0
2013 Base Request	0	0	0	0	0
plus: 2013 Program Change	34	25	$1,000,000	$560,000	$1,000,000
2013 Estimate	34	25	1,000,000	560,000	1,000,000

		2011 Actual		2012 Currently Available		2013 Base		2013 Estimate		Increase/ (Decrease) Over 2013 Base	
Comparison by activity/subactivity:		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	34	$1,000,000	34	$1,000,000
Innovation	FTE/Obl.	0	0	0	0	0	0	25	560,000	25	560,000
Total: National Network for Manufacturing	Pos/Approp	0	0	0	0	0	0	34	1,000,000	34	1,000,000
Innovation	FTE/Obl.	0	0	0	0	0	0	25	560,000	25	560,000
Adjustments for:											
Unobligated balance, end of year			0		0		0		440,000		440,000
Appropriation/BA - Mandatory Account			0		0		0		1,000,000		1,000,000

[1/] NNMI Appropriation/Budget Authority of $1.0 billion 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)

	2011 Actual	2012 Currently Available	2013 Base	2013 Estimate	Increase/ (Decrease) Over 2013 Base
Total Obligations	0	0	0	$560,000	$560,000
Adjustments for:					
Unobligated balance, end of year	0	0	0	440,000	440,000
Appropriation/BA - Mandatory Account [1/]	0	0	0	1,000,000	1,000,000

[1/] NNMI Appropriation/Budget Authority of $1.0 billion 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)

Activity: National Network for Manufacturing Innovation
Subactivity: National Network for Manufacturing Innovation

Line Item		2011 Actual Personnel	2011 Actual Amount	2012 Currently Available Personnel	2012 Currently Available Amount	2013 Base Personnel	2013 Base Amount	2013 Estimate Personnel	2013 Estimate Amount	(Increase/ Decrease) Over 2013 Base Personnel	(Increase/ Decrease) Over 2013 Base Amount
National Network for Manufacturing Innovation	Pos/Approp	0	0	0	0	0	0	34	$1,000,000	34	$1,000,000
	FTE/Obl.	0	0	0	0	0	0	25	560,000	25	560,000
Total	Pos/Approp	0	0	0	0	0	0	34	1,000,000	34	1,000,000
	FTE/Obl.	0	0	0	0	0	0	25	560,000	25	560,000

Note: NNMI Appropriation/Budget Authority of $1.0 billion will obligate over several fiscal years.

MANDATORY ACCOUNT: NATIONAL NETWORK FOR MANUFACTURING INNOVATION

BUDGET ACTIVITY: NATIONAL NETWORK FOR MANUFACTURING INNOVATION (NNMI)

This budget activity is new in FY 2013. This new fund is established as part of the Administration's efforts to strengthen the U.S. manufacturing sector.

As part of its efforts to revitalize U.S. manufacturing, the Administration will propose legislation creating a mandatory account making available $1.0 billion to establish a National Network for Manufacturing Innovation (NNMI), which would consist of a network of institutes where researchers, companies, and entrepreneurs can come together to develop new manufacturing technologies with broad applications. Each institute would have a unique technology focus. These institutes will help support an ecosystem of manufacturing activity in local areas. The Manufacturing Innovation Institutes would support manufacturing technology commercialization by helping to bridge the gap from the laboratory to the market and address core gaps in scaling manufacturing process technologies.

SUBACTIVITY: NATIONAL NETWORK FOR MANUFACTURING INNOVATION (NNMI)

This budget activity is new in FY 2013.

BASE JUSTIFICATION FOR FY 2013:

The NNMI is a new program and no base funding exists.

PROGRAM CHANGES FOR FY 2013:

National Network for Manufacturing Innovation (NNMI) (Base Funding: 0 FTE and $ 0 million; Program Change: +25 FTE and + $ 1.0 billion):

The 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
- 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
- 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 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.

A trend is emerging where other countries are increasingly adept at technology transfer and scaling to production. They have focused on creating a more structured technology development process by partnering with industry. 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.

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 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.

PROGRAM CHANGE PERSONNEL DETAIL

(Dollar amount in thousands)

Activity: National Network for Manufacturing Innovation (NNMI)

Subactivity: National Network for Manufacturing Innovation

Title:	Location	Grade	Number of Positions	Annual Salary	Total Salaries
Program manager	Gaithersburg	ZP V	1	$123,758	$123,758
Program lead	Gaithersburg	ZP IV	8	105,211	$841,688
Grants specialist	Gaithersburg	ZP IV	20	105,211	$2,104,220
Secretary	Gaithersburg	ZA III	2	74,872	$149,744
Administrative/tech support	Gaithersburg	ZA II	3	51,630	$154,890
Total			34		3,374,300
Less Lapse		25%	(9)		(843,575)
Total full-time permanent (FTE)			25		2,530,725
2013 Pay Adjustment (.5%)					12,654
TOTAL					2,543,379

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)

Activity: National Network for Manufacturing Innovation
Subactivity: National Network for Manufacturing Innovation

	Object Class	2013 Increase
11	Personnel compensation	
11.1	Full-time permanent	$2,543
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	2,543
12	Civilian personnel benefits	703
13	Benefits for former personnel	0
21	Travel and transportation of persons	215
22	Transportation of things	51
23.1	Rental payments to GSA	
23.2	Rental Payments to others	0
23.3	Communications, utilities and miscellaneous charges	624
24	Printing and reproduction	8
25.1	Advisory and assistance services	0
25.2	Other services	413
25.3	Purchases of goods & services from Gov't accounts	596
25.4	Operation and maintenance of facilities	
25.5	Research and development contracts	4,098
25.6	Medical care	0
25.7	Operation and maintenance of equipment	463
25.8	Subsistence and support of persons	0
26	Supplies and materials	100
31	Equipment	186
32	Lands and structures	0
33	Investments and loans	0
41	Grants, subsidies and contributions	550,000
42	Insurance claims and indemnities	0
43	Interest and dividends	0
44	Refunds	0
99	Total obligations	560,000

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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	2011 Actual	2012 Currently Available	2013 Base	2013 Estimate	Increase/ (Decrease) Over 2013 Base
11	Personnel compensation					
11.1	Full-time permanent	0	0	0	$2,543	$2,543
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	2,543	2,543
12.1	Civilian personnel benefits	0	0	0	703	703
13	Benefits for former personnel	0	0	0	0	0
21	Travel and transportation of persons	0	0	0	215	215
22	Transportation of things	0	0	0	51	51
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	624	624
24	Printing and reproduction	0	0	0	8	8
25.1	Advisory and assistance services	0	0	0	0	0
25.2	Other services	0	0	0	413	413
25.3	Purchases of goods and services from government accounts	0	0	0	596	596
25.5	Research and development contracts	0	0	0	4,098	4,098
25.7	Operation and maintenance of equipment	0	0	0	463	463
26	Supplies and materials	0	0	0	100	100
31	Equipment	0	0	0	186	186
32	Land and structures	0	0	0	0	0
41	Grants, subsidies, and contributions	0	0	0	550,000	550,000
42	Insurance claims and indemnities	0	0	0	0	0
99	Total Obligations	0	0	0	560,000	560,000

Object Class		2011 Actual	2012 Currently Available	2013 Base	2013 Estimate	Increase/ (Decrease) Over 2013 Base
99	Total Obligations	0	0	0	$560,000	$560,000
	Unobligated balance, end of year	0	0	0	440,000	440,000
	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	25	25
	Other than full-time permanent	0	0	0	0	0
	Total	0	0	0	25	25
Authorized Positions:						
	Full-time permanent	0	0	0	34	34
	Other than full-time permanent	0	0	0	0	0
	Total	0	0	0	34	34

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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Institute Material

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 2011			FY 2012			FY 2013			
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	2,067	2,001	$509,587	2,203	2,175	$589,879	2,327	2,292	$650,250	$648,000
Industrial technology services	202	206	211,321	130	133	141,260	83	87	149,000	149,000
Construction of research facilities	114	121	90,004	118	121	68,703	118	121	60,000	60,000
Gifts and bequests	0	0	43	0	0	5,200 [3]	0	0	NA	0
Mandatory										
Wireless Innovation Fund (WIN)	0	0	0	0	0	0	18	13	15,000 [4]	300,000
National Network for Manufacturing Innovation	0	0	0	0	0	0	34	25	560,000 [5]	1,000,000
Total, direct funding	2,383	2,328	810,955	2,451	2,429	805,042	2,580	2,538	1,434,250	2,157,000
Reimbursable Funding and WCF Investments										
Construction of research facilities - building surcharge	0	0	952	0	0	930	0	0	0	
Research, development and supporting services:										
Federal government	458	476	114,770	474	526	128,894	469	519	110,909	
Calibrations and tests, technical and advisory services:										
Federal government	22	22	5,296	22	25	7,198	22	25	5,251	
Public and non-federal government	78	82	23,811	82	90	32,360	80	89	23,607	
Subtotal, Services	100	104	29,107	104	115	39,558	102	114	28,858	
National Voluntary Laboratory Accreditation Program	23	24	6,528	24	26	6,595	23	26	6,793	
Standard reference materials (SRMs):										
SRM Sales:										
Federal government	3	3	283	3	3	296	3	3	300	
Public and non-federal government	83	86	15,406	86	95	16,209	85	94	16,330	
Subtotal, SRM sales	86	89	15,689	89	98	16,505	88	97	16,630	
SRM investment adjustment	0	0	1,643	0	0	0	0	0	0	
Subtotal, SRM	86	89	17,332	89	98	16,505	88	97	16,630	
Total, Reimbursable program	667	693	168,689 [2]	691	765	192,482 [2]	682	756	163,190	
WCF Investments and Operating Adjustments										
WCF investments	0	0	21,101	0	0	33,599	0	0	20,437	
WCF transfers	0	0	0	0	0	1,695	0	0	1,500	
Excess Amortizations over Equipment Investments	0	0	2,450	0	0	0				
WCF operating adjustments	0	0	(155)	0	0	0	0	0	0	
Total, WCF Investments and operating adjustments	0	0	23,396	0	0	35,294	0	0	21,937	
Total, NIST program	3,050	3,021	1,003,040	3,142	3,194	1,032,818	3,262	3,294	1,619,377	
Offsetting adjustment for amortization of equipment	0	0	(23,551)	0	0	(21,479)	0	0	(20,437)	
Adjusted total, NIST program	3,050	3,021	979,489	3,142	3,194	1,011,339	3,262	3,294	1,598,940	

[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 Malcolm Baldrige National Quality Award Foundation to Baldrige Performance Excellence Program in transition from appropriated to reimbursable base funding.

[4] Of the $300 million WIN mandatory budget authority, only $15 million will obligate in FY 2013.

[5] Of the $1,000 million NNMI, only $560 million will obligate in FY 2013.

Department of Commerce

National Institute of Standards and Technology

REIMBURSABLE PROGRAM AND WORKING CAPITAL FUND INVESTMENTS

(Dollar amounts in thousands)

	FY 2011 Actual	FY 2012 Currently Available	FY 2013 Estimate
Department of Defense			
Air Force	$10,001	$9,843	$9,335
Army	1,429	3,062	1,763
Navy	1,761	1,481	1,361
Other, Department of Defense	16,201	18,067	15,254
Subtotal, Department of Defense	29,392	32,453	27,713
Department of Agriculture	187	60	60
Department of Commerce	16,337	19,351	17,787
Department of Energy	7,059	7,484	6,588
Dept. of Health & Human Services	3,946	4,462	4,389
Dept. of Homeland Security	25,783	29,658	26,487
Department of the Interior	146	20	20
Department of Justice	16,036	15,163	13,850
Department of Transportation	34	1,531	550
Department of the Treasury	110	0	0
Department of Veterans Affairs	165	0	0
Environmental Protection Agency	293	180	100
General Services Administration	219	0	0
National Aeronautics & Space Admin.	3,655	4,884	4,400
National Science Foundation	2,926	2,861	2,940
Nuclear Regulatory Commission	1,141	2,033	500
Other	7,341	8,754	5,525
Subtotal, Other Agency	114,770	128,894	110,909
Calibrations & Testing	8,914	7,457	7,791
Technical & Advisory Services	26,721	38,696	27,860
Standard Reference Materials	17,332	16,505	16,630
Subtotal, Other Reimbursables	52,967	62,658	52,281
Total, Reimbursable Program	167,737	191,552	163,190
Equipment Transfers	0	1,535	1,500
SRM Transfers	0	160	0
Subtotal, WCF transfer	0	1,695	1,500
Equipment Investments	21,101	33,599	20,437
IE Amortization	(23,551)	(21,479)	(20,437)
Excess Amortizations over Equipment Investments	2,450	0	0
WCF Operating Adjustments	(155)	0	0
Total, WCF Investments	(155)	12,120	0
Total, Reimbursable Program and WCF Investments	167,582	205,367	164,690

Exhibit 35

Department of Commerce
National Institute of Standards and Technology
PERIODICALS, PAMPHLETS, AND AUDIOVISUAL SERVICES
(Obligations in thousands)

	2010 Actual	2011 Actual	2012 Estimate	2013 Estimate
Periodicals	$15	$15	$6	$0
Pamphlets	25	20	20	20
Audiovisuals	6	6	14	16
Total	46	41	40	36

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 December 2011and 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, information technology.

Exhibit 36

Department of Commerce
National Institute of Standards and Technology
AVERAGE SALARY

	2011 Actual	2012 Estimate	2013 Estimate
Average ES salary	$168,827	$168,827	$169,671
Average scientific and professional	169,921	169,921	170,771
Average Career Path Salary	105,619	105,619	106,147
Average salary of ungraded positions	56,245	56,245	56,526

FY 2012 average salaries reflect a freeze on federal employee pay schedules and rates and FY 2013 reflects the 0.5% payraise.

DEPARTMENT OF COMMERCE NATIONAL TECHNICAL INFORMATION SERVICE
NTIS Revolving Fund
Budget Estimates, Fiscal Year 2013
President's Submission

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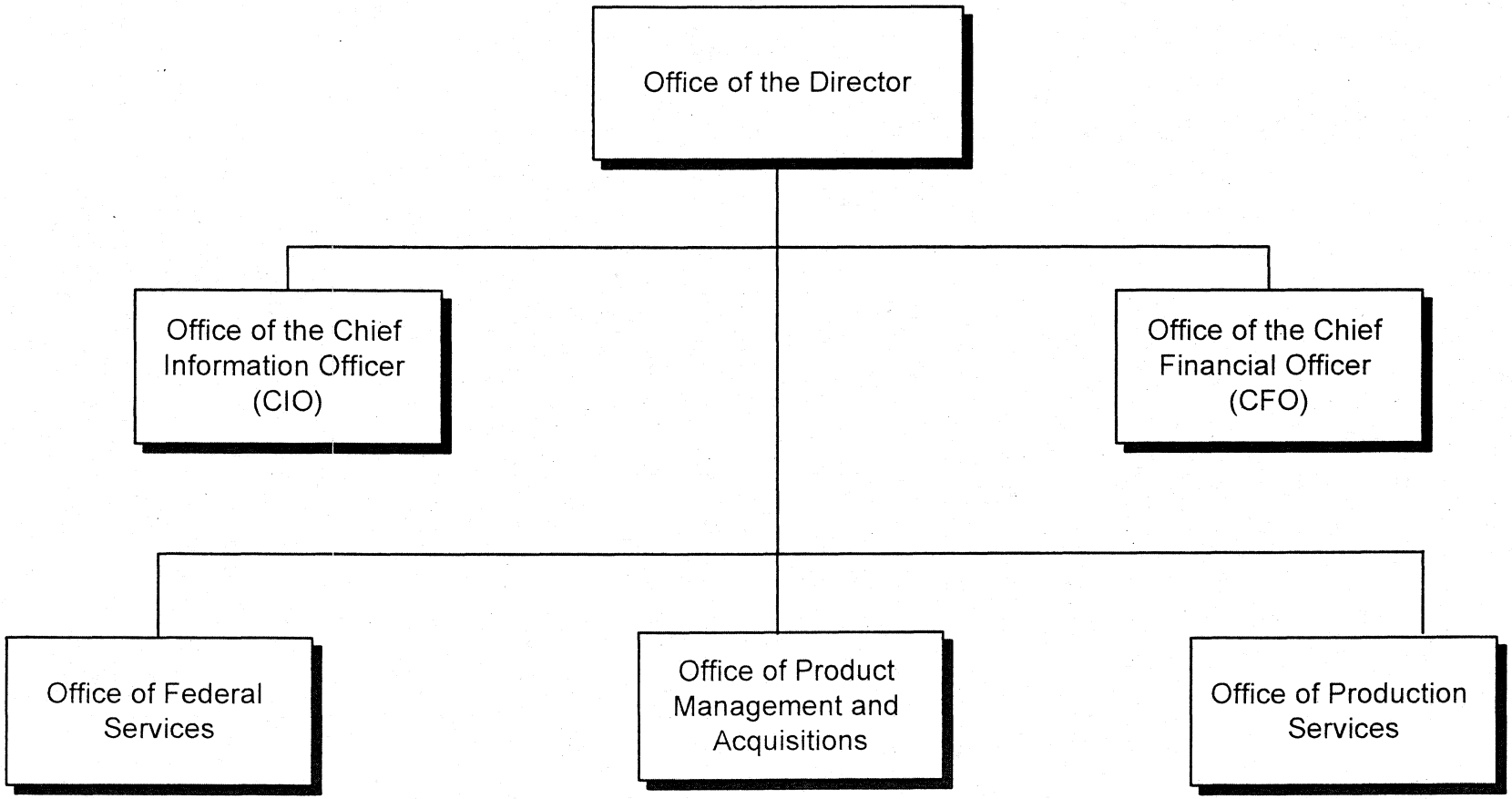
U.S. Department of Commerce
National Technical Information Service



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Department Of Commerce
National Technical Information Service
NTIS Revolving Fund
Budget Estimates, Fiscal Year 2013
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 2013 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 862,500 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 50.9 million information items to the public in FY 2013.

NTIS plans to obligate $66,000,000 of earned revenue in FY 2013.

(Dollar amounts in thousands)

	2011	2012	2013
National Technical Information Service:			
Reimbursement from offsetting collections:			
Information clearinghouse program	$48,853	$65,500	$66,000
Total, NTIS.....	$48,853	$65,500	$66,000

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. The Department's total savings target for FY 2013 is $176 million, which includes $142.8 million in savings initiated in FY 2012 and an additional $33.2 million planned for FY 2013. Building on the NTIS' administrative savings planned for FY 2012 ($0.14 million), an additional $0.03 million in savings is targeted for FY 2013 for a total saving in FY2013 of $0.17 million.

Exhibit 5

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, 2012	0	0	0	0
Plus 2013 Adjustments to Base	0	0	0	0
Less: Obligations from prior years	0	0	0	0
2013 Base Request	0	0	0	0
Plus 2013 program changes	0	0	0	0
2013 Estimate	0	0	0	0

		2011 Actual		2012 Currently Available		2013 Base		2013 Estimate		Increase/ (Decrease) over 2013 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

Exhibit 7

Department Of Commerce
National Technical Information Service
NTIS Revolving Fund
SUMMARY OF FINANCING
(Dollar amounts in thousands)

	2011 Actual	2012 Currently Available	2013 Base	2013 Estimate	Increase (Decrease) over 2013 Base
Total Obligations	$48,853	$65,500	$66,000	$66,000	$0
Offsetting collections from:					
Federal funds	(38,832)	(51,700)	(52,200)	(52,200)	0
Trust funds	0	0	0	0	0
Non-Federal sources	(10,562)	(13,800)	(13,800)	(13,800)	0
Recoveries	0	0	0	0	0
Unobligated balance, start of year	(6,158)	(7,407)	(7,407)	(7,407)	0
Unobligated balance transferred	0	0	0	0	0
Unobligated balance, end of year	7,407	7,407	7,407	7,407	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

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 2013, the National Technical Information Service plans to continue to operate on a self-supporting reimbursable basis, which will include estimated obligations of $66,000,000 and 150 FTE.

BASE JUSTIFICATION FOR FY 2013:

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, database lease services and downloads 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 2013:

None

Deliverables:

Performance Goals and Measurement Data

Performance Measure: Number of updated items available	FY 2011 Actual	FY 2012 Target	FY 2013 Target	FY 2014 Target	FY 2015 Target	FY 2016 Target
Total	836,579	875,000	892,500	910,350	928,500	947,070

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 2011 Actual	FY 2012 Target	FY 2013 Target	FY 2014 Target	FY 2015 Target	FY 2016 Target
Total	49.0M	49.9M	50.9M	51.9M	52.9M	53.9M

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 2011 Actual	FY 2012 Target	FY 2013 Target	FY 2014 Target	FY 2015 Target	FY 2016 Target
Total	99.5%	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		2011 Actual	2012 Currently Available	2013 Base	2013 Estimate	Increase/ (Decrease) over 2013 Base
11.1	Full-time permanent (Compensation)	$9,717	$11,900	$12,500	$12,500	0
11.3	Other than full-time permanent	60	150	150	150	0
11.5	Other personnel compensation	0	650	700	700	0
11.8	Special personnel services payments	0	0	0	0	0
11.9	Total personnel compensation	9,777	12,700	13,350	13,350	0
12.1	Civilian personnel benefits	2,738	4,200	4,500	4,500	0
13	Benefits for former personnel	0	0	0	0	0
21	Travel and transportation of persons	149	200	200	200	0
22	Transportation of things	1,850	2,500	3,000	3,000	0
23.1	Rental payments to GSA	1,911	1,905	1,919	1,919	0
23.2	Rental payments to others	98	1,000	1,000	1,000	0
23.3	Communications, utilities and miscellaneous charges	417	1,800	1,800	1,800	0
24	Printing and reproduction	319	4,000	4,000	4,000	0
25.1	Consulting services	23	100	100	100	0
25.2	Other services	28,846	30,095	29,131	29,131	0
25.3	Purchase of goods and services from Government accounts	878	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	260	500	500	500	0
26	Supplies and materials	514	3,000	3,000	3,000	0
31	Equipment	1,072	2,000	2,000	2,000	0

Department Of Commerce
National Technical Information Service
NTIS Revolving Fund – Reimbursable Obligations
SUMMARY OF REQUIREMENTS BY OBJECT CLASS
(Dollar amounts in thousands)

Object Class		2011 Actual	2012 Currently Available	2013 Base	2013 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	48,853	65,000	66,000	66,000	0
	Earned Revenue/Reimbursable Obligations .	48,853	65,000	66,000	66,000	0
	Total Obligations	48,853	65,000	66,000	66,000	0
Personnel Data						
Full-Time Equivalent Employment:						
	Full-time permanent	113	145	145	145	0
	Other than full-time permanent	1	5	5	5	0
	Total	114	150	150	150	0
Authorized Positions:						
	Full-time permanent	118	190	190	190	0
	Other than full-time permanent	1	10	10	10	0
	Total	119	200	200	200	0

DEPARTMENT OF COMMERCE
NATIONAL TECHNICAL INFORMATION SERVICE
NTIS Revolving Fund
CONSULTING AND RELATED SERVICES
(Obligations in thousands)

Exhibit 34

	2011 Actual	2012 Estimate	2013 Estimate
Consulting Services	$23	$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	$23	$100	$100

Department of Commerce
National Technical Information Service
NTIS Revolving Fund
PERIODICALS, PAMPHLETS, AND AUDIOVISUAL PRODUCTS
(obligations in thousands)

Exhibit 35

	2011 Actual	2012 Estimate	2013 Estimate
Periodicals	$4	$5	$5
Pamphlets	0	0	0
Audiovisuals	0	0	0
Total	$4	$4	$5

DEPARTMENT OF COMMERCE
NATIONAL TECHNICAL INFORMATION SERVICE
NTIS Revolving Fund
AVERAGE GRADE AND SALARIES

Exhibit 36

	2011 Actual	2012 Estimate	2013 Estimate
Average GS/GM Grade	9.10	9.5	10.0
Average GS/GM Salary	$85,237	$87,350	$89,846

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