Revised Technology Transfer Metrics
in Response to the October 28, 2011 Presidential Memorandum:

Accelerating Technology Transfer and Commercialization of Federal Research in Support of High-Growth Businesses[1]

Prepared by:

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I. Introduction

On October 28, 2011, the President issued the Presidential Memorandum -- *Accelerating Technology Transfer and Commercialization of Federal Research in Support of High-Growth Businesses*. Section 2 of the Presidential Memorandum (PM) called for the establishment of performance goals, metrics, and evaluation methods, as well as implementing and tracking progress relative to those goals. The PM further directed that, "[t]he 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)."

Pursuant to the PM, the National Institute of Standards and Technology (in accordance with functions delegated by the Secretary of Commerce) in conjunction with the Office of Science and Technology Policy and the Office of Management and Budget worked with Federal agencies through the Interagency Workgroup for Technology Transfer (IAWGTT) to improve and expand these metrics. The interagency effort began in November 2011 and continued via a series of meetings and discussions through September of 2012 in time to implement the metrics in fiscal year 2013. This effort involved reviewing individual agency plans and agency-specific metrics developed in response to the PM, coordinating with the National Science Foundation on data collected for other efforts (such as the semi-annual Science and Engineering Indicators report), and developing this paper on technology transfer metrics. In addition to Federal efforts, the IAWGTT has examined metrics collected by universities in the area of technology transfer. This broad array of input was used to balance the information needed to improve and expand the understanding of Federal technology transfer with the cost and ability to obtain information. Metrics in several key areas, such as performance of businesses and software, require additional work and will continue to be refined.

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[1] http://www.whitehouse.gov/the-press-office/2011/10/28/presidential-memorandum-accelerating-technology-transfer-and-commerciali

[2] For further information contact the Technology Partnerships Office, National Institute of Standards and Technology, U.S. Department of Commerce, www.nist.gov/tpo.

The IAWGTT is comprised by members from the following agencies:

- Department of Agriculture (USDA)
- Department of Commerce (DOC)
- Department of Defense (DOD)
- Department of Energy (DOE)
- Department of Health and Human Services (HHS)
- Department of Homeland Security (DHS)
- Department of the Interior (DOI)
- Department of Transportation (DOT)
- Department of Veterans Affairs (VA)
- Environmental Protection Agency (EPA)
- National Aeronautics and Space Administration (NASA)

The IAWGTT formed several internal workgroups chaired by IAWGTT agency members. These workgroups focused on the key issues in the PM and served to coordinate activities across agencies. Each workgroup was tasked to develop findings and recommendations in a specific area. The areas addressed include:

- Opportunities – developing and communicating new initiatives within agencies to serve as models to increase commercialization and collaboration.
- Regional partnerships – working with stakeholders; such as regional, state, and local economic development organizations, to look for areas of cooperation.
- Metrics – examining goals, objectives, and data requirements to develop a suite of metrics that better track technology transfer efforts as compared to the current metrics used in annual reporting.
- Communications – using communication tools to increase the pool of potential investment partners interested in available technologies for commercialization, as well as developing improved outreach efforts to communicate available technologies to potential partners.
- Legislative considerations - the IAWGTT examined the impact of the Smith-Leahy America Invents Act to identify how recent changes to patent law and policy impact Federal technology commercialization.
- Administrative considerations - the IAWTTG examined how administrative roadblocks slow technology transfer implementation.

This paper outlines changes to technology transfer reporting as directed by the President. These metrics will be collected beginning in FY2013, and will be reported annually by the Department of Commerce, in conjunction with the IAWGTT, in the Federal Laboratory Technology Transfer Summary Report to the President and the Congress (TT Report).[3] These expanded metrics will help inform future policy decisions with a broader, inter-agency perspective on the inventory of technology transfer products, interactions with small businesses, and collaborative efforts that have the potential to spur discovery and innovation.

[3] 15 U.S.C. § 3710(g)(2).

II. Background (Current Metrics and Agency-specific Plans)

In addition to interagency reporting requirements, the PM required agencies with Federal research laboratories to develop and enact mission-specific plans to improve the rate of technology transfer and thereby improve the economic impact of Federal research. These plans include agency-defined goals and metrics to measure progress and evaluate the success of new efforts to encourage technology transfer activities. Each of these plans was reviewed and common practices and policies examined to form the basis of an expanded set of metrics.

The currently required metrics[4] collected and reported by each agency, as required by 15 U.S.C. § 3710(f)(2), are:

> *(A) an explanation of the agency's technology transfer program for the preceding fiscal year and the agency's plans for conducting its technology transfer function, including its plans for securing intellectual property rights in laboratory innovations with commercial promise and plans for managing its intellectual property so as to advance the agency's mission and benefit the competitiveness of United States industry; and*
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> *(B) information on technology transfer activities for the preceding fiscal year, including—*
>
> > *(i) the number of patent applications filed*;*
> >
> > *(ii) the number of patents received*;*
> >
> > *(iii) the number of fully-executed licenses which received royalty income in the preceding fiscal year*, categorized by whether they are exclusive*, partially-exclusive*, or non-exclusive*, and the time elapsed from the date on which the license was requested by the licensee in writing to the date the license was executed*;*
> >
> > *(iv) the total earned royalty income including such statistical information as the total earned royalty income*, of the top 1 percent*, 5 percent*, and 20 percent* of the licenses, the range of royalty income*, and the median*, except where disclosure of such information would reveal the amount of royalty income associated with an individual license or licensee;*
> >
> > *(v) what disposition was made of the income described in clause (iv)*;*
> >
> > *(vi) the number of licenses terminated for cause*; and*
> >
> > *(vii) any other parameters or discussion that the agency deems relevant or unique to its practice of technology transfer*.*

In addition, agencies currently report information regarding the number of Cooperative Research and Development Agreements (CRADAs)* conducted by the agency pursuant to 15 U.S.C. § 3710a.

[4] For clarity, currently required metrics are identified with an asterisk, *.

These metrics are used as the basis for the interagency summary report described in 15 U.S.C. § 3710(g)(2):

> *(A) The Secretary, in consultation with the Attorney General and the Commissioner of Patents and Trademarks, shall submit each fiscal year, beginning 1 year after November 1, 2000, a summary report to the President, the United States Trade Representative, and the Congress on the use by Federal agencies and the Secretary of the technology transfer authorities specified in this chapter and in sections 207 and 209 of title 35.*
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> *(B) Content. — The report shall—*
>
> *(i) draw upon the reports prepared by the agencies under subsection (f) of this section;*
>
> *(ii) discuss technology transfer best practices and effective approaches in the licensing and transfer of technology in the context of the agencies' missions; and*
>
> *(iii) discuss the progress made toward development of additional useful measures of the outcomes of technology transfer programs of Federal agencies.*

In addition to the existing technology transfer metrics reported, the PM specified coordination of metrics activities with the National Center for Science and Engineering Statistics of the National Science Foundation (NSF). The NSF, under the guidance of the National Science Board, collects and reports on a series of indicators in its semiannual Science and Engineering Indicators (SEI) report.[5] The SEI report was reviewed to identify indicators that are already collected, or can be derived from data already collected, to maximize and leverage the benefit of that investment rather than developing costly and duplicative data sets.

III. Proposed Metrics Structure

The structure of the technology transfer measurement system should reflect the various definitions of technology transfer used across all Federal agencies and should provide information to help guide policy and operational decisions. The metrics imposed by the statute are geared toward demonstrating utilization of the important tools Congress gave Federal laboratories to accomplish technology transfer. These metrics can be more fully developed to provide context and a basis for greater interpretation and analysis of outcomes and impacts, which may be of more value than mere quantitative numbers of outputs.[6]

[5] See http://www.nsf.gov/statistics/seind12/pdf/seind12.pdf

[6] It is important to understand the size and scope of research and development investment at Federal agencies to gain context for technology transfer. The report will include NSF "Federal Funds for Research and Development" Table 10, which provides a breakout of intramural and Federally Funded Research and Development Center data by agency. See http://www.nsf.gov/statistics/nsf12308/content.cfm?pub_id=4121&id=2.

A. New Technology and Scientific Work Products

Intellectual property. The development, patenting, and licensing of new inventions remains an important part of business development and Federal technology transfer.

1) **Traditional output metrics.** Traditional output metrics for intellectual property will be retained to show the volume of actions performed. These metrics will include traditional metrics reported by the agencies currently:
   a) The number of invention disclosures prepared*;
   b) The number of patent applications filed*;
   c) The number of patents received*; and
   d) The number of licenses fully-executed*
      i. Breakout of the number of royalty-bearing licenses categorized by whether they are exclusive*, partially-exclusive*, or non-exclusive*
      ii. Breakout of invention licenses* and other IP licenses* (new and total active).
2) **License income.** In addition, the outcome impact of license income will be reported for intellectual property including:
   a) Breakout of earned royalties*;
   b) Other IP royalties*; and
   c) Anecdotal information on downstream outcomes*.
3) **New metrics.** In addition to existing metrics reported, the following new metrics will be included.
   a) **Number of licenses granted to small businesses**.[7] Although 35 U.S.C. § 209(c) has a clear preference for small businesses in exclusive licensing, no efforts have been made to analyze the component of small businesses licensing Federal inventions. Existing licensing metrics will therefore include a breakout of the number of licenses granted to small businesses.
   b) **Number of startups created.**[8] In support of the Administration's innovation agenda, several agencies are working on new initiatives that support the development of startup companies through efforts that encourage licensing of current patent portfolios, collaborating with federal researchers, and participating in facility use arrangements. In their response to the PM, many of these agencies plan to collect data on their interactions with startups and it is recommended that this be adopted as a cross-agency metric reported annually by all agencies. In addition to the number of startups created, anecdotes should be reported on selected startups as appropriate. It is also recommended that agencies work together to develop a process to track the performance of agency-assisted companies. This includes procedures to track, at the end of specified intervals (e.g., annual intervals), the number of full time and part time jobs created by the startup, and products generated. Anecdotal information about a company's growth and ability to raise additional capital and develop competitive advantages will also be provided, including funding milestones, revenue growth, and other economic impact metrics as available.

[7] For the purpose of this report, a small business is a privately-held, U.S., for-profit company that is not dominant in its field of operation and qualifies as a small business concern under Title 13, Code of Federal Regulations, part 121.
[8] For the purpose of this report, a startup company is a privately-held, U.S., for-profit company operating for less than 5 years and actively seeking financing to commercialize a federal scientific work product.

c) **Number of patents granted categorized by selected technology areas and by agency.** A major objective of the PM is to highlight technology transfer activities as drivers of successful innovations that fuel economic growth. Technology transfer metrics should therefore provide a broader perspective on the innovations involved. One method of doing so is to provide an understanding of the science and technology (S&T) areas where innovation occurs. Several agencies have developed online databases that allow patents and licenses to be searched by technology area but a uniform set of summary statistics has not been developed. However, instead of developing a new set of standard areas and requiring additional data collection on the part of agencies, data on the number of patents granted by selected technology area is available from NSF's annual SEI report[9] based on the USPTO's technical review process for patent applications.

Scientific Articles and Publications. Although intellectual property has traditionally been tracked as a measure of technology transfer, most Federal research results are transferred through publication of research articles and other publications. Patent protection for all research innovations is cost-prohibitive and may slow transfer if not used judiciously. Therefore, by monitoring the volume of scholarly publications, the amount of knowledge transfer to society can be measured, even when technologies cannot be patented. Thus, the following new metrics will be reported:

1) **U.S. Scientific and Engineering (S&E) articles by selected technology areas and Agencies.** Each year more than 35,000 archived technical publications are authored or coauthored by Federal researchers.[10] The number of S&E articles by selected technology areas that are published by researchers from each agency is another metric that will help decision-makers understand current trends in technology transfer. A uniform tracking system across all Federal agencies is not available. However, data on the number of U.S. S&E articles by technology areas are available and published in NSF's SEI report.[11] This data will be expanded to include the number of articles by technology area and by agency.
2) **Citations of U.S. S&E articles in U.S. patents, by selected S&E field and article author sector and by Agency.** In addition to IP developed in Federal laboratories, another valuable metric that suggests trends in the quality of U.S.-authored articles is the number of U.S. S&E articles cited in U.S. patents. This is also published by NSF in the annual SEI report.[12]

Future Metric - The number of software programs available for download developed by Agency and the number of software programs downloaded per fiscal year by Agency. Along the same lines as publications, the number of software programs created by Federal researchers is another important measure of technology transfer. Each year, Federal researchers develop software programs that support or are integral to ongoing research activities. Since software developed by Federal employees cannot be protected by copyright, this important area

[9] SEI report, (http://www.nsf.gov/statistics/seind12/pdf/seind12.pdf), page 6-52, Table 6-8 (to be revised by NSF to include Federal agency distributions).
[10] Estimate is based on a survey of one year's publications reported in the Web of Science Index.
[11] SEI report, page 5-47, Table 5-31.
[12] SEI report, page 5-49, Figure 5-34.

generally goes unreported. It is recommended that each Federal agency undertake a review of how software is developed and made available to the public on agency websites. It is also recommended that agencies work together to develop metrics on the annual number of software downloads grouped by an agreed upon set of S&T areas. To facilitate the assessment of the economic impact resulting from software downloads, agencies should consider developing procedures that identify users who are downloading software, consistent with applicable law and regulation.

B. Collaborations – Public/Private Partnerships for Research and Development

1) **CRADAs and Other Collaborations.** CRADAs remain an important tool for collaboration between federal laboratories and other organizations and an important way to gauge cooperation. Each agency is required to maintain a record of CRADAs (15 U.S.C. 3710a(c)(5)(D)) and these have been traditionally reported in the annual interagency summary report.
   a) **Traditional output metrics.** Traditional output metrics to be retained are:
      i. Total active CRADAs;
      ii. New CRADAs executed in the fiscal year;
      iii. Non-traditional CRADAs active in the fiscal year;
      iv. Other collaborative R&D relationships active in the fiscal year (this includes Space Act agreements and other agency-specific authorities, Material Transfer Agreements, and other important collaborations as deemed relevant by the agency); and
      v. Anecdotal information on the nature, character, and successes of collaborative relationships.
   b) **New metrics.** In addition to existing metrics reported, the following new metrics will be included to demonstrate and encourage collaborations with small businesses:
      i. **Breakout of the number of CRADAs and other collaborations involving small businesses.** Another metric of interest to decision-makers is the number of interactions that Federal researchers have with small businesses. Currently, agencies are statutorily required to give special consideration to small businesses[13], but no metrics have been available to demonstrate the results. In an effort to provide such a demonstration, each agency will provide a breakout of the annual number of new CRADAs and other collaborations involving small businesses.
      ii. **The total number of small businesses involved in CRADAs and other collaborations.** In addition to the number of CRADAs and other collaborations involving small businesses, it is useful to report the total number of unique small businesses involved with government collaborations. This metric could demonstrate the availability of government laboratories to various sectors of the business community and thereby encourage more participation.

[13] 15 U.S.C. § 3710a(c)(4).

C. Process Metrics – Measures of Efficiency

In addition to establishing performance goals to increase the number and pace of effective technology transfer, the PM also directs agencies to review and streamline related administrative processes and to develop plans that address deficiencies.

1) **The amount of time that elapses from the date on which a license was requested by a licensee in writing to the date the license was executed.** Metrics that measure process efficiencies are for the most part agency-specific since they depend on specific practices, opportunities, and the volume of transactions, all of which vary among agencies. However, each agency is required to report "the time elapsed from the date on which the license was requested by the licensee in writing to the date the license was executed." [14] This metric will therefore be included in the annual TT Report.
2) **Narrative description.** Each agency will provide an annual summary on the progress of streamlining administrative processes and highlights.

D. Impact Analysis

In addition to process outputs and anecdotal descriptions, agencies have conducted studies that examine the downstream outcomes and economic impacts of technology transfer. The following metrics will be included in the annual TT Report.

1) **The annual number of technology transfer impact studies completed by agencies.** The PM also requires agencies to track scientific and economic outcomes of technology transfer efforts. As a measure of the effort being made to assess the effectiveness and the impact on the Nation's economy of planned or future technology transfer efforts, agencies will annually report the number of technology transfer impact studies that they have completed. Each agency's annual technology transfer report will also include abstracts of selected impact studies that highlight the success of recent technology transfer activities.
2) **Literature review and summary.** In addition to individual impact analysis reports, the annual TT Report will include an updated literature review of peer reviewed publications that have assessed the economic impact of federal technology transfer efforts.
3) **Agency collaboration.** In considering future analysis, it is also recommended that agencies work together to evaluate information and data collection mechanisms needed to perform impact analysis. This potentially includes procedures to evaluate job creation, products, growth, capital investment, revenue growth, and other economic impact metrics as available. Issues of privacy, cost, and availability of data will need to be considered.

[14] 15 U.S.C. § 3710(g)(iii).