

# **Plan for Accelerating Technology Transfer at NASA**

**October 31, 2012**

*NASA's vision:*

*To reach for new heights and reveal the unknown so that what we do and learn will benefit all humankind.*

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## Executive Summary

On October 28, 2011, President Obama charged all Federal agencies with accelerating technology transfer activities, and, thus, the benefits of Federally-funded research and development investments. The National Aeronautics and Space Administration (NASA) is strategically positioned to answer that call, building upon a legacy of transferring space and aeronautics research for public benefit.

The benefits of NASA research are all around us: Knowledge provided by weather and navigational spacecraft; millions of passengers and packages traveling safely by air every day; efficiency in ground and air transportation; super computers; solar- and wind-generated energy; the cameras in many cell phones; biomedical technologies such as advanced imaging and infant formula; and the protective gear that keeps our military, firefighters, and police safe have all benefitted from the Nation's investments in aerospace technology.

To continue this legacy of public benefit, NASA has a technology transfer office at each of its ten Centers dedicated to the coordinated and strategic transfer of NASA's intellectual assets, as well as broader mechanisms (such as publication of scientific data and cooperative research projects) that also contribute significantly to the realization of public benefits from NASA's research and development work.

The NASA Inspector General recently conducted an audit of NASA's technology transfer activities and made several recommendations for ways to strengthen this key activity, with a primary focus on strengthening the core technology transfer functions across the Agency. NASA committed to implement the recommendations in order to improve the effectiveness of its important technology transfer efforts.

In line with the intent of the president's request and the recommendations of the Inspector General, NASA is exploring additional ways to increase the rate, volume, and quality of technology transfer to industry, academia, and other Government agencies—thereby increasing the economic impact and public benefit of the Federal technology investments. To this end, NASA has identified six objectives:

- Revise Agency policies to ensure alignment with NASA's commitment to technology transfer best practices.
- Identify strategies to build partnerships for technology development, transfer, and mutual benefit.
- Strategically acquire and manage intellectual property
- Increase the number of new technologies reported by NASA civil servants and contractors.
- Develop and implement innovative methods for technology licensing.
- Increase Agency use of Cooperative Research and Development Agreement (CRADA) authority<sup>1</sup> to accelerate licensing of resulting technologies.

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<sup>1</sup> *Stevenson-Wydler Technology Innovation Act of 1980*

Initiatives have been identified and are being implemented which will help the Agency make progress toward these objectives. NASA is prioritizing these initiatives and has developed a five-year plan to complete them. This five-year plan, will serve as a general guideline for the programmatic activities. Milestones for the first year have been set. NASA recognizes, though, that the plan requires flexibility and adaptability in order to be realistic and effective. The initiatives may change, but these core objectives will remain essential as the plan evolves.

Metrics related to new invention disclosures, patent applications, licenses executed, software usage agreements, and success stories have also been defined to measure progress. These represent the core business functions of the Agency technology transfer program, and while they are not inclusive of the entire scope of the Agency's activities, serve as key indicators of the overall health of the program. There is an intentional initial focus on process metrics, as process improvement was a key recommendation of the Inspector General's report. In coming years, the Agency will focus on the development of outcome-related metrics and this effort will be incorporated into the five-year plan.

In addition to the efforts of the technology transfer offices, the SBIR/STTR programs are a key component in fostering economic benefit from NASA's mission-related research and development needs and, therefore, a key component of this report. Similarly, many local, State, regional, national, and international partnerships facilitate commercialization and technology utilization across the breadth of NASA's missions, providing additional benefits to the traditional technology transfer activities and becoming vehicles for more traditional, formal technology transfer activities.

## **I. Technology Transfer at NASA**

At its core, the NASA technology transfer program is focused on creating benefits for society through transferring the Agency's inventions and innovative knowledge to outside organizations. This focus is consistent with NASA's fundamental statutory direction to preserve "the role of the United States as a leader in aeronautical and space science and technology" and encouraging "the fullest commercial use of space" by providing for the "widest practicable and appropriate dissemination of information concerning its activities and the results thereof."<sup>2</sup> NASA is at the forefront of the Nation's initiatives to develop breakthrough space capabilities and applications to support the development of a strong, innovative, and competitive commercial space sector and to support a robust U.S. space industrial base.<sup>3,4</sup> An effective way to transfer technology and support the development of U.S. commercial activity through partnership activities is a core component of NASA's program to develop innovative new space technologies.<sup>5</sup>

Transfer of NASA technology has made us healthier and more productive, introduced space-age efficiencies to our manufacturing processes, made transportation safer, and paved the

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<sup>2</sup> The National Aeronautics and Space Act, 51 USC 20101

<sup>3</sup> A Strategy for American Innovation, Securing our Economic Growth and Prosperity, February 2011.

<sup>4</sup> U.S. National Space Policy (2010)

<sup>5</sup> 2011 NASA Strategic Plan

way for cleaner and greener technologies. Meanwhile, these same technologies have launched companies and even entire industries, created jobs, and saved lives. NASA records many of these benefits in its annual *Spinoff* report, which since its first issue in 1976 has recorded over 1,750 commercialized NASA technologies.<sup>6</sup>

### **A. Investment in Technology is Key to Agency Technology Transfer Efforts**

In 2010, NASA created the Office of the Chief Technologist (OCT) to lead the Agency's space technology initiatives as NASA transitions from the Space Shuttle Program to the next-generation of space systems, in close partnership with the private sector. In addition to developing new technologies for NASA's missions of exploration and discovery, the OCT<sup>7</sup> is charged with continuing the legacy of transferring NASA technologies to the private sector for use and eventual commercialization.

While NASA is engaged in many new initiatives to constantly improve and streamline its technology transfer process, the first element in a robust technology transfer program is a rich portfolio of cutting edge technologies. NASA's increased efforts in space technology development will fuel the technology transfer pipeline and make a vital contribution to a revitalized research, technology, and innovation agenda for the Nation.

NASA's new technology investment strategy will help drive the next wave of innovation, enabling missions to be performed in new ways and creating the ability to undertake missions never before possible. These innovations will provide countless opportunities for advances in science, engineering, transportation, public safety, computer science, industrial productivity, consumer goods, and health and medicine while supporting U.S. global leadership in innovation.

Another foreseeable result of NASA's space technology development is the creation of new industries and markets. This is not without precedent. For example, the Apollo Program provided some of the first practical applications of the integrated circuit—the predecessor of the modern microchip—and demonstrated to industry the viability and reliability of the nascent technology.<sup>8</sup> And NASA's release of open source finite element analysis software in the early 1960s led to the widespread adoption of digital design software. Similarly, NASA's funding of robotics projects for Mars lander missions supported the growth of the domestic robotics industry.<sup>9</sup>

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<sup>6</sup> <http://spinoff.nasa.gov>

<sup>7</sup> The Office of the Chief Technologist oversees Agency-wide technology transfer activities. ([http://www.nasa.gov/offices/oct/partnership/tech\\_transfer.html](http://www.nasa.gov/offices/oct/partnership/tech_transfer.html))

<sup>8</sup> Digital circuits were crucial to early aerospace projects. Both the Minuteman missile and NASA Apollo program needed lightweight digital computers for their inertial guidance systems. Via the Apollo program, NASA needed a guidance computer led and motivated the integrated-circuit technology, whereas the Minuteman missile became a need to drive the technology to be mass-produced. The U.S. Government spent \$4 million on the integrated circuit market in 1962, and by 1968, U.S. Government space and defense spending still accounted for 37 percent of the \$312 million total production. The demand by the U.S. Government supported the nascent integrated circuit market until costs fell enough to allow firms to penetrate the industrial and eventually the consumer markets. The average price per integrated circuit dropped from \$50.00 in 1962 to \$2.33 in 1968. Integrated circuits began to appear in consumer products by 1970, a typical application being FM inter-carrier sound processing in television receivers.

<sup>9</sup> The founders of iRobot, makers of the popular Roomba vacuum robot, credit their start and a line of tactical robots to work done for a series of early Martian rovers and their predecessors.

This type of transfer of knowledge and technology is, itself, a core mission of NASA, perhaps most clearly embodied in the Agency's aeronautics research and development programs. NASA has played a central role in developing and advancing the state of the art in aeronautics technology since its inception as the National Advisory Committee on Aeronautics (NACA) in 1915. NACA was created to foster the evolution of the then-emerging U.S. aviation industry by providing vision, oversight, direction, and partnering on research. This open-innovation partnership continued as NACA was folded into NASA in 1958, greatly contributing to the evolution of the world's leading aviation industry which today is an irreplaceable part of the Nation's transportation system, providing high speed, second-to-none safety, and tremendous reliability. NASA-developed technologies are the DNA of almost all of the civil and military aircraft the U.S. industry has developed and marketed to date. Technological superiority has been a key enabler for the U.S. aerospace manufacturing industry to be the world leader in the aviation sector, bringing a positive trade balance of over \$40 billion per year. This American industry:

- supports high-skill, high-wage technology and manufacturing jobs in globally competitive companies and is America's largest net manufacturing export.
- provides services such as rapid mail and freight delivery and incalculable social value to the daily lives of American people, as air travel becomes safer and more affordable.
- revolutionized U.S. national security by building the best fighter, bomber, and transport aircraft in the world.

Just as NACA did before, NASA continues to enable the most competitive and advanced aeronautics industry on the planet and looking forward is helping energize and foster the growth of a competitive U.S. space industry. NASA has established the Commercial Crew and Commercial Reusable Suborbital Research (CRuSR) programs and is evaluating additional opportunities to for commercial partnerships through our Emerging Commercial Space Office (ESO). These programs are stimulating efforts within the private sector to enable a U.S. commercial space transportation capability. By providing expert advice, access to NASA facilities, and development funding, NASA fosters entrepreneurial activity for developing and demonstrating commercial space transportation capabilities, which stimulates employment growth in engineering, analysis, design, and research. The Agency will build on these valuable partnerships to support and promote commercial development as promising new markets arise.

## **B. NASA's Technology Transfer Activities**

NASA has established technology transfer tools and programs to ensure that technologies developed for NASA missions in exploration and discovery are broadly available to maximize the benefit to the Nation of its investment of taxpayer dollars.

The NASA Mission Directorates<sup>10</sup> substantively contribute to technology transfer by collaborating with internal and external scientific and technology partners on specific projects or missions. Scientist and engineer innovators play an essential role in technology transfer at NASA

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<sup>10</sup> Aeronautics Research Mission Directorate, Human Exploration Operations Mission Directorate, and the Science Mission Directorate

as the source of the intellectual property that may be released openly to the public or patented, licensed, and made available for commercialization.

Each of the ten NASA Centers includes an office dedicated exclusively to technology transfer activities. In addition to these dedicated technology transfer offices, most Centers also have a business development organization, and all have a Center Chief Technologist. Most of the Center business development offices serve as the focal point for NASA's growing engagement in local and regional economic development partnerships, while the Center Chief Technologist is responsible for coordinating much of the technology development activities.

Specific operational mechanisms for technology transfer at NASA may include:

1. Licensing and other contractual agreements for transfer of technology
2. Use of licensing intermediaries, including technology auctions.
3. Software release including open source release.
4. Scientific publication of research results and release of data.
5. Collaborative partnerships

## **1. Licensing and other contractual agreements for transfer of technology**

NASA has an Agency-wide technology transfer program, consisting of a program office at each of the Agency's 10 Centers. Each Center is responsible for maintenance of its own technology portfolio and technology transfer activities, from new technology reporting to reporting of successes. This process was a significant focus of the NASA Inspector General's report<sup>11</sup>, and an area on which NASA will focus on strengthening in coming years.

When a new invention is determined to have significant commercial value and technical viability, NASA will pursue a patent. The Center then works to market and license these technologies for commercial application. In some cases, NASA believes that a technology may have potential commercial benefit but does not pursue a patent or does not have full intellectual property rights to pursue a patent. In these instances, NASA will still market the technologies to industry, often through publication in the NASA Tech Briefs magazine, a monthly report of available NASA technologies marketed to the engineering community.

## **2. Use of Licensing Intermediaries, Including Technology Auctions**

NASA is exploring the use of licensing intermediaries to expand and accelerate patent licensing opportunities with U.S. companies.

In one such arrangement, NASA and ICAP Ocean Tomo entered into a partnership where, through no cost to the Government, the rights to license NASA patents were offered at a live intellectual property (IP) auction. This pilot program is a novel approach to licensing, collaborating with an outside firm dedicated to moving IP from the Government laboratory to the market place. NASA introduced this business practice approach to other Federal Government

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<sup>11</sup> The full text of the NASA Inspector General's report on the technology transfer program is available at: <http://oig.nasa.gov/audits/reports/FY12/IG-12-013.pdf>.

laboratories and other not-for-profit organizations (i.e. universities). The process is consistent with Government policy of releasing public notice of the opportunity to license rights to use Government intellectual property. The auction allows deliberate valuation of technology and an accelerated approach to licensing and technology transfer results.

To capitalize on this innovative approach, in November 2011, NASA released a Request for Information (RFI) for intellectual property marketing and brokerage services. Through this RFI, NASA is seeking ideas for no-cost to the Government ways of enhancing NASA intellectual property utilization and technology transfer. Ultimately, a Request for Proposals (RFP) will be issued, and contractor(s) awarded contracts under this requirement will be able to capture revenues from the innovative new services they provide; however, these revenues will not come directly from the Government.

### **3. Software Release, Including Open Source Release**

NASA has a rich software catalog with broad public access that is well received by U.S. industry. NASA has several methods for transferring both restricted software and open source general releases, including formal Software Usage Agreements.<sup>12</sup>

NASA was the first Agency to develop its own open source license, as well as the first to develop partnerships with open source hosting sites SourceForge and GitHub. NASA's recent release of its Nebula platform to the OPENSTACK initiative promises to revolutionize commercial cloud computing capabilities. For more detail on NASA's open source activities, see Appendix One.

### **4. Scientific Publication of Research Results and Release of Data**

NASA scientists present the results of their research all over the world. This research encompasses all aspects of NASA's activities, from aeronautics to space and Earth science to new materials and medical breakthroughs. To contribute to the body of scientific and technical knowledge, NASA and NASA-sponsored academic researchers often publish their findings in open, peer-reviewed literature. In addition, selected research results are made available to the public online through NASA's Scientific and Technical Information (STI) program, which contains technical reports and information dating back to the Apollo era.

While not a component of the formal technology transfer process, knowledge transfer serves as an informal means for the NASA technology transfer to occur, and it is often a complementary function.

### **5. Collaborative Partnerships**

A significant portion of NASA's technology transfer is implemented through partnerships with other Government agencies, industry, academia, and other entities through mechanisms such as the Space Act Agreement or the Cooperative Research and Development Agreement.

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<sup>12</sup> <http://ti.arc.nasa.gov/opensource/> and <http://code.nasa.gov/> both allow the general public to access NASA open source software.

NASA also actively seeks partnerships, collaboration, and cooperative activities to develop technology with dual purposes: to enable NASA to meet its mission needs and to contribute to the Nation's commercial competitiveness in global markets.

NASA also uses both reimbursable and non-reimbursable Space Act Agreements to enable access to unique NASA goods, services, facilities, or equipment.<sup>13</sup> Through these arrangements, U.S. industry, academia, and other organizations can leverage the Agency's investment in facilities, technology, and expertise.

## **II. NASA's Approach to Technology Transfer**

NASA uses both informal and formal activities as part of its technology transfer and partnership efforts. Informal activities would be those that contribute to the transfer of knowledge, cooperative research partnerships, use of facilities and equipment as test beds for non-NASA projects, and publishing of scientific data with practical application. The more formal aspects NASA's technology transfer activities would include the strategic and coordinated process of identifying innovations and designing methods of providing for their application outside of their original intended mission use.

For the past few years, NASA has focused on the informal technology transfer methods, which has allowed the Agency to excel in this area. Indeed, the informal efforts described above are very robust, with over 3,400 active collaborative relationships for research and development in FY 2011 alone, of which over 1,000 were new to that specific year.

The formal processes, however, can be strengthened. This is consistent with a recent finding by the NASA Inspector General in a review of the program. One of the chief recommendations was that NASA reassess the fiscal and personnel resources available for supporting the technology transfer and commercialization process and provide sufficient resources to meet requirements. Others included making sure NASA personnel are fully aware of their responsibility to report inventions and plan for technology transfer. NASA has the infrastructure for the technology transfer process, but needs to ensure that it is operating at its full capacity.

NASA recognizes the need for this increased emphasis on formal technology transfer approaches. While we are confident that our informal technology transfer activities will continue to flourish, we believe that formal technology transfer activities are an appropriate focus for an Agency such as NASA with a core research and development mission.

To achieve this goal, NASA is undertaking a major effort to increase the visibility and importance of this vital function within the Agency.

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<sup>13</sup> For more information on the Space Act Agreement process, see section VI.

To that end, NASA has added technology transfer to the top-level, Agency-wide performance goals reported annually to the Office of Management and Budget (OMB). For FY2012-13, one of NASA's five Agency Priority Goals (APGs) is a set of key technology transfer metrics. This performance goal emphasizes that, as an Agency, NASA is committed to the transfer of NASA technologies, and not exclusively focused on the creation of new capabilities that enable it to achieve its future space and aeronautics missions. .

### **III. Technology Transfer Goal, Objectives, and Metrics**

NASA's technology transfer goal is simple: to increase the economic impact and public benefit of its technologies by increasing the rate, volume, and quality of the technologies it transfers to industry, academia, and other Government agencies.

To reach this goal, NASA has identified six key objectives:

1. Revise Agency policies to ensure alignment with NASA's commitment to technology transfer best practices.
2. Build partnerships for technology development, transfer, and mutual benefit.
3. Strategically acquire and manage intellectual property.
4. Increase the number of new technologies reported by NASA civil servants and contractors.
5. Develop and implement innovative methods for technology licensing.
6. Increase Agency use of CRADA authority as another tool to accelerate licensing of resulting technologies.

These are broad, open-ended objectives, and as such present areas in which NASA can focus to make progress, though they may never be considered completed. Rather, NASA will, aspire to make incremental improvements toward each of these objectives with frequent self-assessments and adjustments to course.

NASA will develop an internal implementation plan including a schedule of milestones to show how the Agency plans to make progress toward these objectives. Below is a description of the objectives along with representative actions that NASA plans to make toward achieving the desired outcome.

#### **A. Objectives Further Explained**

##### **1. Revise Agency policies to ensure alignment with NASA's commitment to technology transfer best practices.**

The NASA Inspector General audited NASA's Technology Transfer Program in 2012 and made several recommendations related to NASA's technology transfer policy. In particular, they cited NASA's need to implement procedures to ensure that all relevant personnel are fully aware of their responsibilities in the policy; the need to coordinate with programs and projects on

commercialization planning; the need for periodic training across the agency on technology transfer responsibilities as described in the NASA technology transfer policy.

NASA concurs with the recommendations and is in the process of updating its policies, working across the agency to ensure that the policy can be incorporated into programs and projects and accounts for training of staff and inclusion of technology transfer considerations at the earliest stages possible—like in the procurement department, when contracting officials are negotiating intellectual property rights.

The Office of the Chief Technologist will update the Agency technology transfer and commercialization policy to reflect an emphasis in commercialization, incorporate best practices, and ensure that NASA technology transfer planning is both incorporated into Agency policy and being done by programs and projects across the Agency. This will include the following steps:

- Currently a NASA team is reviewing industry best practices, surveying NASA staff, and working with various programs within the Agency to establish a baseline common best practices document and conduct a gap analysis of NASA's program and federal regulations. These two products will be completed FY 2013 Q1.
- A NASA team, comprised of technology transfer staff, agency patent council, and representatives from the Office of the Chief Engineer (representing NASA program and project policy requirements) will review and draft new commercialization planning language to be incorporated into the updated NPR 7500 Technology Transfer Policy. This will be completed by FY 2013 Q1.
- NASA will circulate a draft a plan for agency concurrence by FY 2013 Q2.
- NASA will develop and implement procedures to ensure that project managers, technology transfer personnel, and Center Chief Technologists are accountable to the requirements detailed in the new policy. This is an ongoing process, but will begin in a coordinated fashion when the policy is being circulated for concurrence in FY 2013 Q2.
- The new policy will be implemented FY 2013 Q3.

## **2. Build partnerships for technology development, transfer, and mutual benefit.**

NASA will examine partnering activities for their ability to meet mission needs in an efficient and innovative manner as well as strengthen U.S. global competitiveness and promote the economic vitality of the nation.

NASA will conduct a study to examine different methods to develop and encourage commercial partnerships where NASA and industry share cost and development/operational risk to create new capabilities for mutual benefit.

NASA's Office of Strategy Formulation will establish a multi-Center NASA team to develop recommendations on ways to initiate and implement cost and risk-sharing partnerships to enable development of U.S. capabilities for increased commercial use of space. This team will:

- review and assess the current methods through which NASA develops and implements cost and risk-sharing partnerships and produce a report of best practices, impediments, and recommendations for improvement to incentivize and foster cost and risk-sharing partnerships within the NASA framework. (2013 Q1)
- determine which mission needs have the most potential for commercial applications and may benefit most from using cost and risk-sharing partnerships and identify candidate mission needs ready to take advantage of cost and risk-sharing partnerships that meet NASA needs and offer commercial opportunities. (2013 Q1)
- report to Agency Leadership on study findings and recommended actions for successfully initiating and implementing cost and risk-sharing partnerships along with targeted mission needs ready for commercial application that will provide the most value for the Agency. (2013 Q2)

NASA leadership will review the results of this report and make strategic decisions regarding how best to proceed.

### **3. Strategically acquire and manage intellectual property**

A key component of NASA's technology transfer strategy will be to improve the acquisition and management of Agency intellectual property assets, including identifying strategic technology areas for intellectual property investment during acquisition planning and program execution, facilitating adoption of identified technologies within the agency, and providing adequate resources for intellectual property management.

#### **A. Acquisition Planning**

As part of its overall acquisition planning process, NASA makes strategic decisions leading to best-value decisions benefitting the Agency, the industrial base and the country as a whole. As an element of this decision-making process, NASA needs to evaluate likely areas of high value technology development to ensure that program and project activities are appropriately structured to ensure that these high value technologies are reported and captured. This evaluation process should include the procurement planning process to ensure that contracts include appropriate intellectual property clauses and contractors understand their obligations to report inventions created under NASA contracts.

A team from NASA HQ comprised of OGC, OCT, Office of the Chief Engineer, and Office of Procurement staff will review existing policies and practices to determine how the Agency's technology priorities should be defined, how best to identify those programs and projects likely to result in the development of high value technology meeting those priorities and how to ensure that intellectual property rights are appropriately considered during the acquisition process for identified programs and projects. The team will produce a list of recommendations in FY 2013 Q4.

#### **B. Facilitating Adoption of Identified Intellectual Assets.**

It is important to note that the value of the New Technology Reports (NTR) database is not limited to the technology transfer process. This data represents the collective results of all technology development at NASA. In the absence of comprehensive technical exchanges between programs, the NTR database is the best way for programs and projects to identify newly developed technologies relevant to their own mission goals.

Regardless of whether NASA has sufficient intellectual property rights commercialize the technology identified in the NTR database, a common element of all these assets is that the government retains the right to use the technology for government purposes. The ability to leverage NTR data in order to eliminate unnecessary duplication of development work across programs, for example, would generate immediate benefits to the agency by lowering the cost of technical progress.

Evaluation and characterization of NTR data would also provide valuable data relating to the Agency's progress towards technology development goals – especially those technologies identified as keystones for future deep space exploration efforts.

These additional uses of NTR data would create significant direct value to NASA's programs and projects. Because NTR data would be used to benchmark programmatic progress, NASA programs and projects would be much more likely to contribute to the database to ensure their contributions were counted. Increased contributions also increase the value of the data to direct technology transfer activities.

Numerous issues arise in developing an approach for access to NTRs beyond the technology transfer community. For example, NTRs contains several categories of restricted information, including contractor proprietary data and personally identifiable information of inventors. There are difficulties in creating a robust searchable taxonomy and accessible interface. Early disclosure of NTR data could jeopardize intellectual property rights in disclosed inventions. Additionally, NASA is under resource constraints, including both staff and dollars necessary to do this work while still addressing routine process requirements.

NASA OCT is in the process of developing a new system which complements the NTR database, called TechPort. TechPort is intended to track the progress of all technology development projects across the Agency. The NASA Technology Transfer System (NTTS) and TechPort development teams have begun, in coordination with OCT management and OGC guidance, discussions of how the two systems can be linked. Providing access to appropriate NTR data elements through the TechPort system may be a solution.

NASA OCT is also exploring the option of working within the existing NTTS system to develop a new module for internal release of information to NASA civil servants.

### **C. Resource Requirements for IP management**

The NASA General Counsel has responsibility for the Agency's Intellectual Property Law Program. In this role, the General Counsel oversees the NASA patent attorneys responsible

for ensuring that NASA identifies and receives the intellectual property rights required for the Agency to achieve its mission. This requires their full participation during the full cycle of technology development activities – advising during acquisition planning, evaluating contracts and partnership agreements, negotiating intellectual property provisions, identifying and enforcing NASA’s rights in intellectual property developed by civil servants and contractors, and obtaining appropriate protections for those rights.

Over the past ten years, NASA has seen a 35 percent decline in the number of patent attorneys it employs (from 29 to 19 FTE agency-wide). Patent attorney FTE are at a historic low. This is concurrent with a decline in filed patents, increasing NTR and patent backlogs and, most importantly, the loss of an Agency-level coordinated strategy for intellectual property protection and investment. As the Agency directs significantly more resources and program dollars to research and development, the creation of the OCT itself being the primary example, a concomitant commitment of resources to evaluate and protect the results of that R&D is required if the Agency is to fully capitalize on that investment.

#### **4. Increase the number of new technologies reported by NASA civil servants and contractors.**

NASA innovators record their new inventions in a NASA-designed, publically accessible online system, e-NTR, by filing New Technology Reports (NTRs). These reports are designed to record every invention, discovery, improvement, or innovation whether or not patentable, either conceived or first actually reduced to practice in performance of NASA work. This includes, but is not limited to, new processes, machines, manufactures, and compositions of matter, and improvements to, or new applications of, existing processes, machines, manufactures, and compositions of matter. New technologies also include new computer programs, and improvements to, or new applications of, existing computer programs.

Reporting of new technologies is an important element of the technology transfer process, as it is where the products first enter the pipeline. To ensure full capture of new inventions:

- NASA will increase emphasis on the importance of new technology reporting across the Agency through top-level support and attention, including letters and messages to employees from the NASA Administrator and Center Directors, inclusion of the importance of new invention disclosure in senior management meetings and the Administrator’s All-Hands meetings, and calling attention to the importance of invention disclosures by embedding a message from the Administrator in relevant NASA internal courses and training. This is an ongoing process that will begin in 2013 Q1 with drafting of an Agency strategy plan.
- The OCT will lead and implement an awareness campaign on new technology reporting, to include development of a formal training module to be made available in NASA’s e-Learning tool. Portions of the training module will become mandatory for selected personnel. This will begin in 2013 Q1.

- New invention disclosure requirements will flow from all relevant Agency documents (NASA Policy Requirements [NPRs] and NASA Policy Directives [NPDs]) down to the project development work processes that innovators use.
  - NASA OCT and OGC will review all relevant NASA polices and conduct a gap analysis to determine where polices could and should include mention of the disclosure requirement. (Completed report 2013 Q3.)
  - NASA OCT and OGC will contact policy holders across the Agency to help them strengthen their policy commitments to Agency invention disclosure. (2013 Q4)
- NASA will assess the Agency awards programs, including the Inventions and Contributions Board awards, to determine how and if they appropriately recognize and reward employees' contributions as innovators in technology transfer. (2013 Q2)
- Centers will document and implement best practices for invention disclosure.
  - Field Center technology transfer offices will create a working group to discuss reporting procedures, interview innovators, and begin documenting best practices. (2013 Q1).
  - The NTR working group will share quarterly reports with NASA OCT management.
- NASA will release a new, user-friendly e-NTR website in FY2013 Q1.
- NASA will use new and standardized tools to provide training to project managers and innovators about the New Technology Reporting process. The training will cover the value of filing an NTR, the proper time to disclose an NTR, what happens after an NTR is submitted, and the possible outcomes of an NTR. The tools will be released in FY 2013 Q1.
- The NASA field center technology transfer offices will host at least one training session at their center per month beginning FY 2013 Q1.

## **5. Develop and implement innovative methods for technology licensing.**

The process of executing technology licenses can be time consuming and intensive. It involves the art of negotiation and partnership building and is ultimately driven by both the availability of a robust patent portfolio and the resources needed to engage with potential licensees. NASA has several plans under way to encourage licensing of its patented inventions, including development of an Agency-wide Web site for its diverse intellectual property portfolio, cross-Center industry outreach events, and internal education.

The transfer of technology occurs through the interaction of technical experts – either through interpersonal interaction or through the transmission of codified knowledge in documents. Licenses in this context are not a method of technology transfer *per se* but rather are a legal mechanism by which firms can legally use transferred technology in the commercial marketplace. As such, to maximize the public economic benefit, NASA will evaluate the development of an automated licensing process for patents with the belief that this will stimulate the commercialization of NASA technology to the maximum extent. Options for implementation may include a credit-card fixed-fee or a no-cost, nonexclusive licensing agreement.

- NASA will release an RFP related to intellectual property brokering in FY 2013 Q2.

- NASA will award contracts for intellectual property brokerage services in FY 2013 Q3.
- NASA will develop and launch an automated licensing portal for simplified access to select portions of its intellectual property portfolio. This will be incorporated into NASA's technology transfer portal and launch FY 2013 Q2.
- NASA will examine ways to incorporate licensing into Announcement of Opportunities, Broad Agency Announcements, and other calls by offering, when appropriate, a research license for use of NASA intellectual property. This gives the contractor/partner access to royalty-free IP while engaging in technology development to fulfill an identified NASA technology need and positions NASA-enabled technology for new commercial markets. A team will be assembled to explore opportunities in this area and will report out to management in FY 2013 Q4.

Like the capture of new technologies, this objective represents an ongoing process. Early milestones will include the release of the RFP, launch of the integrated marketing Web site, and release of the automated licensing portal. NASA will monitor the effectiveness of its new activates and continue to search for new and innovative methods to transfer its technologies. Ultimately, this objective will be measured by an increase in patented technologies and technology licenses executed.

#### **6. Increase Agency use of CRADA authority as another tool to accelerate licensing of resulting technologies.**

CRADAs have been the typical type of agreement for joint research and technology transfer partnerships across the Federal Government. NASA has entered into very few CRADAs because most Partners who sought CRADAs were comfortable proceeding with a Space Act Agreement (SAA) which could be signed locally. Those CRADAs entered into by NASA were signed by the Administrator.

Currently the authority to enter into a CRADA with NASA has never been delegated from the Administrator (largely because SAAs were a good substitute). This self-imposed stove-piping of the process restricts broader use of this potentially valuable technology transfer tool. IN light of the instructions in the Presidents Memorandum instructing agencies to pursue streamlining of processes related to technology transfer, NASA will explore possibilities for delegating this authority, perhaps to the Center Directors.

By increasing the use of CRADAs across NASA, the Agency should see an increase in technology licensing, consistent with NASA's technology transfer objectives because a CRADA provides some advantages over the SAA, especially related to technology transfer and commercialization. Also, it is a widely used instrument across the Federal Government so it is largely familiar to potential partners.

NASA could also save money by allowing commercial development of capabilities that may be of use to the Agency in the future. During the CRADA, NASA may stay involved in the development of the technology because CRADAs can be used for joint research.

CRADAs are expected to lead to additional partnering opportunities, especially where NASA wants to spin out a technology for commercial use. The CRADA provides a better approach because unlike with a SAA, NASA must grant the partner the option for an exclusive license for a pre-negotiated field of use for any invention under the CRADA. This includes inventions by NASA civil servants and contractors. No first option is permitted with a SAA. For SAAs, any such exclusive licenses are required to be advertised to the public before issuance and competing interests must be considered in the license decision. Securing this first option in inventions may be critical for fundraising by the Partner required to commercialize the NASA technology because any uncertainty as to the ownership of the associated intellectual property may affect the success of the commercialization effort.

In response to requests from the field centers to delegate CRADA authority under the Federal Technology Transfer Act of 1986 (51 U.S.C. § 3710) to the Center Directors (to negotiate, execute and amend CRADAs), the NASA Office of General Counsel put together a team at NASA Headquarters to evaluate this proposal. The team included members from across all relevant missions and program offices. It researched related laws and policies, as well as the policies, handbooks, templates and model CRADAs in use across the Federal Government and ultimately proposed the delegation from the Administrator and drafted a delegation policy and a NASA guidance handbook.

Several steps still remain before any new policy is implemented:

- The NASA Mission Support Council (MSC) will review the issue, consult all relevant stakeholders, and determine how best to exercise NASA's CRADA authority. (FY 2012 Q4)
- The decision of the MSC will be forwarded to the NASA Executive Council (EC) for a final determination. (FY 2013 Q1)
- NASA OGC will incorporate any new decisions into the draft CRADA policy, develop a form CRADA document for use in implementing technology development activities, and then begin circulation through NASA's policy concurrence system. (FY 2013 Q1)
- While the policy is circulating for concurrence, NASA will begin development and launch of a centralized system for tracking and approval of CRADAs, similar to NASA's Space Act Agreement Maker (SAAM) software tool. (FY 2013 Q1)
- NASA should release a new CRADA policy toward the end of FY 2013.

OCT will track the number of CRADAs signed by fiscal year; as well as track the number of technologies licensed as a result of efforts under CRADAs. Also, NASA will require commercialization metrics from each of its CRADA Partners to track whether the licenses lead to commercialized products and services.

## **B. Metrics**

NASA will use the following five metrics<sup>14</sup> to manage its overall technology transfer improvement efforts and monitor progress: **New Invention Disclosures, New Patent Applications Filed, Technology Licenses Executed, Software Usage Agreements, and Success Stories.** The metrics are defined in the table below and are consistent with the core information typically used to assess the progress and health of a technology transfer program:

**Monitoring Technology Transfer Progress**

<b>Metric</b>	<b>Definition</b>	<b>Measurement</b>
New Invention Disclosure	The New Technology Report (NTR) is filed by NASA employees and NASA-funded parties when a new invention, discovery, improvement, or innovation--whether patentable or not--is conceived or introduced.	Categorized by filing date: NTRs are counted once they are assigned a case number by the NASA Technology Transfer System.
New Patent Applications Filed	Requests for protection of new, NASA-owned (wholly or jointly) inventions and IP for which there is a NASA inventor included. (Non-provisional, divisional, continuation, and continuation in-part.) This will also include patents filed by Caltech under contract through the Jet Propulsion Laboratory.	Categorized by application filing date: Patents filed by NASA. Includes joint inventions with Small Business, Large entities, Universities and Non-Profits that are filed by NASA.
Technology Licenses Executed	Signed agreements with external parties for use of NASA inventions (i.e. formal transfer of technology).	New technology licenses, counted by date effective. Includes sublicenses, U.S. and international partnerships, and both royalty-bearing and non-royalty bearing.
Software Agreements	Public release of NASA software.	1. Software Usage Agreements: All releases except for Beta Agreements. 2. Software copyright licenses.

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<sup>14</sup> Although these metrics do not lend themselves to tracking the outcomes of fundamental research and development activities across the Agency, such investments often provide the foundation for specific products and technologies that end up being transferred and thus measured by these metrics.

Success Stories	NASA's annual report of technology transfer successes highlights significant benefits from NASA technology. Each story represents one documented technology transfer success.	Fully vetted (company and Center), but not yet published; published stories.
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While additional metrics are being considered for future management and data analysis, these are the core business functions of formal technology transfer, and NASA will focus on monitoring and improving these areas, as improving the process elements was the recommendation of the Inspector General. As the process continues to improve, NASA will also begin to consider new outcome metrics.

NASA has also begun to develop a method to conduct a retrospective analysis to track outcomes, such as number of lives saved and jobs created as a result of transfer of its technologies into the social fabric of the Nation. While this effort is in its infancy, it shows great promise for measuring the effect of NASA technology transferred and incorporated into society. (See Appendix Two for more detail.)

While the number of success stories NASA publishes each year is fixed, as the Agency publishes an average of 40 to 50 of the best examples of its technology transfer each year, the Agency will monitor the distribution of transfer mechanisms in the stories published with an expected increase in patent invention license successes.

Sustained commitments to technology transfer at NASA will enable consistent progress in both metrics and outcomes, and with the renewed emphasis on both technology development and transfer, NASA anticipates progress in the numbers of inventions it captures per year, the number of filed patent applications, the number of executed technology licenses, and an increase in the number of software usage agreements it records per year.

#### **IV. Technology Transfer Five-Year Plan and Implementation**

In addition to the actions and initiatives already described above, NASA will continue to develop and refine its implementation plan for years two through five. The plan assumes a static budget and continued level of personnel and scope.

The primary goal over the next five years will be to shore up the fundamental technology transfer program, establishing baselines, monitoring progress, and improving the processes. Key elements of that include ongoing assessment and improvements to internal processes, as well as feedback from partners to best adapt to the external environment.

##### ***Year One***

NASA will work toward accomplishing the listed actions and initiatives during the first year. In addition, NASA will work toward meeting the objectives established in its Agency Performance Goal (APG) to improve core technology transfer metrics. During the course of the

APG reporting process, Agency leadership will have the opportunity to review the quarterly progress of the program and make specific recommendations as to how the Agency can better meet its goals. Key initiatives in the first year include:

NASA will implement a new Agency technology transfer policy.

NASA will conduct a baseline review of its programmatic funding, to ensure that the program is within scope and core functions are adequately supported.

NASA will also increase its in-reach and education activities, moving out on the initiatives highlighted above to improve the visibility and understanding of the technology transfer function within the Agency and increase external awareness. NASA will emphasize, not only the importance of tech transfer to the Nation, but also will increase awareness of the entire process, the value of technology transfer, and the required and necessary role each person plays in the process, whether it is through filing new invention reports or participating in the delivery of the spinoff/public benefits message.

During this first year, NASA will also explore options for increasing its patent support. Potential solutions include staffing solutions, training, and leveraging outside expertise. All of these potential solutions require resources, and this year will be spent researching this problem and finding a solution.

During the first year, NASA will review the results of the no-cost IP brokerage RFI and issue an RFP.

NASA will examine the methods in which it engages in commercial partnerships and consider new initiatives for increasing the number and quality of these partnerships.

NASA will also work to increase the number of CRADA agreement the agency enters into.

### ***Year Two***

During the second year, NASA will continue to closely monitor its technology transfer metrics through performance toward the APG. These metrics will also be reported on NASA's technology transfer Web site.

The new NASA technology transfer policy will be implemented, as will the proposed solution to the problem of the declining patent portfolio. During year two, NASA will also award the no-cost contracts for IP brokerage.

During this year, NASA will broaden its outreach, hosting outreach events with economic development organizations, industry, and academia. Through these events, NASA will better learn the needs of its external partners and adapt according to the new perspectives.

NASA will begin performance assessment of the objective outlined in this plan, first by designing performance measures, and then by monitoring and making improvements and adjustments as necessary.

The OCT will review recent Agency-wide process analysis initiatives results to implement resources and skills required to achieve technology transfer results throughout the critical path to commercialization.

### ***Year Three***

The third year is a measurement and management phase. Adjustments will need to be made to programs, fine tuning them to run optimally.

At this point, it is also expected that through the attention and focus provided the program by its inclusion in the Agency's APG metrics, the technology transfer program will have strengthened the core, fundamental technology transfer business functions and will begin to expand and explore new and innovative paths to commercialization.

### ***Years Four and Five***

In the fourth year, NASA plans to request a formal program evaluation by an independent third party organization.

The Agency will also continue its trend of performance monitoring and process improvement into the fifth year.

## **V. SBIR/STTR Program Activities**

NASA's SBIR and STTR programs continue to support early-stage research and development by small businesses through competitively awarded contracts. These programs continue to produce innovations for both Government and commercial applications.

SBIR and STTR programs are implemented under the Space Technology theme, with the dual objectives of providing the high technology small business sector with an opportunity to develop technology for NASA and commercializing that technology to spur economic growth. These technologies have extended their reach beyond NASA's missions, contributing to commercial successes that ultimately result in marketable products and societal benefits.

Research and technologies funded by SBIR and STTR programs have made important contributions to numerous NASA programs and projects, and the Agency is actively working to increase the number of NASA-funded SBIR and STTR technologies used in NASA's missions and projects. Some of NASA's high-profile programs directly benefiting from SBIR technologies include the International Space Station, Mars Exploration Rovers, and the Phoenix lander.

Each year, 28 to 30 percent of applicants represent firms new to NASA's SBIR and STTR program.

In order to support greater innovation through the SBIR/STTR Programs—and support it more efficiently—the Agency will continue its efforts to:

- streamline the process.
- publish performance timelines.
- explore award flexibility.
- use external reviewers.
- seek coinvestment for SBIR/STTR companies.

### **Streamline the Process**

Congressional mandate and the Small Business Administration's policy require all participating agencies in the SBIR/STTR programs to have a "timely receipt and review of proposals." Accordingly, NASA has compressed its schedule to the greatest extent possible by improving the efficiency of its proposal in-processing, including proposal distribution to reviewers, proposal evaluation submissions by reviewers, and proposal selections for award by making the program totally paperless through the Electronic Handbook processing system. Full contract management from proposal submission to the contract closeout is all managed electronically, thereby reducing the processing time.

Furthermore, in order to minimize funding gaps, the Phase II proposal submission period is available approximately six weeks prior to the completion date of the Phase I contract, and the receipt of all Phase II proposals are due on the last day of performance under the Phase I contract.

### **Publish Performance Timelines**

NASA has been tracking SBIR and STTR timelines for managing the conduct of these programs and strives to reduce the times from proposal submission to award. Selections for negotiation of award are typically announced about 2½ months after the proposal due date, and contract negotiations are completed about 60 days after the selection announcement. The schedule for both programs is in the annual SBIR/STTR solicitation and is published on the SBIR/STTR homepage ([www.sbir.nasa.gov](http://www.sbir.nasa.gov)), which shows the solicitation period, selection announcement, contract negotiation period, and anticipated period of performance for each phase. If there are any changes to the schedule, it is posted immediately to the SBIR/STTR homepage.

### **Explore Award Flexibility**

In the 2011 SBIR solicitation, and in accordance with the White House SBIR 2.0 initiative, NASA devoted a subtopic to licensing NASA's internally developed technologies that would benefit either NASA projects or commercialization (technology transfer) with further research and development. Subtopics with the "TAV," or technology available, designation

address the objective of increasing the commercial application or infusion of innovations derived from NASA intellectual property. While NASA scientists and engineers conduct breakthrough research that leads to innovations, the range of NASA's effort does not extend to product development in any of its intramural research areas. Additional work is necessary to exploit these NASA technologies for either infusion or commercial viability and likely requires innovation on behalf of the private sector. However, NASA provides these technologies "as is" and makes no representation or guarantee that additional effort will result in infusion or commercial viability. As with all SBIR awards, these TAV subtopics are intended to cultivate innovation in the private sector and to identify a commercially promising NASA technology and the technological gaps that must be filled in order to transition it to the marketplace. Information on available NASA intellectual property was provided in the subtopic description, when applicable.

### **Use External Reviewers**

In addition to Government personnel, NASA, at its discretion, uses qualified individuals from outside the Government for review of the SBIR/STTR proposal's commercial potential. This is called the Commercial Peer Review Process.

The Commercial Peer Review Process is designed to enhance the evaluation process for NASA and the small businesses by including the insights of personnel with significant private sector commercialization experience. For every Phase II cycle, the Mission Directorate Liaison Center Program Managers (MDLCPM) select peer review panel members. In selecting evaluators, the MDLCPM considers both the evaluators' qualifications and their objectivity to evaluate specific technical proposals.

Each proposal must have one commercial review with a secondary evaluator validating the findings. The review of commercial potential at the Phase II level is rigorous. It is expected that the committee will meet to discuss the proposals and produce a consolidated final write-up with a commercial merit rating for each proposal. The peer review committee's evaluation is recorded for every proposal.

### **Seek Co-Investment for SBIR/STTR Companies**

NASA has several programs and Web sites aimed at assisting with commercialization and attracting private equity and industry partners for SBIR/STTR firms. These range from program enhancements to special projects that target small- and large-businesses partnerships.

## **VI. Facilitating Commercialization and Technology Transfer Through Partnerships**

A significant portion of NASA's mission to facilitate the transfer of NASA technology is implemented through partnerships with other Government agencies, industry, academia, and other entities, with the overarching goal of generating U.S. commercial activity and contributing to the growth of the American globally-interconnected economy. Recognizing a broader application of fundamental technology, NASA makes a determined effort to transfer

technologies outside of NASA through the development of technology partnerships. NASA actively seeks partnerships, collaboration, and cooperative activities to develop technology with dual purposes: to enable NASA to meet its mission needs and to contribute to the Nation's commercial competitiveness in global markets.

The NASA partnership portfolio is both broad and deep. NASA partners with external entities for a wide variety of reasons, including to:

- develop and mature technology needed by NASA's missions at a lower cost.
- enhance NASA capabilities to perform its mission.
- engage with the public and our other stakeholders.
- leverage and or supplement other NASA core missions, such as education and outreach.

Pursuing these partnerships bring direct value to NASA's current and future missions, advances the interests of the partners, transfers technology to the private sector, and encourages additional commercial space development.

NASA engages in cooperative agreements with other entities and Federal agencies to encourage and promote development of crosscutting technologies of mutual benefit and works collectively through these partnerships to avoid duplication of effort and resources on space technology activities. The Agency utilizes inter-agency working groups, alliances, and councils to identify and characterize interdependent activities, encourage interdependent programs and networking, exchange technical and programmatic information, identify critical technology "hot topics," and promote technology transfer and infusion. Where appropriate, goals have been and will continue to be developed to identify top joint program candidates, generate joint plans, and budget proposals and synergistic development programs. Through cooperation and collaboration, NASA and its partners will maximize investments and resources, in the best interest of the public, while pursuing common commercial space industry research goals.

Beyond partnership strategies, NASA seeks to transfer technology directly to other Government agencies, the National aerospace industry, and the broader U.S. commercial sector. NASA-spurred advances in energy, communication, health, materials science, and other fields generate spinoff applications that benefit the Nation. Each of the 10 NASA Centers has a core team charged with technology transfer, licensing, and new partnership development; the teams work closely with scientists and engineers to match NASA technologies with the needs of organizations external to NASA. NASA also actively coordinates with State and local Governments and regional economic development organizations to assess the market and develop strategies that will meet the emerging needs of NASA and its partners. NASA will continue to identify non-traditional strategies and approaches to engage external partners, such as the use of auctions that highlight NASA patents available for licensing.

In addition, NASA transfers the results of aeronautics-related fundamental and systems-level research to the community through dissemination of research results, concepts, and design methods through the technical research community. In some instances, companies may build on specific technologies and capabilities developed through NASA research, investing their own

research and development dollars to take those last steps to become a commercialized product. In other instances, NASA provides design methods and understanding used by companies in developing new products. By maturing new technologies and validating design methods, NASA research in aeronautics concepts and technologies can buy down the risk of incorporating new technologies and systems in aircraft, shortening the path through safety certification in the Federal Aviation Administration (FAA) and speeding the transition of new technologies into the fleet.

U.S. companies are well positioned to build on discoveries and knowledge resulting from NASA research, turning them into commercial products, benefiting the quality of life for our citizens, providing new high-quality engineering and manufacturing job opportunities, and enabling the United States to remain competitive in the global economy. Concept simulations and field trials in real-flight environments of NASA-developed technologies have demonstrated the potential annual savings of hundreds of millions of dollars to airspace users through reduction in flight delays and fuel usage.

## **Space Act Agreements**

The National Aeronautics and Space Act of 1958 authorizes NASA:

to enter into and perform such contracts, leases, cooperative agreements, or other transactions as may be necessary in the conduct of its work and on such terms as it may deem appropriate, with any Agency or instrumentality of the United States, or with any state, territory, or possession, or with any political subdivision thereof, or with any person, firm, association, corporation, or educational institution.

In addition, the Space Act permits NASA to engage in cooperative programs pursuant to the Agency's missions. Under its Space Act authority, NASA has entered into a great number of agreements with diverse groups of people and organizations, both in the private and public sector, in order to meet wide-ranging NASA mission and program requirements and objectives.

NASA engages in about 500 new Space Act Agreements each year, many of which involve the lease of unique NASA facilities and joint basic research with the U.S. private sector, academia, and other Federal agencies, as well as with foreign Governments and other foreign entities. About half of NASA's partnership agreements involve the U.S. private sector. Agency partnership collaborations generally involve persons and entities primarily from sectors beyond NASA's traditional aerospace community. These initiatives constitute a grassroots open invitation to individuals and entities of all types to contribute their creative ideas for technologies that can be used in NASA's missions.

NASA implements its partnership development activities through offices at each of its 10 Centers. Since NASA's Centers each specialize in a set of particular technology areas (with some overlap), collaborative opportunities involving a particular technology area are best pursued at those Centers with the relevant expertise.

NASA has developed an internal Web-based tool to streamline the process of partnership development and assure a consistent approach to Agreement content across the Agency. Called the Space Act Agreement Maker (SAAM), the tool uses queries and interrogation to bring up appropriate clauses for a particular agreement. NASA has found that using SAAM to create Space Act Agreements yields significant benefits in the quality and consistency of partnership engagements across the Agency.

While deployment of a common tool has simplified the process of creating Space Act Agreements, there is still more streamlining to do across the Agency. NASA will continue to conduct routine and regular process improvement exercises through its Space Act Agreement Community of Practice, with the goal of reducing the time it takes to create and deploy an approved agreement.

## **VII. Conclusion**

Since its establishment, NASA has spurred profound changes in our knowledge, culture, and expectations. Congress enacted the National Aeronautics and Space Act of 1958 “to provide for research into problems of flight within and outside Earth’s atmosphere” and to ensure that the United States conducts activities in space devoted to peaceful purposes for the benefit of humanity. NASA has since been instrumental in numerous scientific discoveries and technological advances that have advanced humankind, while inspiring the Nation and the world to imagine that much more is possible. NASA’s mission is to drive advances in science, technology, and exploration to enhance knowledge, education, innovation, economic vitality, and stewardship of Earth. NASA has taken humans to the Moon, visited other planets in the solar system, gazed into the vast cosmos, and looked back to the earliest moments of the universe’s beginnings. NASA has powered aircraft to 10 times the speed of sound, built the ISS, and launched satellites that study our ever-changing Earth.

Our Nation’s current economic competitiveness is due in large part to decades of investment in technology and innovation. Since NASA’s inception, the Agency has used innovative technology development programs to generate new science, exploration, and aeronautics capabilities. NASA’s innovations have enabled our missions, contributed to other Government agencies’ needs, cultivated commercial aerospace enterprises, and fostered a technology-based U.S. economy. This is a tradition to which NASA is firmly committed.

NASA will continue technology development programs that advance its missions’ capabilities and effectiveness, and it will enable future scientific discovery and improved capabilities of other Government agencies and the aerospace industry. Aggressive technology investments for exploration and discovery missions will create a vibrant commercial space sector through the establishment of new markets in future technologies. Investments in aeronautics research and development to address critical national challenges will make air travel safer, more flexible, and environmentally friendly and help commercial aviation to serve as an engine of the economy.

NASA will make it a top priority to transfer Agency-developed technologies, processes, discoveries, and knowledge to the commercial sector through various means, including licenses, partnerships, broad dissemination of results, and cooperative activities. These transferred technologies will be used to create products, services, cascading innovations, and other discoveries to fuel the Nation's economic engine and improve our quality of life.

## Appendix One: Open Source Software Release

One initiative within NASA for increasing the public accessibility of its software is open public release through sites such as [code.nasa.gov](http://code.nasa.gov). Through this site, and several other open source repositories, NASA is expanding transparency, participation, and collaboration, creating a new level of openness and accountability. The Agency is focusing on embedding open Government into three integrated aspects of its operations—policy, technology, and culture. Whether NASA is using social networks to allow students to interact directly with astronauts, or creating a Cloud Computing Platform to give unprecedented access to scientific data, it has embraced the Open Government Directive through this site.

A collaborative platform, openNASA allows the open Government community to share success stories and projects they are working on. NASA views it as a way to tell the narrative of interesting things at NASA that enable the public to better understand, participate, and collaborate with the Agency. The platform is open to contribution by anyone with a [NASA.gov](mailto:nasa.gov) email address, including civil servants, contractors, interns, and other affiliates. Since its launch in July 2011, it has had 137,000 visitors and has been used as a platform to announce new initiatives, including [data.nasa.gov](http://data.nasa.gov), [code.nasa.gov](http://code.nasa.gov), the NASA Google+ page, and the NEEMO Zooniverse project<sup>15</sup>.

The most recent addition to this site is [code.nasa.gov](http://code.nasa.gov), through which NASA will continue, unify, and expand its open source activities. The site will serve to surface existing projects, provide a forum for discussing projects and processes, and guide internal and external groups in open development, release, and contribution. There are currently 23 open source projects cataloged on the site, with five of them being available as repositories on the public GitHub page (<http://github.com/nasa>). NASA plans on expanding this initiative to include more projects and is actively working with a number of developers from across the Agency to make their code available on the site.

NASA has had phenomenal response to this effort, with dozens of news articles, top-rated stories on Reddit and Slashdot, tens of thousands of hits to the site, and great feedback on Twitter, Facebook, and Google+. The current site, however, is only a beginning to these efforts. NASA is currently working to build a platform to host discussions related to open source with the aim of creating a community of both internal and external developers and policymakers that can help shape the future of NASA's open source activities.

Another successful example of NASA's open source activities is the ARMD DASHlink virtual laboratory for scientists and engineers to disseminate results and collaborate on research problems in health management technologies for aeronautics systems.<sup>16</sup> Web-2.0-style content generation and social-software technologies, along with a community-moderated posting policy, make it easier and faster for NASA aeronautics researchers and research partners to share data and knowledge with each other and the general public. Participants can upload technical projects

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<sup>15</sup> <http://neemo.zooniverse.org/>

<sup>16</sup> <http://www.nasa.gov/open/plan/aeronautics.html>

to disseminate, collaborate, and innovate more easily both within NASA and beyond. DASHlink connects researchers working in similar areas, permitting the upload of open-source algorithms and downloading of public data.

## Appendix Two: Quantification of Spinoff Benefits

While traditional technology transfer output metrics are of value in assessing the progress of a technology from the laboratory to the market, providing insight into the health of a technology transfer process, they do not provide the full picture of the value of technology transfer. To address this, NASA has developed a new, systematic method for routinely capturing quantifiable benefits from its spinoff successes.

In 2011, NASA initiated a pilot survey of approximately 200 companies that had commercialized technologies and had recently been featured in the Agency's annual technology transfer report, *Spinoff*. As a result of this effort, NASA has developed a suite of standard categories that can be used to quantify benefits<sup>17</sup>. Through the survey, NASA was able to collect additional quantitative data retrospectively and has begun now to use these new categories to collect and standardize reporting data each year, as the year's *Spinoff* stories are collected and developed. While not comprehensive of all benefits generated by the Nation's investment in space research and technology, this new analytic framework provides a sustainable and consistent source of data from the top technology transfer successes published in *Spinoff* each year, with the data coming directly from the firms that are commercializing NASA technologies. The new quantification categories include jobs created, revenue generated, productivity and efficiency improvements, lives saved/not lost, and lives improved.

As NASA continues to gather the stories for the annual *Spinoff* report, the writers will now routinely survey the companies being interviewed and collect quantifiable data within the standard categories. This will provide the Agency with an ongoing record of measurable successes in technology transfer. As years pass and the volume of more accurate data continues to increase, it is possible that broader analyses could be conducted from the aggregate of this information related to the number of jobs and revenue, for example, that secondary uses of NASA technology have provided.

The information gathered in the future will be written into the *Spinoff* articles and will supplement the existing qualitative data, not replace it. While this new data will be a valuable supplement to the traditional anecdotal reporting of spinoff successes, the stories will continue to tell the grainy, interesting, and unexpected personal stories of NASA's contributions to the Nation's well-being.

Future data gathering could be aided by the inclusion of a requirement in patent licensing documentation or SBIR contracts that requires partner companies to report back on the successes of their activities.

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<sup>17</sup> NASA has published two papers on this work: "[A Sustainable Method for Quantifying the Benefits of NASA Technology Transfer](#)" and "[A Structure for Capturing Quantitative Benefits From the Transfer of Space and Aeronautics Technology](#)."

