Accelerating Technology Transfer and Commercialization of Federal Research in Support of High-Growth Businesses

U.S. Department of Commerce

Report prepared by:

National Institute of Standards and Technology
National Oceanic and Atmospheric Administration
National Telecommunications and Information Administration
Institute for Telecommunication Sciences

Pursuant to the
Presidential Memorandum -- Accelerating Technology Transfer and Commercialization of Federal Research in Support of High-Growth Businesses, October 28, 2011

September 2012

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FOREWORD

This report is in response to the Presidential Memorandum of October 28, 2011 directing agencies with Federal laboratories to establish goals and measure performance, streamline administrative processes, and facilitate local and regional partnerships in order to accelerate technology transfer and support private sector commercialization.

This report has been organized and prepared with the participation of the NIST, NOAA and NTIA/ITS technology transfer offices. An electronic version of this report is available online at: **http://www.nist.gov/tpo/publications/index.cfm**

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CHAPTER 1

DEPARTMENT OF COMMERCE OVERVIEW

The President of the United States issued a Presidential Memorandum titled "Accelerating Technology Transfer and Commercialization of Federal Research in Support of High-Growth Businesses" on October 28, 2011 (Presidential Memorandum, Attachment 1). In response to the challenges set forth by the President, the Department of Commerce (Department) has evaluated its many different assets available to assist the government to achieve this vision. In addition to directly developing and transferring leading edge technology, the Department will also play an important role in the implementation of this Presidential Memorandum through its role in coordinating, analyzing, and reporting on the performance of technology transfer across Federal agencies.

Technology transfer plays an important role in the Department's mission to advance economic growth and job opportunities within the United States. The Department works in partnership with businesses, universities, state governments, and communities to promote innovation and to improve the Nation's overall competitiveness in the global economy. The Department pursues these objectives through policies and programs directed at strengthening the Nation's economic infrastructure, facilitating the development of cutting-edge science and technology, providing critical scientific information and data, and managing national resources.

Research and Development (R&D) is conducted within the Department in numerous areas of fundamental and advanced science and technology at the National Institute of Standards and Technology (NIST), the laboratory facilities of the National Oceanic and Atmospheric Administration (NOAA), and the National Telecommunications and Information Administration's (NTIA) Institute for Telecommunication Sciences (ITS). Technology transfer is a key part of the programmatic activities in each of these agencies' Federal laboratory systems, connecting the technological advances from the Department's science and engineering programs to the American economy.

More information about Department of Commerce technology transfer from its research laboratories is available on the following websites:
NIST: http://www.nist.gov/tpo/index.cfm;
NOAA: http://www.noaa.gov/
ITS: http://www.its.bldrdoc.gov/

Annual reporting on technology transfer performance is already required by statute in 15 USC §3710(f) and (g). Previous reports on technology transfer from the Department and on interagency technology transfer are available at http://www.nist.gov/tpo/publications/index.cfm. The Department will continue to use these annual reporting mechanisms to provide information and updates on its implementation of the Presidential Memorandum.

Using the existing framework from the annual reports, the Department coordinated its response across its research organizations. NIST, NOAA, and NTIA have each provided individual

sections to this document, as well as developed unique policies and procedures that serve their specialized mission, business practices, and stakeholders.

In addition to its internal mission for technology transfer, the Department has a leadership role in coordinating technology transfer activities across Federal laboratories. Specific functions of the Department include coordinating the Interagency Workgroup for Technology Transfer (Workgroup). The Workgroup was initially established under Executive Order 12591, Section 7 to identify and disseminate creative approaches to technology transfer from Federal laboratories. The Workgroup is currently hosted by NIST for the Department and continues to fulfill this function as well the functions of the Secretary described in 15 U.S.C §3710(g).

- As part of the functions described in 15 U.S.C §3710(g), NIST prepares the annual Summary Report to the President and the Congress on Federal Laboratory Technology Transfer.
- NIST serves as the "host agency" for the Federal Laboratory Consortium for Technology Transfer (FLC) under 15 U.S.C §3710(e).
- NIST also fulfills Department functions relating to the promulgation of regulations (found at 37 CFR Part 401) pertaining to patent rights in inventions made with Federal assistance, as well as to the licensing of federally owned inventions, and the ownership of inventions made by Federal employees under the University and Small Business Patent Procedures Act of 1980, commonly known as the "Bayh-Dole Act," Pub. L. 96-517, as amended, 35 U.S.C. §200 et seq. and Executive Order 10096.

The United States Patent and Trademark Office (PTO) is collaborating with NIST to identify useful technology transfer metrics to measure the effective use of intellectual property in the support of the commercialization of university-based federally funded research. In support of the Presidential Memorandum, the PTO will compose a report on technology transfer and commercialization. The focus of the report is on recommending sets of metrics to be propagated throughout university technology transfer programs. This report will be part of a collaborative effort by the PTO and the National Institute of Standards and Technology in support of NIST's larger and presidentially mandated report on technology transfer activities in federal laboratories. The goal of the report is for universities to utilize these metrics and practices to develop more appropriate commercial and developmental policies, and for the use of these metrics and practices to encourage the diffusion of technology into the marketplace.

CHAPTER 2

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY

Overview of NIST Technology Transfer

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 quality of life. Since 1901, NIST,[1] 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 cyber security; nanotechnology, and diffusing advanced technologies and business practices to smaller manufacturers. Long-standing or new, all NIST programs support the Nation's agility, innovation, and competitiveness.

NIST Laboratories

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. The NIST Laboratories continue to address increasingly complex measurement challenges. For example, NIST develops measurement science and technologies 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. The measurement science research at NIST is useful to all science and engineering disciplines.

The NIST Laboratories (sometimes referred to as Organizational Units or OUs) are organized into three main groupings:

Technology Laboratories

- Engineering Laboratory
- Information Technology Laboratory

Measurement Laboratories

- Material Measurement Laboratory
- Physical Measurement Laboratory

[1] Originally known as the National Bureau of Standards (NBS), the Omnibus Trade and Competitiveness Act of August 1988 (Pub. Law 100-418, as amended, 15 U.S.C. §271 et seq.) changed the name of NBS to the National Institute of Standards and Technology and gave to NIST the added task of helping U.S. industry increase its competitiveness in the global market place

User Facilities

- Center for Nanoscale Science and Technology
- NIST Center for Neutron Research

The 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 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 developed by 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 and Advancement Act of 1995 (NTTAA) (Pub. L. 104-113) as the coordinator for all Federal agencies using documentary standards that are developed by private-sector consensus bodies to carry out their policy objectives.

NIST Actions to Implement the Presidential Memorandum

In response to the Presidential Memorandum, NIST began a detailed process to review existing NIST policies and processes related to technology transfer. To accomplish this task, the NIST Director established a NIST Technology Transfer Policy Committee to develop a more comprehensive definition of technology transfer, and to identify improvements to processes and metrics that would more accurately capture the full impact of NIST's scientific enterprise. The Committee included the following senior NIST management, as well as the Chief Counsel for NIST:

- Associate Director, Innovation and Industry Services, chair
- Chief Financial Officer
- Director, Center for Nanoscale Science and Technology
- Director, Engineering Laboratory
- Director, Manufacturing Extension Program
- Director, Physical Measurement Laboratory
- Director, Standards Coordination Office

From January to March the Committee held seven formal meetings, assessing NIST's processes for particular aspects of technology transfer. Prior to the first meeting, staff of NIST's Technology Partnership Office (TPO), Program Coordination Office (PCO) and Economic Analysis Office (EAO) met with individual NIST Laboratories to assess existing metrics and discuss new metrics, and prepared detailed analyses of policy and practice. Staff compared existing and proposed metrics with reporting requirements of the Balanced Scorecard and the Government Performance and Results Act of 1993 (GPRA) to synchronize systems and reduce administrative burden. During the meetings the Committee:

- Reviewed definitions of technology transfer used by NIST, other agencies, and the Federal Laboratory Consortium and developed a definition to fit NIST;
- Reviewed NIST's policies governing formal, statutory means of technology transfer and discussed many other, less formal means by which NIST transfers technology to benefit the Nation;
- Discussed the need to encourage and facilitate formal mechanisms of technology transfer when these best suit the mission of NIST and the special roles of the NIST Laboratories;
- Reviewed the performance metrics that NIST collects now and could collect in the future;
- Recognized the need to measure technology transfer activities more accurately and endorsed efforts to broaden the collection of performance metrics that will efficiently measure technical and economic impacts;
- Noted that the Stevenson-Wydler Act states that technology transfer is a responsibility of each laboratory science and engineering professional, and should be recognized in employee performance plans, as appropriate; and
- Discussed matters of ethics, some of which are also being addressed by the Workgroup, that affect NIST personnel in regards to technology transfer.

The Committee developed preliminary recommendations in four key areas:

- Defining technology transfer activities at NIST,
- Inventions, and other types of NIST intellectual property output,
- Collaborations, both formal and informal, and
- Broad metrics to measure and analyze impact.

These preliminary recommendations and their implementation will be reviewed periodically and, as necessary, modified by the Committee. A Final Report of the Committee was submitted to the NIST Director in October, 2012. Updates to NIST technology transfer policy, and the implementation of technology transfer recommendations, will be described in the annual Technology Transfer reports that are submitted each January in accordance with the Technology Transfer Commercialization Act of 2000 (Pub. L. 106-404).

The Committee and NIST recognize that technology transfer is an important and integral component of NIST's scientific program. Therefore, the Committee broadened the NIST definition of "technology transfer" to ensure that the many mechanisms which exist for NIST's scientific and technological advances to benefit the economy and society are recognized and tracked through NIST's reporting systems and metrics.

Transferring Public Good Technologies

A key tenet of U.S. science and technology policy has been that basic science is a public good and therefore warrants significant Federal support. As such, basic science performed at national laboratories and universities enjoys widespread support. However, a key complementary insight

is that there is also significant public good content in the practical application of basic scientific knowledge.

Measurement science ranges from the basic research that is necessary to measure the previously un-measurable to the development of new technologies that lower the cost or improve the accuracy of measurement. This basic research, and the technologies that derive from the basic research, are undertaken by NIST because: 1) they underlie the Nation's system of weights and measures; 2) they may require large investments that generally would not be recoverable in the marketplace; and 3) they benefit many more parties than just the producer of the technology. These NIST research and technology results are therefore classified as public goods because, unlike private goods, their use is both non-rivalrous (i.e., each person's use does not preclude another person's use) and non-excludable (i.e., no person can be prevented from benefitting). This is an important distinction because such developments, being only rarely produced by the private sector, have no discernible market price.

Gregory Tassey,[1] NIST's Chief Economist, explains that the technology infrastructure that supports the research, development, production and diffusion of novel technologies has public good content. NIST technical outputs such as measurement and test methods, scientific and engineering data, process modeling and techniques, and component interfaces, are examples of public good technologies that support all phases of the technology lifecycle (research, development, deployment and diffusion). These technical outputs positively impact all firms – even competing firms - that adopt these technical outputs as well as adopting firm's customers. Given the resulting widespread use, it is not surprising that economic impact analyses indicate that the use of NIST technical outputs lowers private sector R&D costs, manufacturing costs, and market transactions costs across entire industries and supply chains. These public good technologies raise private rates of return and encourage further private sector investment.

In the process of performing its core responsibilities to support and develop the public technology infrastructure, NIST scientists also develop particular technologies that are best protected and transferred using mechanisms such as patenting and licensing that are appropriate for private goods. In order to capture the breadth of NIST technology outputs which encompass both NIST's core public good technology infrastructure as well as particular technologies that warrant traditional intellectual property protection, NIST has developed a new and broader definition of technology transfer and new metrics to support the measurement and assessment of the full scope of NIST's technology transfer activities.

It is through this combination of public dissemination and private goods protection that NIST views its overall technology transfer strategy.

NIST Definition of Technology Transfer

Technology transfer is a core element of NIST's mission. Building from its mission statement, NIST has proposed a revision of its definition of technology transfer in order to capture the broad

[1] Tassey, Gregory (1997), The Economics of R&D Policy. Westport, CT: Quorum Books. Tassey, Gregory (2007), The Technology Imperative. Northampton, MA: Edward Elgar.

spectrum of activities that lead to transfer and/or commercialization of NIST's science and technology:

"Technology transfer is the overall process by which NIST knowledge, facilities, or capabilities in measurement science, standards and technology promote U.S. innovation and industrial competitiveness in order to enhance economic security and improve quality of life."

The proposed NIST definition of technology transfer encompasses many means of transferring technology. Thus, it includes knowledge transfer, the act of transferring knowledge from one individual to another by means of mentoring, training, documentation, or other collaboration. Commercialization, another means of technology transfer, is the adoption of a technology into the private sector through a business or other organization and is also included within the proposed definition.

Establishing Goals and Measuring Progress

NIST's technology transfer activities are designed to disseminate the results of the Institute's fundamental research and measurements, and standards research to industry, academia, state and local government, standards organizations and other interested parties. In order to provide leading-edge scientific and technical results, NIST is required to have expertise in multiple disciplines, to maintain high levels of collaboration with organizations and people with diverse capabilities, and to have highly specialized facilities and tools. For more than a century, NIST's laboratories have successfully collaborated with others to provide the measurement techniques and technical tools needed by America's innovators and manufacturers. Consistent with the previous discussion of the public-goods nature of basic research in measurement science, NIST uses many different mechanisms to promote innovation and ensure that the resulting technologies are broadly disseminated.

NIST is expanding the metrics collected for technology transfer beyond those required by statute and reported in the annual Summary Report to the President and the Congress on Federal Laboratory Technology Transfer (Summary Report). Each Federal agency with Federal Laboratories prepares an annual report (Agency Report) that includes the statutorily required metrics and any other material the agency deems relevant or unique to its practice of technology transfer.

The Summary Report includes the following metrics:

- Collaborative Relationships for Research and Development including Cooperative Research and Development Agreements (CRADAs) and other collaborative R&D relationships,
- Invention disclosure and patenting,
- Profiles of active licenses,
- Characteristics of income bearing licenses, and
- Income from licenses.

In the Agency Report prepared by NIST for the Department of Commerce, NIST collects and reports on NIST's activities and details of NIST's technology transfer programs including:

- The items in the Summary Report above;
- An explanation of the agency's technology transfer program;
- Royalty distribution.
- Research Agreements;
- International Cooperation Agreements;
- Guest Researchers;
- Small Business Innovation Research (SBIR);
- User Facilities;
- Technical publications;
- Standard Reference Materials;
- Standard Reference Data;
- Calibration and Accreditation Services;
- Software tools;
- Conferences, workshops, and inquiries; and
- Participation in Documentary Standards Committees.

NIST has reviewed the metrics used in these existing reports and in its ongoing operations.

Traditionally, the metrics reported are counts of activities, such as the number of CRADAs, with anecdotal examples of public benefit. In order to improve the measurement of technology transfer, NIST will refine the existing set of metrics and develop new metrics, when appropriate, that can serve as the basis for the application of rigorous economic assessment tools.

To establish appropriate goals and develop valid measurements (or eliminate metrics that are not useful), NIST will continue the process of benchmarking its tech transfer activities against other agencies and adopting "best practices." (An example of benchmarking is the day-long review of NIST's patent review process by sister agencies conducted in FY 2012; an example of "best practices" adoption is NIST's adoption of License Incentive Programs described in this plan.)

A necessary step in measurement is the collection of relevant data about technology transfer activities. The diversity of NIST's activities and the comprehensive collection of detailed data will require a multi-level, multi-year approach. A further requirement will be the application of existing analytic tools, and very likely the development of new analytic tools, to effectively assess the impact of these activities.

Consequently, in this initial plan, absolute numeric goals or percent increases in activities are not proposed. NIST will continue to report metrics in future Summary Reports and the Agency Reports. As improvements in data collection and impact evaluation are introduced, changes will be reflected in updated plans and reports.

The following section describes in detail NIST's technology transfer activities, proposed improvements in the system, and a schedule of deliverables.

Goal: Improve Transfer of NIST Technology and Work Products[1]

Expanded Metrics

1. Participation in Documentary Standards Committees

The term "standard" includes all of the following: (1) common and repeated use of rules, conditions, guidelines or characteristics for products or related processes and production methods, and related management systems practices; and (2) definition of terms; classification of components; delineation of procedures; specification of dimensions, materials, processes, products, systems, services or practices; test methods and sampling procedures; or descriptions of fit and measurements of size or strength.[2] Documentary standards specify almost every product and service with which the U.S. consumer interacts – including building codes, communication protocols, fuel quality, food safety, and thousands more. Econometric studies have concluded that standards contribute significantly to economic growth. The econometric works reviewed and evaluated by Swann (2010)[3] lead to several conclusions. Among these conclusions are: development of standards are integral to innovation; documentary standards contribute to economic growth at least as much as do patents; and the macroeconomic benefits of the development of standards extend beyond the benefits to the companies that use the standards.

NIST provides its expertise in measurement science to standards committees, national and international, that develop consensus standards. NIST's participation in the development of consensus documentary standards is one of the mechanisms used to transfer NIST measurement-science research and other technologies to market use. NIST participation in standards committees enables its scientists and engineers to bring NIST technology and know-how directly into standards-setting bodies. NIST participation also helps NIST respond programmatically to needs of the private sector. NIST reports its activities in standards development to the Office of Management and Budget and Congress, as required by the NTTAA. In FY 2011, nearly 400 NIST employees were involved with more than 119 Standards Development Organizations.

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[1] "Annual Report on Technology Transfer:Approach and Plans, Fiscal Year 2011 Activities and Achievements" U.S. Department of Commerce, 2011 refers to baseline technology transfer activities. This section of the current report describes technology transfer mechanisms beyond those included in the referenced annual report.

[2] OMB Circular A-119, "Federal Participation in the Development and Use of Voluntary Consensus Standards and in Conformity Assessment Activities." http://www.whitehouse.gov/omb/circulars_a119.

[3] Peter Swann, G.M., Report for the UK Department of Business, Innovation, and Skills (BIS), 2010 http://www.bis.gov.uk/assets/biscore/innovation/docs/e/10-1135-economics-of-standardization-update.pdf

NIST will:

- Expand the Standards Committee Participation Database to collect information beyond what is required by NTTAA and OMB Circular A-119 including:
    - Staff tenure on standards committees;
    - Standards developed largely through NIST staff effort; and
    - Awards and other relevant information
- Complete database work by end of CY 2012.

2. Standard Reference Data

Many types of reference data are critically important in the engineering of structures, the optimization of chemical processes, and other industrial applications. The Standard Reference Data Act of 1968 (Pub. L. 90-396, codified at 15 U.S.C. §290) gave to NIST the responsibility to provide "standard reference data," described as: "quantitative information, related to a measurable physical or chemical property of a substance or system of substances of known composition and structure, which is evaluated as to its reliability." The Standard Reference Data Act also allowed NIST to copyright and sell standard reference data. Standard reference data are extracted from the scientific and technical literature, or developed from measurements made at NIST laboratories, and are evaluated for accuracy and reliability. NIST's SRD databases cover many areas of science, including analytical chemistry, atomic and molecular physics, biotechnology, and materials sciences.

NIST has 120 Standard Reference Data titles available currently. Some of the databases are accessible free of charge on the Web, other SRD products are sold or licensed. Additionally, NIST operates the only scientific journal devoted solely to the publication of scientific reference data, the Journal of Physical and Chemical Reference Data. NIST will seek to better understand the usage, and impact, of its Standard Reference Data in science and engineering.

NIST will:

- Conduct a study by end of FY 2013 to determine whether data regarding usage of databases is sufficiently centralized, and whether more comprehensive data for evaluating impact can be obtained.

3. Standard Reference Materials

NIST supports accurate and compatible measurements by certifying and providing over 1,300 different types of highly characterized Standard Reference Material® (SRM). NIST SRMs are used to perform instrument calibrations as part of overall quality assurance programs, to verify the accuracy of specific measurements, and to support the development of new measurement methods. Industry, academia, and government use NIST SRMs to facilitate commerce and trade and to advance research and development. NIST SRMs are currently available for use in areas such as industrial-materials production and analysis, environmental analysis, health measurements, and basic measurements in science and metrology. NIST SRMs are also a

critically important mechanism for supporting measurement traceability in the United States. (Traceability of measurement to a National Measurement Institute (such as NIST) is a prominent feature of quality systems used in measurement laboratories throughout the country.) In FY 2011, NIST sold approximately 33,000 SRM units. In order to gauge the impact of NIST's SRMs, additional data will be collected and examined.

NIST will:

- Complete, by the end of FY 2013, a study of existing customer data to assess the impact of NIST SRMs.

4. Patents and Licenses

NIST is statutorily required to report annually the numbers of invention disclosures, patent applications, patents awarded and licensing data. In order to better evaluate impact of NIST's patenting and licensing activities, NIST will collect additional information such as the ages and sizes of license companies and the number of jointly-owned inventions. This information will be used to assess NIST's support of entrepreneurial, high-growth businesses, as well as larger-sized businesses that manufacture measurement, and other, technologies. In FY 2011, NIST researchers disclosed 25 inventions, NIST filed 15 patent applications, received issuance of 12 U.S. patents, and had 26 patent licenses.

NIST will:

- Implement expanded data gathering in CY 2012.

New Metrics

5. Software Downloads

NIST provides a wide variety of application software programs and testing tools to U.S. industry, academia and other interested users. NIST develops standards, conformance tests, tools, and methods to evaluate the quality of software and the software's conformity to standards. Software developed by NIST ranges from simulation of fire and smoke movement in burning buildings to prediction of cement hydration to time-logging synchronized to NIST's time standards. These software application locations are decentralized on NIST servers and in the NIST web-space. NIST does not currently track the number of software downloads for all software or in a centralized manner.

NIST will:

- Create a NIST-wide group to exchange effective practices (end of CY 2012).
- Study appropriate metrics and data collection for assessing the impact of NIST published software (end of CY 2013).

Retained Metrics

6. Technical Publications

Technical publications form one of the major mechanisms by which NIST disseminates the results of its research to industry, academia, and other agencies. NIST staff author more than 1,200 publications in peer-reviewed journals each year. NIST will continue to maintain metrics on the number and on publication quality factor.

NIST will:

- Explore ways of improving the assessment of bibliometric data in conjunction with the Information Services Office (NIST Library) by end of FY 2013.

Goal: Improve NIST Technology Transfer Through Collaborations

Expanded Metrics

7. Formal and Informal Collaborations

NIST researchers are involved in a large variety of collaborations with scientists in industry, academia, and other Federal laboratories. Some of these collaborations utilize formal agreements, such as Cooperative Research and Development Agreements (CRADAs) and Material Transfer Agreements (MTAs). When appropriate, NIST utilizes its CRADA authority and reports its CRADA activity annually.

Other collaborations are less formal, involving joint participation in research projects of mutual interest and co-authorship on publications. Informal collaborations are an important means by which NIST shares its facilities and expertise without the formality of Facility Use Agreements or CRADAs. Many other interactions of NIST with other organizations also might be considered informal collaborations, for example, road-mapping workshops that outline technology development plans. In order to measure and assess the impact of informal collaborations, a definition will be needed that distinquishes between an informal consequential collaboration to be counted (credited) and other, less significant, interactions with individuals and organizations regarding NIST technologies.

NIST will undertake a series of actions to provide information by which NIST will attempt to evaluate the impact of its informal collaborations.

NIST will:

- Define a credited informal collaboration by end of FY 2013
- Create processes to capture credited informal collaborations by end of CY 2013
- Complete a feasibility study on impact data by end of FY 2014.

8. User Facility Research Participants

NIST's User Facilities are a vibrant means by which NIST customers tap directly into NIST measurement expertise to solve their problems. The current metric, which reports the number of facility users, will be changed to a measure of the number of Research Participants. The term Research Participants is inclusive of those who directly benefit from the work undertaken at NIST, not just those physically present at the User Facilities, and better reflects the breadth of interactions with NIST User Facilities.

NIST will:

- Examine information that the User Facilities are already collecting. Complete by end of FY 2013.
- Conduct a feasibility study on generating impact data by the end of FY 2013.

New Metrics

9. Postdoctoral Researchers

Postdoctoral research is a means by which recent doctoral graduates obtain further education and training. Postdoctoral positions are temporary positions that prepare the researcher for further careers in industry, academia, or government research. Some NIST postdoctoral researchers have started small technology companies, while others have become researchers in high-tech industries. To assess the value of NIST's postdoctoral training in producing the next generation of innovator, NIST must better understand the activities of its postdoctoral researchers once they have left NIST. Although NIST has some clearly identified postdoctoral researchers, e.g. those with NRC postdoctoral research appointments, other postdoctoral researchers are not specifically identified as such. NIST will determine the most efficient manner of identifying the latter. NIST is examining the use of the National Science Foundation's (NSF's) description of a postdoctoral researcher, namely, "Post-doctoral researchers are a temporary position taken after the completion of a doctorate … as a period of apprenticeship for the purpose of gaining scientific, technical, and professional skills" (NSF Science and Engineering Indicators 2012) combined with the National Research Council and NIST's agreed definition of five years since the Ph.D. date, to define a postdoctoral researcher.

NIST will:

- Develop a complete, NIST-wide accounting of current and recent postdoctoral researchers. Complete by end of FY2012.
- Expand on the current systems for tracking where postdoctoral researchers are employed after leaving NIST. Complete by end of FY 2013.
- Begin "mining" the data for impact analysis. Complete by end of FY 2014.

10. Non-NIST Employees on NIST Campus Engaged in Research

NIST engages large and increasing numbers of guest associates at its Gaithersburg and Boulder campuses (2,900 in FY 2011). NIST will significantly expand the relevant information mined from existing sources of information and will study the linkages between these data and other metrics with the goal of providing better impact measures.

NIST will:

- Study resources on non-NIST employees and develop recommended metrics by the end of FY 2014.

11. Startups and Young Entrepreneurial Companies

NIST technology can be transferred through the creation of companies by former NIST staff, NIST collaborators, licensees or others making use of NIST research. NIST also nurtures small and young technology companies by transferring its technology and support through its Small Business Innovation Research (SBIR) Program.

NIST will:

- Develop metrics that gauge NIST's support of young entrepreneurial companies by end of FY2013.
- Develop a list of start-ups and NIST-assisted young technology companies by end of CY 2013.
- Attempt to track supported companies over an appropriate period of time, including anecdotal information.

Retained Metrics

12. Calibration Services

The NIST laboratories provide physical measurement services to help manufacturers and users of precision instruments achieve the highest possible levels of measurement quality and productivity. NIST calibrations often provide the basis for companies that provide calibration services and calibration equipment. NIST calibrations are a means for establishing traceability of measurement. In FY 2011, NIST conducted more than 18,000 calibrations.

NIST will continue to collect and report information on calibrations.

13. STEM Education and Other Training

NIST has been recognized as a vital contributor to encouraging and supporting the Nation's efforts in science, technology, engineering and mathematics (STEM) education. As part of its mission, and to help create a long-term and well-qualified workforce for standards and

measurement research, NIST has several education outreach programs and partnerships that enrich basic research programs such as:

- the Summer Undergraduate Research Fellowship (SURF) program;
- the NIST Summer Institute for Middle School Science Teachers; and
- the Professional Research Experience Program (PREP).

Over the past five years, approximately 6,000 students have participated in NIST Seminars. During FY 2011, 1,200 students participated in over 60 NIST measurement and documentary standards seminars.

NIST will continue to collect and report information on STEM education and training.

14. Accreditation Services

The National Voluntary Laboratory Accreditation Program is a voluntary and fee-supported program to accredit laboratories that are found competent to perform specific tests or calibrations, or types of tests or calibrations. Through laboratory accreditation, NIST efficiently leverages its primary calibration services to support a broader base of secondary calibrations conducted within the private sector. In FY 2011, NIST was involved with 800 laboratory accreditations.

NIST will continue to collect and report information on accreditations.

15. Conferences, Workshops, and Inquiries

Some of the most important mechanisms for technology dissemination are communication, education, and interaction among researchers, developers and users of technology. NIST hosts numerous conferences, workshops, and other meetings each year to facilitate the transfer of technology. Further, NIST staff answer e-mail, telephone, and mail inquiries from the public, including inquiries from the public requesting information and details about NIST technical developments and research results. NIST currently reports anecdotal information on conferences, workshops and inquiries.

NIST will continue to collect and report information on conferences workshops, and inquiries.

Table 1: Summary of Technology Transfer Metrics and Schedule of Action Items

	FY 2012	FY 2013	FY 2014
Improve Transfer of NIST Technology and Work Products			
Documentary Standards		**X**	
Standard Reference Data		**X**	
Standard Reference Materials		**X**	
Patents and Licenses		**X**	
Software Downloads		**X**	**X**
Technical Publications		**X**	
Improve NIST Technology Transfer Through Collaborations			
Formal and Informal Collaborations		**X**	**X**
User Facility Research Participants		**X**	
Postdoctoral Researchers	**X**	**X**	**X**
Non-NIST Employees on NIST Campus			**X**
Startups and Young Companies		**X**	**X**
Calibration Services	**X**		
STEM Education	**X**		
Accreditation Services	**X**		
Conferences, Workshops, and Inquiries	**X**		

Commercialization Initiatives

Invention Disclosure and Patent Procedures
The process that NIST uses to move discoveries from the bench to practical application provides an understanding of the potential applications of the discoveries, helps NIST technologies reach markets sooner, and provides better motivation for NIST scientists and engineers to recognize and participate in the entire process from disclosure to licensing.

It is part of NIST's mission to transfer the results of its research, including intellectual property, to industry, academia and government agencies. NIST has many ways of collaborating on research and commercialization to ensure that the results give maximum benefit to the U.S. public. Patenting is one of the tools NIST uses to make intellectual property available. As noted in the previous discussion of public and private goods, patents can encourage the investment necessary to enable commercialization of a technology.

Revised Policy Statement
In support of the NIST Mission to promote U.S. innovation and industrial competitiveness, NIST will actively encourage patent protection on an invention that has been assigned to NIST by one or more inventors, when a patent would fulfill at least one of the following:

1. Increase the potential for current or future commercialization of the technology,
2. Have a positive impact on a new field of science or technology and the visibility and vitality of NIST,
3. Further the goals of a CRADA or other collaborative agreement,
4. Further U.S. manufacturing, or
5. Further the potential to enter into a commercial license for the invention.

NIST will take additional steps to promote innovation and invention including:

- NIST patent procedures shall emphasize the importance of intellectual property protection.
  - NIST will give preference to NIST Patent Review Committee (PRC) nominees who had significant industry and/or patent experience,
  - PRC members should have a term limit of not more than three consecutive years, followed by a one year hiatus.
  - Reemphasize use of subject matter experts on the PRC
- NIST will retain the current policy for sharing patent licensing revenue with inventors of 30% of royalties rather than the statutory minimum 15%. However, rather than the remaining funds being directed to the NIST Working Capital Fund, NIST is planning to provide the remaining funds to the OU, preferably at the level of the group responsible for the patent from which the invention originated to further technology transfer.
- Shorten the time from invention disclosure to patent filing by 25%.
- Honoring NIST staff responsible for an invention that results in a patent during NIST’s Annual Awards Ceremony. NIST patents will be celebrated with a plaque posted where NIST displays the achievements of annual awardees in a prominent location in the NIST central building.

License Incentive Programs
NIST recognizes the needs of small businesses, start-ups and entrepreneurs to obtain capital and develop products. NIST will take measures to implement licensing options to aid these innovators and to lower the risk for other potential partners in obtaining and using NIST technology. In addition to traditional commercialization licenses, NIST offers the following license incentive programs:

Table 2: NIST License Incentive Programs

Science/Technology Advancement Research (STAR) License	Small Business Innovation Research - Technology Transfer (SBIR-STAR) License	Technology Acceleration and Growth (TAG) License	Science/Technology for Entrepreneurship Program (STEP) License
• No-cost, non-exclusive field-of-use research licenses to explore and advance the development of NIST technologies for eventual commercialization. • No fees or payments for research purposes. • Can be converted to a commercialization license (exclusive or non-exclusive). Financial terms negotiated • NIST may issue licenses to another party for research or commercialization.	• Available through the NIST SBIR Program. • Subtopics designated as "TT" for technology transfer). • SBIR awards resulting from "TT" subtopics will include, as necessary, a STAR license for work identified within the "TT" subtopic being awarded. • Awardees will be given the opportunity to negotiate a commercialization license to background inventions.	• NIST technology not licensed within five years of the patent issue date. • Only available to domestic businesses or organizations • Designated technologies available under this program at: http://tsapps.nist.gov/techtransfer/ • One-year field of use-limited exclusive commercialization license for a $1,000 execution fee. • Convertible into an exclusive license for the term of the patent life upon negotiation of fees and terms.	• Small business license agreement to help attract investors and develop early stage technologies. • Domestic companies that are less than 5 years old, have fewer than 25 employees and less than $2M in capital (does not include subsidiaries of larger companies). • Non-exclusive commercialization license at no cost for the first year. • Exclusive licenses per TAG requirements but $500 execution fee. • Flexibility to meet the needs of growing companies in developing terms.

Cooperative Research and Development Agreements
NIST recognizes that the process for establishing a formal CRADA can be time-consuming. Although a legal agreement will always need to be carefully weighed by all parties, there are some steps that can help to improve NIST processes.

NIST will:

- Revise the standard CRADA procedures to closely reflect the statutory requirement that, when deciding what CRADAs to enter into, the OU Director will:
    - give special consideration to small business firms and consortia involving small business firms and

    - give preference to business units located in the United States which agree that products embodying inventions made under the CRADA or produced through the use of such inventions shall be manufactured substantially in the United States.

- Seek advice, as early as practical in the CRADA process, from the U.S. Trade Representative in the cases of collaborators subject to the control of foreign companies or governments, and take into consideration whether or not such foreign government permits U.S. agencies, organizations or other persons to enter into CRADA-like agreements or licensing agreements.
- Conduct a detailed review of the Standard NIST CRADA with a view toward eliminating any unnecessary restrictions or hindrances to acceptance by U.S. industry by the end of FY 2012. (Completed in FY 2012).
- Achieve a 10% reduction in the time to review and approve CRADAs by the end of CY 2012.
- Improve communication by making the internal CRADA database available on-line to both the program and legal teams to implement new system to aid in quick identification of the different types of collaborative agreements.
- Work with NIST Office of Chief Counsel and DOC Counsel, as necessary, on eliminating the legal barriers to NIST Associates participating on the NIST CRADA project team to the extent possible.
- Provide a website for outside parties to express interest in developing partnerships with NIST.

Small Business Innovation Research Program

In addition to traditional technology transfer activities, the Presidential Memorandum recognized the important role of the Small Business Innovation Research Program (SBIR) in supporting small business innovation. In response to the Presidential Memorandum, this year NIST has implemented steps to improve and streamline administrative practices in its SBIR Program so as to reduce the administrative burden on small businesses and also reduce the time needed to process and issue awards.

In FY 2012, NIST:

- Streamlined administrative practices to reduce the administrative burden on small businesses and reduce the time needed to process and issue awards.
- Reduced the number of topics and subtopics to balance the work required to obtain proposals and increase the selection rate for worthwhile proposals. The former streamlines the process and the latter reduces burdens on small businesses of preparing proposals that are not funded because of limited resources. NIST Programmatic Investment Priority Areas in the NIST Three Year Programmatic Plan serve as Topics to align SBIR priorities to NISTs mission. The goal was to bring the Phase 1 SBIR award rate up to the national average of 17%.
- Implemented a two-step review process to evaluate technical feasibility and to maximize investments, catalyze commercialization, and achieve a strategic focus. The first step is a technical evaluation conducted by the NIST laboratories. The second step is prioritization of

proposals considered meritorious in the laboratory review through the use of criteria based on the overall NIST strategy and SBIR program goals.

- Reduced by 10% the time from close of solicitation to award issuance.

NIST will:

- Set aside funding, as allowed by statute, to assist companies in commercialization.
- Improve measurements of downstream outcomes of the SBIR awards.

Economic Analysis

Improved Measurement and Analysis

Federal laboratories generate knowledge, skills, processes, and technical outputs that are adopted by others in innovation processes that promote broad economic and public benefits. Measurement and analysis of this adoption process and of the resultant benefits that flow from Federal laboratory research is inexact.[1] Difficulties arise in determining a benefit that resulted from one technological improvement, when that technological improvement conflates with other technological improvements. The diversity of processes that are used for transferring different technological innovations from Federal research further complicates any effort to assess a laboratory's social or economic impact.[2] Clearly, improved measurement and analysis of the connections between research and economic benefits are timely and critical to provide a realistic quantification of the results of Federal investments in research.

The Presidential Memorandum explicitly calls on the Secretary of Commerce – with NIST taking a leadership role – to "improve and expand" technology transfer measurements and metrics. In response, NIST has revised its definition of technology transfer to better capture the breadth and diversity of NIST's technology outputs and will engage in efforts to analyze the impacts of innovations that result from its research.

Assessing the Economic Impact of Technology Transfer

As a Federal research organization, NIST provides a wide range of public goods that would otherwise be inadequately provided or not be provided at all by private sector sources. While such public sector investments in areas of measurement science, standards and innovative technology solutions are deemed to be critical for the Nation's sustained economic security and growth, there is a continuing need to demonstrate the value of NIST's investments.

Over the past 15 years, NIST has commissioned numerous studies that analyze the development and impact of selected technologies transferred from the NIST laboratories to U.S. industries such as electronics, healthcare, information technology, and advanced manufacturing. These

[1] Science and Technology Policy Institute (2011), "Technology Transfer and Commercialization Landscape of the Federal Labs."
[2] Barry Bozeman (2000), Technology Transfer and Public Policy: A Review of research and Literature," Research Policy, vol. 29: 627-655.

studies have been very effective in helping to explain how public institutions such as NIST can quantify the social contribution of their activities, provide important lessons to management about the effectiveness of resource allocation decisions, and provide guidelines for future strategic planning efforts.[1]

NIST has established the Economic Analysis Office (EAO) to manage the development of prospective and retrospective economic impact studies that evaluate the effectiveness of NIST's investments.

In carrying out these tasks, EAO will:

1) establish data collection methodologies and make recommendations to NIST management regarding efforts to improve the collection of technology transfer metrics;
2) establish criteria to evaluate the feasibility of performing economic impact studies;
3) investigate novel sources of research data such as the National Science Foundation's Star Metrics project[2] and other methods that quantitatively analyze technical publications; and
4) develop training materials that explain how economic data are gathered, how the results of economic impact studies should be interpreted, and how these studies can be used to justify public sector investments in R&D.

EAO will also commission a series of studies to assess economic impact utilizing the wider range of technology transfer metrics identified in this report and will initiate novel attempts to measure the broad impacts of critical outputs such as, standard reference materials, standards committee participation, CRADA participation, etc. These studies will begin during the initial years of the proposed five year plan.

Working closely with staff from the NIST laboratories and building on ongoing analytic efforts by the Standards Coordination office, NIST will increase the regularity with which it implements lessons learned from these studies. In addition, NIST will engage with other bureaus within the Department of Commerce that have analytic capabilities and relevant responsibilities such as, the Economic and Statistics Administration (ESA) and the Patent and Trademark Office (PTO). NIST will also continue to engage with, participate in, and benefit from the work conducted by other federal agencies and nonfederal stakeholders such as the Association of Public and Land-grant Universities (APLU) and the Association of University Technology Managers (AUTM) that are expanding the measurement and analysis of the impacts associated with university-based technology transfer.

Along with providing an effective response to the PM, NIST's efforts will address the Office of Science and Technology Policy's request to support the development and use of the "Science of Science Policy Roadmap" that calls on agencies to work together to develop new tools, methods,

[1] Albert Link and John Scott, "The Theory and Practice of Public Sector R&D Economic Impact Analysis", NIST Planning Report 11-1, January, 2012.
[2] Julia Lane and Stefano Bertuzzi, 'The STAR METRICS Project: Current and Future Uses for S&E', National Science Foundation, September 8, 2011.

data, and data infrastructure to help science and technology policy makers make better decisions.[1]

Through all of these efforts, NIST will improve its ability to measure and analyze the economic impact of its funding decisions and will work to remove barriers that prevent the efficient and timely transfer of technologies to industry.

Facilitate Commercialization through Local and Regional Partnerships

Support of innovation – applying science and technology to drive economic recovery – is a key element of NIST's technology transfer strategy. The rationale and priorities of governmental support for innovation has been outlined in reports issued by the Administration, including "A Strategy for American Innovation: Driving Toward Sustainable Growth and Quality Jobs" (September, 2009). The Federal government's commitment to innovation through American leadership in fundamental research has been reflected in strong support for the R&D budgets of the National Science Foundation, the Department of Energy's Office of Science, and NIST's Laboratories.

Regional innovation clusters – geographic concentrations of interconnected businesses, suppliers, service providers, coordinating intermediaries and institutions such as universities and community colleges – have emerged as a strategic economic development approach that provides an efficient mechanism for capturing the benefits of R&D investments. In recognition of this, the Presidential memorandum encourages agencies to "collaborate…with external partners to share the expertise of Federal laboratories with businesses and to participate in regional technology innovation clusters…".

NIST works closely with local, regional and state organizations in support of both broad technology transfer initiatives and in creating opportunities for transferring specific NIST technology, knowhow, and expertise. Some examples of NIST local and regional partnerships for technology transfer are:

- NIST has a Memorandum of Agreement with the Maryland Technology Development Corporation (TEDCO). Under this agreement, NIST and TEDCO have partnered to hold a series of seminars with regional businesses featuring presentations by NIST research staff on collaboration and patent licensing opportunities. TEDCO has also provided financial support to companies engaged in joint CRADA research with NIST.
- NIST plays a leading role in collaborating with TEDCO, Rockville Economic Development Inc., Montgomery County Maryland, the State of Maryland, other federal agencies and the Kauffman Foundation on a Post-Doc Conference and Career fair uniquely targeted at the local community of over 5,000 Federal post-docs and regional businesses.
- NIST has collaborated with CO-LABS in Boulder, Colorado to present collaboration and patent licensing opportunities arising from the NIST campuses in Colorado.

[1] National Science and Technology Council, November 2008.

- NIST works closely with the Federal Laboratory Consortium to host interagency technology events to connect Federal technologies to potential partners based on geographic interests in technology sectors.

The Hollings Manufacturing Extension Partnership

The Hollings Manufacturing Extension Partnership (MEP) works with small and mid-sized U.S. manufacturers to help them create and retain jobs, increase profits, and save time and money. MEP, with field staff located in every state, works with partners at the state and federal levels on programs that put manufacturers in position to develop new customers, expand into new markets, and create new products.

As manufacturers develop new products, enhance existing products, strive to expand and diversify markets, develop and improve production and engineering systems and processes, and work to strengthen competitive positions within supply chains – technology in some shape or form is frequently a lynchpin enabler. MEP's Technology Acceleration strategy has four principal components:

- Connecting manufacturer technology needs with laboratory technologies
- Technology Scouting
- Supplier Scouting
- Product Development and Commercialization Assistance.

MEP's mission and structure align to facilitate the successful transitioning of technologies to the private sector, including NIST technologies. Plans to accelerate the technology transfer and commercialization of Federal research in support of high-growth businesses will include the following scenarios:

- As technology commercialization licenses are negotiated, and through their term, the MEP may serve to identify manufacturing requirements (i.e., prototype evolution, design for manufacture, scale-up issues, distribution, market diversification) as well as support quality control/management issues or certification requirements for successful transition.
- As CRADA relationships emerge and evolve (perhaps informal arrangements as well), the MEP may be consulted to ensure that any manufacturing/qualification issues are identified early in the research stages so as to not miss opportunities and maximize efficiencies.
- NIST standards capable of impacting the manufacturing sector may be communicated to industry through MEP channels, among other means.
- When Federal labs, such as NIST, seek to source American products as part of a mission-directed initiative – the MEP may provide appropriate support with Supplier Scouting program(s).
- As Federal agencies seek to maximize their economic returns on SBIR investments – the MEP may partner with SBIR companies to support successful commercialization.

Joint Institutes

NIST Laboratories have established a number of specialized joint research institutes through partnerships with academic research organizations and State agencies, serving as primary sources of technology in their local clusters.

JILA

Founded in 1962 as a joint institute of the University of Colorado Boulder (CU) and NIST, JILA is recognized as a leading center in the region for research, scholarship, and training in atomic, molecular, and optical sciences, with expanding capabilities in biophysics and nanotechnology. Located on the Boulder campus of CU, the principal researchers at JILA are 28 Fellows evenly provided by CU and NIST, complemented with 220 research associates, graduate students and professional staff.

JILA generates leading-edge science that improves the art of precision measurement, and it provides a robust training ground for highly skilled scientists with significant entrepreneurial potential. The optics and photonics industry is highly concentrated in eastern Colorado. This industry benefits from staff that includes former JILA research associates and graduate students. At least 11 businesses trace their roots to founders who were researchers at JILA. Through JILA's connection to its CU host, JILA is recognized in the State of Colorado's new manufacturing strategy as a critical asset for its regional cluster activity.

Hollings Marine Laboratory

The Hollings Marine Laboratory (HML) was dedicated in 2000 as a unique partnership among NOAA's National Ocean Service, the South Carolina Department of Natural Resources (SCDNR), the College of Charleston, Medical University of South Carolina (MUSC), and NIST. At HML, NIST works to improve the quality of analytical measurements used in marine environmental research and monitoring, and also improves national capabilities to assess trends in environmental quality by developing environmental specimen banking. HML, located at the South Carolina Marine Resources Center in Charleston, contains a staff of 125, of whom 22 are NIST employees, 22 are university faculty and students, and approximately 80 are employees of NOAA and SCDNR. Many of the NIST researchers serve as adjunct faculty at the partner universities.

NIST's unique capabilities at HML include state-of-the-art facilities for preparing and cryogenically storing marine tissue specimens, analyzing these samples for contaminants and indicators of health; essential support for local aquaculture and fishing industries, which are significant components of the region's economy. In addition, these facilities were essential to assessing the impact and remediation of the 2010 Gulf Oil Spill.

Joint Quantum Institute

Created in 2006 to pursue theoretical and experimental studies of quantum physics in the context of information science and technology, the Joint Quantum Institute (JQI) is a research partnership between the University of Maryland (UMD) and NIST, with participation of UMD's Laboratory for Physical Sciences (LPS), a partnership between UMD and the National Security Agency (NSA). JQI is an interdisciplinary laboratory that combines three fields of physics:

atomic, molecular and optical physics; condensed matter physics; and quantum information science.

Located on the University of Maryland's College Park campus in Prince George's County, JQI has 28 Fellows, half from NIST and half from UMD. NIST JQI Fellows are adjunct faculty within the UMD. JQI receives additional support from the National Science Foundation and the Department of Defense.

Institute for Bioscience and Biotechnology Research

Established in 2010 as a joint research enterprise among the University of Maryland College Park (UMCP), the University of Maryland Baltimore (UMB), and NIST, the Institute for Bioscience and Biotechnology Research (IBBR) offers state-of-the-art measurement and bio-synthesis capabilities for basic and translational research in nanobiotechnology, structural biology, protein design and drug discovery. IBBR is located in Montgomery County, Maryland and is staffed by 10 NIST researchers (some of whom serve as adjunct faculty at UMCP) plus 19 UMCP faculty and 4 faculty from UMB.

IBBR was a natural outgrowth of the Center for Advanced Research in Biotechnology and the Center for Biosystem Research, established in 1984 by UMCP, NIST, and Montgomery County to serve the growing biotechnology cluster in the region.

These joint institutes enhance NIST's technology transfer capabilities through their co-location with university facilities, their direct contact with graduate and undergraduate students, their close interaction with scientists from other institutions, and the flexibility that university technology transfer capabilities allow for working with industry. The joint institutes produce the same technology transfer outputs, e.g., publications, patents, graduate student training, as does NIST, and are seen by their States and communities as major assets for economic development, evidenced by the extensive non-federal public investments that are provided to the institutes.

CHAPTER 3

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Overview of NOAA Technology Transfer

NOAA's mission is to understand and predict changes in climate, weather, oceans, and coasts; to share that knowledge and information with others; and to conserve and manage coastal and marine ecosystems and resources. This mission will become ever more critical in the 21st century as national issues related to climate change, severe weather, limited freshwater supply, ecosystem management, and homeland security intensify.

NOAA views technology transfer as *the process by which existing knowledge, facilities, or capabilities developed under federal research and development funding are utilized to provide building blocks for the private sector.*

NOAA Goals and Technology Transfer

NOAA is one of the nation's premier scientific agencies providing science-based forecasts and related services to the public on the current and future state of oceans, coasts, the climate, and the weather. Accurate and longer range forecasts depend on a robust and ongoing program of research and development, much of which is done in collaboration with non-federal scientists or is transferred to the public, positively impacting the daily lives of the nation's citizens and providing substantial economic benefits.

NOAA's technology transfer program disseminates applications resulting from its meteorological and oceanographic technologies to individuals, industry, government, and universities. In addition, NOAA provides real-time weather information, including forecasts and warnings, seasonal projections, drought outlooks, and other products through a variety of media. NOAA also transfers its technology through presentations at scientific meetings, publication in peer-reviewed scientific journals, and publication of NOAA scientific and technical documents.

NOAA collaborates with a wide range of academic and private sector partners, and with other Federal research agencies, on many topics of joint interest in science and technology development. For example, a current collaboration with the National Institute of Standards and Technology, the U.S. Forest Service, and other agencies provides research in support of operational fire weather forecasts. Many of the tools and fire behavior models developed through this project will be used by state and local governments to inform citizens, and may be used by private companies to develop value-added technology applications to better respond to the needs of the public.

To ensure that the United States benefits from and fully exploits scientific research and technology developed abroad, NOAA collaborates and shares information with organizations in countries throughout the world. Through these international relationships, NOAA receives technology that may eventually benefit U.S. industries and public users. For example, the

understanding and forecasting of global phenomena that occur in the atmosphere, oceans, and on the sun require worldwide collaboration and information sharing. This is accomplished through formal agreements with individual countries and participation in international organizations, such as the World Meteorological Organization (WMO), the Intergovernmental Oceanographic Commission (IOC), and the International Astronomical Union (IAU). NOAA participates in international scientific programs, such as in the Global Earth Observation System, and shares technology and scientific data. This effort involves nearly 50 countries, the European Commission, and 29 international organizations. NOAA also provides technical assistance and training to individuals from other countries, and participates in an international visiting scientist program. Further, NOAA shares environmental data through its participation in the World Data Center system.

Over the next five years, NOAA will continue to direct its technology transfer and international collaboration activities toward accomplishing its four mission goals:

1. **Climate Adaptation and Mitigation:** An informed society anticipating and responding to climate and its impacts;
2. **Weather-Ready Nation:** Society is prepared for and responds to weather-related events;
3. **Healthy Oceans:** Marine fisheries, habitats, and biodiversity are sustained within healthy and productive ecosystems; and
4. **Resilient Coastal Communities and Economies:** Coastal and Great Lakes communities are environmentally and economically sustainable.

Current Technology Transfer Mechanisms

NOAA's primary technology transfer mechanism has historically been the open dissemination of scientific and technical information to individuals, industry, government, and universities. This means of transfer is consistent with the agency's mission and scientific tradition. Although NOAA finds this method of technology transfer to be the most efficient and economical, NOAA continues to transfer certain intellectual property through Memoranda of Understanding, licenses, and Cooperative Research and Development Agreements (CRADAs) which provide a competitive edge to U.S. companies. The following is a detailed list of the indirect technology transfer mechanisms used by NOAA, including our partnerships and data portals:

Cooperative and Joint Institutes

NOAA Cooperative Institutes are academic and non-profit research institutions that demonstrate the highest level of performance and conduct research that supports NOAA's Mission Goals and Strategic Plan. Many of the Cooperative Institutes are collocated with NOAA research laboratories, creating a strong, long-term collaboration between scientists in the laboratories and in the university. Cooperative Institutes not collocated with a NOAA laboratory often serve diverse research communities and research programs throughout NOAA. In addition, many of the cooperative agreements between NOAA and our academic partners provide for formal NOAA sponsorship of students through fellowships. Cooperative Institutes are located at parent institutions whose geographic expanse extends from Hawaii to Maine and from Alaska to

Florida. Currently, NOAA supports 18 Cooperative Institutes consisting of 48 universities and research institutions across 21 states, Puerto Rico and the US Virgin Islands.

National Sea Grant College Program
A partnership between universities and the federal government's National Oceanic and Atmospheric Administration (NOAA), Sea Grant directs federal resources to pressing problems in local communities. By drawing on the experience of more than 3,000 scientists, engineers, public outreach experts, educators and students from more than 300 institutions, Sea Grant is able to make an impact at local and state levels, and serve as a powerful national force for change. Partnerships enable Sea Grant to expand its effort and scope. Sea Grant has established state-federal partnerships with great capabilities for promoting coastal economic growth, improving the quality of coastal environments,educating students in marine sciences, solving critical marine and Great Lakes resource problems.

International Working Groups and Assessments
Because many environmental policy-setting institutions rely on clear scientific information for decisions, NOAA researchers make it a priority to summarize and translate scientific understanding for constituents. Our researchers play leading roles in scientific assessments that relate the "state of the science" on topics including ozone layer depletion (Montreal Protocol, United Nations Environment Programme / World Meteorological Organization), climate change (International Panel on Climate Change, US Global Change Research Program), safety and security of shipping and the prevention of marine pollution by ships (International Maritime Organization), and air quality (NARSTO – North American Consortium for Atmospheric Research in Support of Air Quality Management).

As an indication of the value placed on such assessments, the IPCC (Intergovernmental Panel for Climate Change) was awarded the 2007 Nobel Peace Prize for its role in communicating understanding of man-made climate change through its scientific reports over the past 20 years. Several NOAA researchers played an active role as lead authors and reviewers throughout this important assessment.

National Data Centers and Public Data Portals
NOAA provides a wide variety of environmental data, models, and resources to the public through its public data centers and data portals. Scientists, academics, industry specialists, and the interested public may all access full data sets relating to the full range of NOAA's mission activities. Following are the primary NOAA data centers and portals.

National Oceanographic Data Center (NODC) archives and distributes oceanographic data and information. These data include physical, biological, and chemical measurements from in situ oceanographic observations, satellite remote sensing, and industrial oceanographic activities in coastal and deep ocean areas.

Through NODC archive and access services, these ocean data are used to answer questions about climate change, ocean phenomena, and management of coastal and marine resources, marine transportation, recreation, national security, and natural disasters. Another significant user group

is the Education community, where these data and information products are used to help teach each new generation of students about the oceans.

The National Climatic Data Center (NCDC) is the world's largest active archive of weather and climate data. These are the cornerstone for the prediction of future events, which affect the world's environment and economy. NCDC responds to data requests from all over the world. NCDC is an important source for climate monitoring. State of the Climate reports are published monthly and annually for the United States and the globe. NCDC operates the World Data Center for Meteorology that is co-located at NCDC in Asheville, North Carolina, and the World Data Center for Paleoclimatology that is located in Boulder, Colorado.

NCDC supports a three tier national climate services support program - the partners include: NCDC, Regional Climate Centers, and State Climatologists.

The National Geophysical Data Center (NGDC) manages over 850 digital, and analog, environmental data sets for the Nation, enabling access by scientists, industry, and the public. NGDC stewards the data for quality and longevity and produces products to address arising national needs, such as digital coastal elevation models used to forecast the danger of coastal flooding or the World Magnetic Model (WMM) for the Department of Defense, a model, based on worldwide magnetic field data, describes the Earth's constantly changing magnetic field in time and location. The WMM is a component of GPS devices, cell phones, cameras, and computing tablets that use magnetic field for direction; it is paramount for safe navigation and the military's war fighting ability. The volume of data that NGDC archives doubles every few years, so the Center must continually develop innovative and streamlined data management systems to effectively and efficiently preserve and distribute the Nation's geophysical data.

The Geophysical Fluid Dynamics Laboratory (GFDL) Data Portal: Public data sets from GFDL are made available through the GFDL Data Portal. The Data Portal is designed to allow one to download files, display data files attributes, and graphically display the data. Users can download complete files via "http" and "ftp" access. Users can also display data file attributes that provide information about file contents without having to download the file itself. Continued development of the Live Access Server is ongoing to enhance the ability of a remote user to graphically display the data.

NOAA Environmental Visualization Laboratory (EVL): EVL is the only full-time science and data visualization program within NOAA. Our staff is supported through the National Environmental Satellite, Data and Information Service (NESDIS), Center for Satellite Applications and Research (STAR) NESDIS/STAR and through collaboration with other NOAA organizations and scientists. All animations and images accessed through this website are in the public domain and are freely available for reuse.

NESDIS Office of Satellite and Product Operations (OSPO): The Satellite Products and Services Division (SPSD) within the Office of Satellite and Product Operations provides automated environmental products and interpretive analyses using data from NOAA and non-NOAA environmental satellites. These products are generated in support of NOAA program requirements but are also distributed to other U.S. Federal Government agencies, international

partners and the public. Information on these environmental satellite products and other services can be obtained at http://www.ospo.noaa.gov.

CLASS Data Archive: The Comprehensive Large Array-data Stewardship System (CLASS) is an electronic library of NOAA environmental data. This web site provides capabilities for finding and obtaining those data.

National Data Buoy Center: The National Data Buoy Center (NDBC) manages the development, operations, and maintenance of the national data buoy network. It serves as the NOAA focal point for data buoy and associated meteorological and environmental monitoring technology. It also operates the NWS test center for all surface sensor systems, which is a source of NOAA patent and technology licensing opportunities.

National Centers for Environmental Prediction (NCEP) Central Operations (NCO): NCO sustains and executes the operational suite of numerical analyses and forecast models and prepares NCEP environmental information products for dissemination to the public.

NCEP Environmental Modeling Center(EMC): EMC develops and improves numerical weather, climate, hydrological and ocean prediction through a broad program in partnership with the research community.

U.S. Integrated Ocean Observing System (IOOS®): Data Management Subsystem: The Data Management and Communications (DMAC) subsystem is the central mechanism for integrating all existing and projected data sources. The U.S. IOOS Program has developed common services for bringing data together and making it accessible in a common format. IOOS partners collect coastal and marine data — water temperature, water level, currents, winds, waves, and more — using satellites, buoys, tide gauges, radar stations and underwater vehicles. This ocean data is then turned into information that people can use, often in the form of forecasts and products designed to track, predict, manage, adapt, and respond to changes in our marine environment. At the Global level, NOAA's OAR/CPO/Climate Observation Division provides access to data from global programs such as ARGO, Tide gauges, drifting buoys, and open-ocean moored buoys. At the National level, the National Data Buoy Center (NDBC), the Center for Operational Oceanographic Product and Services (CO-OPS) and NOAA/NESDIS Coastwatch are U.S. IOOS data assembly centers that contribute to U.S. IOOS. At the Regional level, U.S. IOOS has eleven Regional Coastal Ocean Observing Systems (RCCOS) spanning the entire United States coastal area and the Great Lakes. The RCOOS have stood up Regional data assembly centers that provide access to State, Local, Tribal government, academia and research institutes, industry and non-governmental organizations. Two examples are the IOOS Regional Partner, Central and Northern California (CeNCOOS), which provides real-time ocean and coastal information from 183 assets and 23 partners and our Pacific Northwest partner, the Northwest Association of Networked Ocean Observing Systems (NANOOS), which provides information from 167 assets and 25 partners. The U.S. IOOS data catalog/portal provides users a single location where they can search for and retrieve data. The goal is to maximize the availability of data by allowing users to find the data they want, for the location and time period of interest, from all available U.S. IOOS partners without having to know in advance what partners actually operate the observing systems and data servers. **NOAA Test Beds and Proving Grounds**

Testbeds and proving grounds have become a key strategy in NOAA to link research and operations (http://www.testbeds.noaa.gov). NOAA testbeds and proving grounds include:

Aviation Weather Testbed (AWC): AWC tests new science and technology to produce better aviation weather products and services.

Climate Testbed (CTB): CTB accelerates transition of scientific advances from the climate research community to improved NOAA climate forecast products and services.

Developmental Testbed Center (DTC): DTC improves weather forecasts by facilitating transition of the most promising new NWP techniques from research into operations.

GOES-R Proving Ground (GRPG): GRPG tests and evaluates simulated GOES-R products before the GOES-R satellite is launched into space.

Hazardous Weather Testbed (HWT): HWT accelerates transition of new meteorological insights and technologies into advances in forecasting and warning for hazardous weather events.

Hydrometeorology Testbed (HMT): HMT conducts research on precipitation and weather conditions that can lead to flooding, and fosters transition of scientific advances and new tools into forecasting operations.

Joint Center for Satellite Data Assimilation (JCSDA): JCSDA accelerates and improves use of research and operational satellite data in weather, ocean, climate and environmental analysis and prediction systems.

Joint Hurricane Testbed (JHT): JHT is a competitive, peer-reviewed, grant program that selects the best mature research products for testing and transitioning to operations. Includes modeling, data gathering, and decision support components.

Operations Proving Ground (OPG): NOAA's National Weather Service OPG serves as a framework to advance NWS decision-support services and science & technology for a weather-ready nation.

Space Weather Prediction Testbed (SWPT): SWPT supports development and transition of new space weather models, products, and services.

Related programmatic testing activities in NOAA include the Coastal and Ocean Modeling Testbed (COMT), established by the U.S. IOOS Program with the Southeastern Universities Research Association (SURA) to accelerate the transition of scientific and technical advances from the coastal and ocean modeling research community to improve identified operational ocean products and services. Initially developed to address chronic issues of high relevance in the Atlantic and Gulf regions, such as flooding from storm surge and seasonal depletion of oxygen in shallow waters, this project has established a robust infrastructure to facilitate model assessment and detailed scientific investigation of both model output and data. Through the

COMT, methods will also be explored for effectively delivering model results to regional centers, scientists, and managers relying on U.S. IOOS.

Peer Reviewed Publications and Technical Reports
Peer-reviewed publications and technical reports are a direct method of disseminating our research results to industry, academia, and other agencies. In 2011, NOAA staff authored more than 1,000 publications in peer-reviewed journals and produced 150 technical reports.

Websites and Web Portals
NOAA and its programs, laboratories, and data centers each have a dedicated public website. These sites provide useful environmental data and information to the public. In addition, NOAA portals, such as the Climate Portal at Climate.gov, seek to provide the public and decision-makers with educational materials, news, data, and access to specific services.

Outreach and Education
The NOAA Office of Education oversees a range of programs, scholarships, and grant programs that encourage scientific training, hands-on interaction, technology development, and knowledge transfer between NOAA scientists and academia. Among these programs, the Educational Partnership Program and the Ernest F. Hollings Scholarship program provide effective technology transfer through direct intereaction between NOAA scientists and students.

The Educational Partnership Program: The goal of the Educational Partnership Program is to increase the number of students from underrepresented communities who are educated, trained and graduated in fields that directly support NOAA's mission.

> Cooperative Science Centers: EPP established five Cooperative Science Centers at Minority Serving Institutions (MSIs) to advance collaborative research in the NOAA-related sciences. Each Center is directly partnered with a NOAA Line Office.
>
> Graduate Sciences Program: The Graduate Sciences Program (GSP) is aimed primarily at increasing opportunities for students in NOAA-related fields to pursue research and educational training in atmospheric, environmental, remote sensing and oceanic sciences. It includes 16 weeks of NOAA work experience per year for participants.
>
> Undergraduate Scholarship Program: The Undergraduate Scholarship Program provides an opportunity for rising junior and senior students to study disciplines relating to the NOAA's mission. Participants are eligible for NOAA internships in addition to tuition support.

The Educational Partnership Program provides students with the opportunity to interact directly with NOAA staff in their field of study. Between 2001 and 2006, this interaction resulted in 152 collaborative projects and 204 research papers published in peer reviewed journals.

Ernest F. Hollings Scholarship Program: The Hollings Scholarship Program provides successful undergraduate applicants with awards that include academic assistance (up to a maximum of $8,000 per year) for full-time study during the 9-month academic year; a 10-week,

full-time internship position ($650/week) during the summer at a NOAA facility; and, if reappointed, academic assistance (up to a maximum of $8,000) for full-time study during a second 9-month academic year. The internship between the first and second years of the award provides the Scholars with "hands-on" practical educational training experience in NOAA-related science, research, technology, policy, management, and education activities.

Commercialization and Technology Development Plan and Transfer Initiatives

Overview:
The NOAA Office of Research and Technology Applications (ORTA), housed under the NOAA Office of Oceanic and Atmospheric Research (OAR), serves as the central point for providing service to NOAA Labs and external organizations for technology transfer.

In 2010, ORTA staff conducted an initial survey of NOAA staff from each Line Office to determine the overall awareness of the program and effectiveness of the tools provided. The results showed a general lack of knowledge related to mechanisms for technology transfer across the organization, as well as a consistent need for knowledgeable, dedicated staff in ORTA to act as a single resource for NOAA scientists with commercialization activities. To quote one response: "To develop any of these types of commercialization agreements requires development of this skill set by leadership and other staff who work to develop these types of agreements…scientists have the technical skill sets but not the legal knowledge of how to move these agreements forward and this often leads to very inefficient use of time by both parties." Based on the findings from these initial surveys, ORTA has proposed a series of eight programmatic actions to increase internal and external awareness, improve support and programmatic functions, and better track our progress toward increasing technology transfer.

Action 1: Optimize ORTA Management and Staffing Structure:
The ORTA (Technology Transfer Office) is the link between internal laboratories and external technology transfer customers. In order to provide the required level of service, the ORTA has reviewed staffing levels and made recommendations for optimal staffing. In addition, ORTA will work through the NOAA Research Council to request each NOAA lab designate one scientific staff member as a point of coordination for Laboratory technologies and technology transfer activities.

ORTA will make available two staff-level details to work for a six to twelve month period on technology transfer activities. These details will enable candidates to combine their science, legal or business background with training and experience in the technology transfer field. The selected staff will work with ORTA staff, as well as researchers and technology and business development individuals within and outside NOAA on the following activities:

- Evaluation of technology for patentability and commercialization;
- Identifying laboratory technologies to be used in partnering efforts;
- Development of marketing materials, such as brochures, posters, or technology summaries;
- Drafting and negotiating Cooperative Research and Development Agreements; (CRADAs) for NOAA scientists and their industrial/academic research partners;

- Organization of specialized meetings or conference sessions;
- Development of technology transfer educational programs for scientists;
- Program coordination and monitoring;
- Developing technology transfer success stories;
- Overseeing patent related issues for NOAA scientists;
- Other duties as pertaining to intellectual property and technology transfer.

ORTA staff will work closely with other agencies to implement a set of commercialization best practices for NOAA. The goal for these activities will be to maintain and develop a consistent process and framework with other agencies, streamline administrative processes where possible, and take advantage of the lessons-learned from more mature programs.

Lastly, ORTA will seek to have a trained specialist in technology transfer processes to answer staff questions regarding licensing, CRADAs and MOUs. This person will work closely with designated staff in the NOAA Office of General Counsel to provide consistent and seamless support and minimize the administrative burden on NOAA scientists and staff.

Action 2: Central Management of Patents:
To encourage the broader use of patents in NOAA, ORTA will review the feasibility of setting aside a portion of its program funding to support patent application and ongoing patent maintenance fees. Centralized payment capabilities, as well as centralized management of NOAA patents by the ORTA would reduce the administrative and cost burden on NOAA labs, thereby encouraging staff to disclose their inventions to the ORTA and more readily seek patent protection for new technologies. Once mature, a centralized management process would allow the ORTA to develop a more robust and fair process for evaluating which new technologies have the highest licensing potential and have the greatest need for patent protection (see Action 4 below).

Action 3: Programmatic Advice and Guidance:
The ORTA has already been working through the NOAA Research Council (RC) to review and approve SBIR annual solicitations. Expanding on this paradigm, the RC agreed to provide advice and general guidance to the ORTA for technology transfer activities. The ORTA has also stood up a NOAA-wide coordination group to increase the awareness and facilitate a range of technology transfer activities.

The NOAA ORTA is located administratively under the Office of Atmospheric and Oceanic Research and receives funding from across NOAA. While the ORTA will maintain programmatic independence; the RC will provide guidance and advice to the ORTA on issues of strategic importance for NOAA R&D. The RC will also help focus NOAA technology transfer activities to align closely with strategic R&D priorities. Finally, the RC will provide ORTA staff a direct line of communication with NOAA leadership through the NOAA Chief Scientist.

In addition, the ORTA will closely coordinate with NOAA Line Office Transition Managers to ensure ORTA policies and procedures are consistent with their activities as guided by NOAA Administrative Order NAO 216-105.

Action 4: Establish Technology Transfer Review Board:
Determining technologies for which NOAA should seek patent protection is a key component of the technology transfer process. Currently, there is no process in place for this activity. A NOAA review board would provide inventors the opportunity to present detailed information concerning their technology. The review board would determine which technologies to move forward with based on NOAA mission and which has the highest commercial potential. ORTA will work with the RC to determine the best path forward for establishing this proposed board.

Action 5: Enhance Internal Education on Patents and Technology Transfer Issues:
ORTA will provide NOAA laboratory and program personnel with training in the following areas:

- A general understanding of intellectual property and intellectual property rights
- Avoiding premature disclosure of new technologies, which could compromise future efforts to patent and license
- Working with the NOAA ORTA and patent counsel
- The benefits of CRADAs
- Filing disclosure statements
- Filing patent applications

Activities may include:

- Educating NOAA leadership and staff of the benefits of technology transfer.
- Quarterly technology and innovation newsletter to highlight NOAA activities and links to educational materials on line.
- Continuing to communicate to research staff and management that invention recognition, disclosure, patenting (when appropriate) and licensing are important to NOAA's mission.
- Brown bag seminars, webinars, one-on-one and small group interactions on topics including:
    - Staff responsibility to disclose inventions
    - How to recognize technological innovation and inventions
    - How to report emergent inventions using the invention disclosure form
    - ORTA support for invention disclosure
    - Staff incentives for disclosure
- Update ORTA website to provide points of contact, links to needed forms and templates, as well as extensive background information on program benefits.

Action 6: Increase Outreach to Industry:
The ORTA will begin activities designed to better inform the public of the processes and benefits of partnering with NOAA for research and development activities. The activities may include:

- **Website Redesign**: We will redesign the ORTA website to feature pending opportunities, benefits, success stories, and answers to FAQs for staff, private companies, or other entities looking to partner with NOAA.
- **Trade Show Marketing**: ORTA staff will attend selected events and trade shows to meet with target audiences and distribute ORTA marketing materials.
- **Targeted Meetings**: ORTA staff will meet with select trade associations and NGOs to increase awareness of technology transfer opportunities and brainstorm methods of increasing technology transfer activities with NOAA.

- **Joint Meetings with DoC Partners:** ORTA staff will collaborate with its sister bureaus in the Department of Commerce and in other agencies to initiate joint outreach and promotional activities.

Action 7: Develop Database of NOAA Technologies and Opportunities:
An important component of the ORTA plan to improve management of NOAA's technology transfer activities will be a database to easily track and monitor basic information on CRADAs, MOUs, invention disclosures, and patents (including status and regular maintenance fees). Tracking this basic information will allow staff to develop regular reports without adding administrative burden to the labs and will provide easy tracking of metrics.

In addition, the ORTA envisions a portion of the Laboratory Technology Transfer Representative's time would be spent compiling a list of technologies available in their respective Laboratory. These technologies and capabilities would be tracked in the data base and provided to the public through the ORTA website.

ORTA is currently exploring a number of internal NOAA and existing technology transfer database capabilities for hosting NOAA technology transfer data. The focus of the ORTA effort will be to use existing capabilities to meet these needs and not recreate or duplicate efforts.

Action 8: Improve Performance Measurement and Tracking:
NOAA has identified 8 performance measures as an initial basis to track the effectiveness of its technology transfer. ORTA will review this set annually and update measures to ensure NOAA's ability to effectively monitor its performance. The NOAA ORTA will request reporting of these performance measures quarterly to determine progress toward quarterly and annual goals. We believe individual performance results will vary even under ideal programmatic circumstances. However, taken as a whole, we believe this set of performance metrics will offer an accurate snapshot of NOAA's ongoing technology transfer activities and will provide valuable insight for ORTA to structure its education and training activities in the future.

The NOAA ORTA will use the following chart and measures to track its performance metrics each annually.

	Q1 Goal	Q1 TTL	Q2 Goal	Q2 TTL	Q3 Goal	Q3 TTL	Q4 Goal	Q4 TTL	Annual Goal	Annual Total
Number of CRADAs Completed										
Number of Licenses Completed										
Number of MOUs with External Entities Completed										
Number of Patents Completed										
Number of NOAA CI/JI authored peer-reviewed papers										
Number of Data/Data Product Downloads from NOAA Data Centers										
Number of Peer Reviewed Publications										
Number of In-Reach Training Seminars by ORTA										

CHAPTER 4

NATIONAL TELECOMMUNICATIONS AND INFORMATION ADMINISTRATION

Overview of NTIA Technology Transfer

The Institute for Telecommunication Sciences (ITS) is the chief research and engineering arm of the National Telecommunications and Information Administration (NTIA).

ITS supports NTIA telecommunications objectives of promoting advanced telecommunications and information infrastructure development in the United States, enhancing domestic competitiveness, improving foreign-trade opportunities for U.S. telecommunications firms, and facilitating more efficient and effective use of the radio spectrum. ITS also serves as a principal Federal resource for solving telecommunications concerns of other Federal agencies, state and local governments, private corporations and associations, and international organizations.

ITS uses three principal means for achieving technology transfer: cooperative research and development; technical publications; and leadership and technical contributions in the development of telecommunications standards.

ITS is also a partner in the Public Safety Communications Research (PSCR) program with the NIST Office of Law Enforcement Standards. Over the last 15 years this joint program has focused on improving first respondercommunications and interoperability through the development of communication standards, research, testing, and evaluation (RDT&E) on behalf of sponsors at the Department of Homeland Security (DHS) and the Department of Justice (DOJ).

Cooperative Research and Development
Cooperative Research and Development Agreements (CRADAs), based on the Federal Technology Transfer Act (FTTA) of 1986, are a means through which ITS aids the private sector. The FTTA provides the legal basis for, and encourages, shared use of government facilities and resources with the private sector in advanced telecommunications technologies.

The goal of these partnerships is to aid in the commercialization of new products and services, as well as enhance the capabilities of ITS laboratories. CRADAs also provide insights into industry's needs for productivity growth and competitiveness. This enables ITS to adjust the focus and direction of its programs for effectiveness and value.

In FY 2012, ITS's efforts in technology transfer and commercialization fostered cooperative telecommunications research in areas where U.S. companies can directly benefit from improved competitiveness and market opportunities. These efforts will continue in future years. ITS also participated – as it has for a number of years – in CRADAs with private-sector organizations to design, develop, test, and evaluate advanced telecommunication concepts. The private industry partner benefits through such cooperative relationships, as does the Institute, because the partner

is able to conduct research in commercially important areas that it would not otherwise be able to undertake.

To date, major contributions to personal communication services (PCS), local multipoint distribution service (LMDS), ultra wideband (UWB), and Broadband over Power Line (BPL) technologies have been achieved through CRADAs. These have aided U.S. efforts to rapidly introduce new socially constructive communications technologies. More recently, CRADAs in the areas of objective audio and video quality, advanced antennas for wireless systems, and remote sensing and global position (GPS) technology have allowed ITS to contribute to the development of new products and services.

The vast majority of CRADAs that ITS has established in the past two years, and will likely continue to establish for the next several years, are the Public Safety 700 MHz Broadband Demonstration Agreements. These agreements allow vendors who intend to supply 700 MHz LTE (long term evolution) equipment and service to Public Safety organizations to operate various elements of an LTE network in the PSCR test bed and over-the-air (OTA) network in order to test interoperability of public safety communications equipment under simulated field conditions, with the participation of public safety practitioners. The CRADAs protect the intellectual property of vendors and manufacturers, encouraging participation in testing that simulates real multi-vendor environments in the field.

Summary of ITS CRADAs for FY 2012:

Type of Research	Number of CRADAs
700 MHz Broadband Demonstration Network	54
Table Mountain CRADA	4
Other Research	4
Total	62

Type of CRADA Partner	% of All CRADAs
Large business	77%
Small business	19%
University	3%

Technical Publications

Publication has historically been the means through which ITS has transferred research results to other researchers, the commercial sector, and government agencies. Technical publication remains a principal means for ITS technology transfer. Many of these publications—both NTIA official publications and peer-reviewed articles in external scientific journals—have become standard references in several telecommunications areas.

To ensure information quality, ITS engages a peer review process managed by the ITS Editorial Review Board (ERB) under which publications undergo thorough technical review by internal or external experts.

As the standard for dissemination of technical publications has moved from print to electronic media, ITS has followed suit, with several recently released technical articles appearing in electronic-only technical journals and all NTIA technical publications are being published first to the web. In addition, ITS has undertaken an effort, which will take several years to complete, to increase availability of its prior publications over the internet. A significant component of this effort is a recent re-design of the ITS website which incorporates an advanced search function to enable targeted search within the publications library. As well, technical publications and web pages are being methodically updated to incorporate appropriate Dublin Core metadata tags (as recommended in the DOC Searchable Web Pages policy) to increase the probability that they will be found in an internet-wide topical search.

ITS-Developed Software

In the past, ITS-developed computer code has been classified as a technical publication, since much of it was literally published as a text file as the appendix to a technical report. Later, some computer programs were distributed under licensing agreements. Both of these conventions have been largely abandoned, and ITS-developed software not protected under a CRADA or IAA is now made available via open-source download. For a small number of downloads, ITS requests user registration, principally to enable notification of upgrades.

Metrics for Publications and Software

With the transition to open technology transfer through the public website, site statistics provide the data for metrics—but meaningful website metrics are increasingly difficult to isolate. ITS is in the process of developing new metrics that will identify only downloads of publications, data or software—a much more accurate measure of technology transfer than the number of raw hits. For example, at the beginning of FY 2012, there were 1,241 registered users who had downloaded Video Quality Metrics (VQM) software developed by ITS, but the pages from which download could be initiated were averaging more than 3,500 raw hits per year. A metric of raw hits overstates penetration and does not provide meaningful benchmarks against which improvement can be measured. For FY 2012 and FY 2013, metrics in this area will be reported on unique pageviews of pages from which downloads are initiated as a proxy for a download count metric which is currently under development and targeted for implementation in the second quarter of FY 2013. For software or data repositories that require registration, registered users is the tracking metric. Baseline targets will be estimated by annualizing the FY 2013 partial data and validated against the full year FY 2014 data.

Type of Access	Unique Pageviews
Technical Publication Abstract and Download	2036
Video Quality Experts Group (VQEG) Tutorials and Resources	5296
Radio Propagation Modeling Data and Software Tools	2052
PSCR Project 25 Documents & Standards PDF Compilation	904
PSCR Video Quality in Public Safety (VQiPS) Recommendations Tool for Video Requirements	492

Software or Data Repository	Registered Users
VQM	1241
Consumer Digital Video Library (CDVL)	242

Development of Telecommunication Standards
This method of ITS technology transfer directly addresses improvement of U.S. competitiveness in telecommunications. For several decades, ITS has provided leadership and technical contributions to organizations, both national and international, responsible for developing telecommunication standards. For example, a plurality of the technical recommendations of the International Telecommunication Union (ITU), a treaty organization, are based on research conducted at ITS. Also, key national quality-of-service standards developed under the American National Standards Institute (ANSI) T1 committee for video, audio, and digital data incorporate research results obtained at ITS.

ITS continues to chair numerous committees and working groups in the ITU, ANSI T1 (now ATIS – Alliance for Telecommunications Industry Solutions), and other telecommunication standards organizations, providing technical leadership that is trusted by the commercial-sector participants. ITS's technical inputs are relied upon as technically advanced and sound, and as unbiased by commercial interests.

In FY 2012, ITS continued its technical leadership and contributions to communications standards for public safety, particularly for first responders. ITS's primary contribution in this area has been interoperability standards and testing procedures. ITS's objective video quality measurement method has been made a national standard by ANSI. This method was also the best-performing metric in comparison testing by the ITU with other methods from around the world.

In FY 2012, 13 ITS employees participated in 45 committees or working groups in seven different Standards Development Organizations (SDO) and held 11 Chair/Co-Chair positions. Other offices of NTIA participate in the same standards bodies in different, non-technical capacities and and ITS participation metrics are aggregated to those of other offices in an agency-wide report.

SUMMARY

Technology transfer is an essential mission of the Department of Commerce, using our nation's innovation and investment in science and technology to strengthen our economy and competitiveness in world markets. This report details the results of technology partnering activities originating from the Department of Commerce's Federal laboratories. Federal research is a complex process that provides the opportunity for new ideas and innovations to be successfully marketed to serve citizens. The success stories in this report provide examples of how society benefits from technology transfer activities across the Department of Commerce's Federal laboratories. As knowledge advances and the needs of the economy change, the Department of Commerce will continue to play a role in keeping America in the forefront of innovation and supporting our economy by aiding in the transfer and commercialization of knowledge.

Attachment 1

The White House

Office of the Press Secretary

For Immediate Release
October 28, 2011

Presidential Memorandum -- Accelerating Technology Transfer and Commercialization of Federal Research in Support of High-Growth Businesses

MEMORANDUM FOR THE HEADS OF EXECUTIVE DEPARTMENTS AND AGENCIES

SUBJECT: Accelerating Technology Transfer and Commercialization of Federal Research in Support of High Growth Businesses

Section 1. Policy. Innovation fuels economic growth, the creation of new industries, companies, jobs, products and services, and the global competitiveness of U.S. industries. One driver of successful innovation is technology transfer, in which the private sector adapts Federal research for use in the marketplace. One of the goals of my Administration's "Startup America" initiative, which supports high growth entrepreneurship, is to foster innovation by increasing the rate of technology transfer and the economic and societal impact from Federal research and development (R&D) investments. This will be accomplished by committing each executive department and agency (agency) that conducts R&D to improve the results from its technology transfer and commercialization activities. The aim is to increase the successful outcomes of these activities significantly over the next 5 years, while simultaneously achieving excellence in our basic and mission focused research activities.

I direct that the following actions be taken to establish goals and measure performance, streamline administrative processes, and facilitate local and regional partnerships in order to accelerate technology transfer and support private sector commercialization.

Sec. 2. Establish Goals and Measure Progress. Establishing performance goals, metrics, and evaluation methods, as well as implementing and tracking progress relative to those goals, is critical to improving the returns from Federal R&D investments. Therefore, I direct that:

(a) Agencies with Federal laboratories shall develop plans that establish performance goals to increase the number and pace of effective technology transfer and commercialization activities in partnership with non Federal entities, including private firms, research organizations, and non profit entities. These plans shall cover the 5 year period from 2013 through 2017 and shall contain goals, metrics, and methods to evaluate progress relative to the performance goals. These goals, metrics, and evaluation methods may vary by agency as appropriate to that

agency's mission and types of research activities, and may include the number and quality of, among other things, invention disclosures, licenses issued on existing patents, Cooperative Research and Development Agreements (CRADAs), industry partnerships, new products, and successful self sustaining spinoff companies created for such products. Within 180 days of the date of this memorandum, these plans shall be submitted to the Office of Management and Budget (OMB) which, in consultation with the Office of Science and Technology Policy (OSTP) and the Department of Commerce, shall review and monitor implementation of the plans.

(b) The Interagency Workgroup on Technology Transfer, established pursuant to Executive Order 12591 of April 10, 1987, shall recommend to the Department of Commerce opportunities for improving technology transfer from Federal laboratories, including: (i) current technology transfer programs and standards for assessing the effectiveness of these programs; (ii) new or creative approaches to technology transfer that might serve as model programs for Federal laboratories; (iii) criteria to assess the effectiveness and impact on the Nation's economy of planned or future technology transfer efforts; and (iv) an assessment of cooperative research and development venture programs.

(c) The Secretary of Commerce, in consultation with other agencies, including the National Center for Science and Engineering Statistics, shall improve and expand, where appropriate, its collection of metrics in the Department of Commerce's annual technology transfer summary report, submitted pursuant to 15 U.S.C. 3710(g)(2).

(d) The heads of agencies with Federal laboratories are encouraged to include technology transfer efforts in overall laboratory evaluation.

Sec. 3. Streamline the Federal Government's Technology Transfer and Commercialization Process. Streamlining licensing procedures, improving public availability of federally owned inventions from across the Federal Government, and improving the executive branch's Small Business Innovation Research (SBIR) and Small Business Technology Transfer (SBTT) programs based on best practices will accelerate technology transfer from Federal laboratories and other facilities and spur entrepreneurship. Some agencies have already implemented administrative changes to their SBIR and SBTT programs on a pilot basis and achieved significant results, such as reducing award times by 50 percent or more. Over the past year, some agencies have also initiated pilot programs to streamline the SBIR award timeline and licensing process for small businesses. In addition, some agencies have developed new short term exclusive license agreements for startups to facilitate licensing of inventions to small companies. Therefore:

(a) Agencies with Federal laboratories shall review their licensing procedures and practices for establishing CRADAs with the goal of reducing the time required to license their technologies and establish CRADAs to the maximum practicable extent.

(b) The Federal Chief Information Officer and the Assistant to the President and Chief Technology Officer shall, in coordination with other agencies: (i) list all publicly available federally owned inventions and, when available, licensing agreements on a public Government database; (ii) develop strategies to increase the usefulness and accessibility of this data, such as

competitions, awards or prizes; and (iii) report their initial progress to OMB and OSTP within 180 days of the date of this memorandum.

(c) The heads of agencies participating in the SBIR and SBTT programs shall implement administrative practices that reduce the time from grant application to award by the maximum practicable extent; publish performance timelines to increase transparency and accountability; explore award flexibility to encourage high quality submissions; engage private sector scientists and engineers in reviewing grant proposals; encourage private sector co investment in SBIR grantees; partner with external organizations such as mentoring programs, university proof of concept centers, and regional innovation clusters; and track scientific and economic outcomes. The OMB, OSTP, and the Small Business Administration shall work with agencies to facilitate, to the extent practicable, a common reporting of these performance measures.

Sec. 4. Facilitate Commercialization through Local and Regional Partnerships. Agencies must take steps to enhance successful technology innovation networks by fostering increased Federal laboratory engagement with external partners, including universities, industry consortia, economic development entities, and State and local governments. Accordingly:

(a) I encourage agencies with Federal laboratories to collaborate, consistent with their missions and authorities, with external partners to share the expertise of Federal laboratories with businesses and to participate in regional technology innovation clusters that are in place across the country.

(b) I encourage agencies, where appropriate and in accordance with OMB Circular A 11, to use existing authorities, such as Enhanced Use Leasing or Facility Use Agreements, to locate applied research and business support programs, such as incubators and research parks, on or near Federal laboratories and other research facilities to further technology transfer and commercialization.

(c) I encourage agencies with Federal laboratories and other research facilities to engage in public-private partnerships in those technical areas of importance to the agency's mission with external partners to strengthen the commercialization activities in their local region.

Sec. 5. General Provisions. (a) For purposes of this memorandum, the term "Federal laboratories" shall have the meaning set forth for that term in 15 U.S.C. 3703(4).

(b) This memorandum shall be implemented consistent with applicable law and subject to the availability of appropriations.

(c) Nothing in this memorandum shall be construed to impair or otherwise affect the functions of the Director of OMB relating to budgetary, administrative, and legislative proposals.

(d) Independent agencies are strongly encouraged to comply with this memorandum.

(e) This memorandum is not intended to, and does not, create any right or benefit, substantive or procedural, enforceable at law or in equity by any party against the United States, its departments, agencies, or entities, its officers, employees, or agents, or any other person.

BARACK OBAMA