SMALL BUSINESS ADMINISTRATION

Small Business Innovation Research
Small Business Technology Transfer
Innovation in Manufacturing Report
Annual Report

Fiscal Year 2014

This report will summarize the Agencies' activities in terms of implementing the February 26, 2004, Executive Order signed by President George W. Bush requiring Small Business Innovation Research (SBIR) agencies, to the extent permitted by law and in a manner consistent with the mission of the department or agency, to give high priority within the SBIR programs to manufacturing-related research and development (R&D). "Manufacturing-related is defined as "related to manufacturing processes, equipment and systems; or manufacturing workforce skills and protection."

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Department of Agriculture (USDA)

Examples of USDA manufacturing-related SBIR/STTR projects

Several of our topic areas give priority and visibility to manufacturing and in that way applicants are encouraged to submit proposals that focuses on this issue. Below are examples of FY14 projects that were funded and contained a manufacturing component.

1. Development of Reliable, Economical Briquetting of Torrefied Forest Residue Without Binders to Produce Sturdy, Water Resistant Briquettes (2014-00011, HM3 Energy, Inc.; Phase I)
2. Novel Spacer Textiles for Insect Control (2014-00329, Luna, Inc.; Phase I)
3. Vegetable Oil Processing with Non-Porous Polymer Membranes (2014-00579, Compact Membrane Systems, Inc.; Phase I)
4. Forest-to-Factory: Round Timber Supply Chain Tools and Techniques (2014-04557, Whole Trees, LLC.; Phase II)
5. Novel and improved extraction techniques and supply chain development for indigo crop and black walnut hull (2014-02766, Stony Creek Colors, Inc; Phase II)
6. Product recovery from novel fermentation processes for bio-manufacturing high-value chemicals from renewable feedstocks (2014-02634, Lygos Inc.; Phase II)

Procedures and mechanisms USDA has used to date to give priority to manufacturing-related projects

The USDA SBIR program issues a request for proposals or program solicitation each fiscal year that lists 11 broad topic areas that encompass the full range of research and development priorities for USDA. From the beginning of the USDA SBIR program, topic areas have been discipline-specific, not technology-specific. The 11 topic areas contained in the program solicitation are Forests and Related Resources; Plant Production and Protection; Animal Production and Protection; Air, Water, and Soils; Food Science and Nutrition; Rural and Community Development; Aquaculture; Industrial Applications; Marketing and Trade; Wildlife; and Animal Waste Management. Technology-specific topics such as nanotechnology, biotechnology, information technology, or manufacturing technology are not listed separately but may be submitted to one of the eleven topic areas. Numerous projects in these technology areas have been supported and will continue to be supported.

For the past two years the USDA SBIR program solicitation has included the statement “Proposals are encouraged that focus on problems dealing with bioterrorism and homeland security, especially as these issues relate to rural communities.” There has been a significant increase in proposals dealing with both issues in direct response to including this statement in the program solicitation. In the FY05 Program Solicitation that was released on June 7, 2004, this statement was expanded to include agriculturally-related manufacturing technology as an area in which proposals are encouraged. It is the expectation of the USDA SBIR program that the inclusion of this statement will result in a significant increase in proposals that deal with manufacturing issues that are relevant to the USDA mission.

The review panels will be instructed to use the existence of manufacturing-related proposals as a tie breaker during the evaluation process. When two proposals are considered approximately equal in merit and one proposal has a focus on manufacturing, that proposal will be given priority in both the Phase I and Phase II selection process.

Specific actions USDA has taken toward promoting and supporting manufacturing-related research projects

Later in FY15, the USDA SBIR website will establish a link (http://www.commerce.gov/DOC_MFG_Report_Complete.pdf) to the document "Manufacturing in America" that was issued by the Department of Commerce. This document provides a comprehensive strategy to address the challenge to U.S. manufacturers. The USDA SBIR program will work closely with the other Federal SBIR programs and SBA to ensure that upcoming National SBIR Conferences highlight the importance of manufacturing to the U.S. economy. In addition, opportunities will be emphasized to submit appropriate R&D proposals to the different SBIR programs that deal with manufacturing issues of significance to the mission of the Federal agency. A similar effort will be made to highlight this focus on manufacturing R&D in talks that are presented at the various state SBIR meetings.

Department of Commerce (DOC)

Examples of DOC manufacturing-related SBIR/STTR projects

The DOC awarded three (3) Phase I and 3 Phase II manufacturing-related awards in FY14.

Procedures and mechanisms DOC has used to date to give priority to manufacturing-related projects.

The NIST SBIR program supports manufacturing-related research project through its solicitation and awards. In FY14, NIST's annual SBIR solicitation contained 7 manufacturing-related research topics. The solicitation included a notice describing Executive Order (EO) 13329 and encouraged innovation in manufacturing by giving high priority, where feasible, to projects beneficial to the manufacturing sector. A manufacturing-related R&D emphasis in SBIR web page is available. The NIST SBIR solicitation asks proposers authorization to provide their contract information and project title to NIST Manufacturing Extension Partnership (MEP). The NIST SBIR program supports manufacturing-related research project through its solicitation and awards. In FY14, NIST's annual SBIR solicitation contained 7 manufacturing-related research topics. Three (3) Phase I and 3 Phase II manufacturing-related awards were made. The solicitation included a notice describing EO 13329 and encouraged innovation in manufacturing by giving high priority, where feasible, to projects beneficial to the manufacturing sector. A manufacturing-related R&D Emphasis in SBIR web page is available. The NIST SBIR solicitation asks proposers authorization to provide their contract information and project title to NIST Manufacturing Extension Partnership (MEP).

The NOAA SBIR Program solicits manufacturing-related projects through many of the subtopics described in this Solicitation. Further, NOAA encourages innovation in manufacturing by giving high priority, where feasible, to projects that can help the manufacturing sector through technological innovation in a manner consistent with NOAA's mission.

In the event of a "tie" between proposals, manufacturing-related projects as well as those regarding energy efficiency and renewable energy systems will receive priority in the award selection process.

Specific actions DOC has taken toward promoting and supporting manufacturing-related research projects.

NIST identified manufacturing as one of its priorities in the "NIST 3-Year Programmatic Plan FY 2014-2014." NIST's laboratories develop and supply test methods, measurement tools and knowledge, and scientific data that are embedded in the processes, products, and services of the U.S. manufacturing industry. NIST hosts the interagency Advanced Manufacturing National Program Office and the Advanced Manufacturing Technology Consortia (AMTech) Program. NIST's Hollings Manufacturing Extension Partnership (MEP) is a federal-state partnership that provides a network of technical assistance centers and offices located in every state.

Department of Defense (DOD)

Innovation in manufacturing, through small businesses, is the key to improving the United States economy. EO guidelines state that all government agencies with one or more SBIR programs or one or more STTR programs give high priority to manufacturing related R&D processes, systems, and workforce protection. This includes manufacturing processes, equipment and systems; or manufacturing workforce skills and protection. The DOD SBIR/STTR programs have worked to integrate manufacturing related projects into their programs since EO 13329 was signed.

Manufacturing Related SBIR/STTR Awards FY14				
Agency	Dollar Amount Phase I	Number of Awards Phase I	Dollar Amount Phase II	Number of Awards Phase II
Air Force	$6,974,520	47	$6,745,335	9
Army	0	0	$44,482,242	50
CBD	0	0	$2,998,754	3
DARPA	$4,399,050	37	$35,937,627	31
DLA	$598,711	6	0	0
DTRA	0	0	$949,985	1
MDA	$1,477,857	13	$14,150,856	15
Navy	$5,118,032	58	$22,198,501	38
OSD	$298,764	3	$2,449,629	4
SOCOM	$150,000	1	0	0
DOD TOTAL	$19,016,934	165	$129,912,929	151

Examples of DOD manufacturing-related SBIR/STTR projects

Firm Name	Component	Project Title	Award Amount
Texas Research Institute Austin, Inc.	Air Force	Residual Stress Determination for Cold Expanded Holes	$150,000
TDA Research, Inc.	Air Force	Chromate-Free Fuel Tank Coating	$150,000
Solid Concepts, Inc.	Air Force	Implementation of Direct Metal Laser Sintering (DMLS) to Manufacture Monel K500 Liquid Rocket Engine Components	$150,000
Quallion LLC	Army	Lithium Air Rechargeable Battery	$729,030
FIRST RF CORPORATION	Army	Enhanced Field Expedient Body Wearable Antenna	$1,455,365
RE2, Inc.	Army	Highly Dexterous Manipulation System (HDMS)	$1,529,852
CFD Research Corporation	OSD	First-Principles-Based Framework for Discovery and Design of Sustainable Non-	$749,942

		Rare-Earth High-Temperature Alloy Systems	
Michigan Engineering Services, LLC	OSD	Functional Allocation Trades between Hardware and Software	$999,888
Scalable Network Technologies Inc.	OSD	Human-Centric Training and Assessment System for Cyber Situational Awareness	$199,799
nanoGriptech, Inc.	CBD	Microfiber-Based Closures with Hermetic Sealing for Chem Bio Protective Garments	$999,810
Triton Systems, Inc.	CBD	Self-Healing Shape Memory Polymer Based Coatings for Protective Garments	$999,911
Laser Operations, LLC	DARPA	Ultra-Bright Diode Laser Emitters for Pumping High-Power Fiber Amplifiers	$1,743,001
Carbon-Carbon Advanced Technologies, Inc.	DARPA	Manufacturing and Strength Improvement for Thick Carbon-Carbon Laminates	$999,051
Gen9	DARPA	Next Generation synthesis of low cost, long length DNA Assemblies	$982,260
Retriev Technologies, Inc.	DLA	Green Lower Cost Batteries	$99,876
Physical Sciences Inc.	DLA	Development of Advanced Battery Manufacturing Techniques	$99,975
CAMX Power LLC	DLA	Logistically Robust, Long Life, High Power Rechargeable Battery	$99,933
CAMX Power LLC	DLA	Reduced Manufacturing Cost for Li-ion Batteries	$99,963
Xerion Advanced Battery Corporation	DLA	Advanced Battery Manufacturing Technologies	$99,920
ADA Technologies, Inc.	DLA	High Speed, Automated Lithium Ion Laser Electrode Cutter	$99,999
K2 Energy Solutions, Inc.	DLA	Advanced Battery Manufacturing Technologies	$99,008
Multibeam Corp.	DTRA	Low-Energy e-Beam Direct Write for Trusted IC Production	$2,000,000
Materials & Electrochemical Research (MER) Corp.	Navy	Direct Digital Fabrication and Characterization of New Low-Cost Titanium Alloys	$899,799
NALAS Engineering Services Inc.	Navy	Environmentally Friendly Alternative Synthesis and Process to Manufacture Cost-Effective Hexanitrohexaazaisowurtzitane (CL-20)	$149,965
Advanced Powder Solutions, Inc.	Navy	Engineering Aluminum Alloys for Additive Manufacturing	$79,959

Cornerstone Research Group, Incorporated	SOCOM	Advanced Transparent Armor Materials and Manufacturing Methods	Currently moving forward to Phase II

Procedures and mechanisms DOD has used to date to give priority to manufacturing-related projects.

DOD SBIR/STTR releases three solicitations per year and included in these solicitations are topics related to and promoting manufacturing technology. Some examples of promoting manufacturing related projects by participating DOD components are as follows:

- The Air Force identifies manufacturing technology as a tie-breaker in solicitations, stating the Air Force will evaluate proposals in descending order of importance with technical merit being most important, followed by the Commercialization Plan, and then qualifications of the principal investigator (and team) and that, where technical evaluations are essentially equal in merit, and the cost and/or price is a substantial factor, then cost to the Government will be considered in determining the successful offeror. The next tie-breaker on essentially equal proposals will be the inclusion of manufacturing technology considerations.

- The Army collaborates with the U.S. Army Manufacturing Technology (ManTech) Program to integrate and align SBIR efforts directly into ManTech projects. The ManTech Program Management Office (PMO) reviews, evaluates, and endorses manufacturing-related topics for manufacturing-relatedness against the following five categories:

    1. Core Manufacturing Innovation Topic
    2. Addresses manufacturing process, technique, or innovation
    3. Addresses manufacturing development, application, and tools used in advanced processes.
    4. Targets manufacturing manufactures for related equipment, systems, or production lines
    5. Addresses the affordability, and reproducibility of demonstrated technology

- Of specific concern to the Chemical and Biological Defense Program is unit cost of technologies having the potential for distribution to individual Warfighters. Therefore, SBIR topics that address the affordability, producibility, or manufacturing of an innovative technology are of importance and given greater priority for inclusion into future SBIR solicitations. CBD SBIR topics are assigned to one of the following seven categories:
    1. Research for a process or product that has significant manufacturing implications, although not the sole purpose of the topic
    2. Topic addresses the development or application of advanced technologies for manufacturing processes, tools, and equipment
    3. Topic includes manufacturing issues associated with technology under development

4. Research Topic that has Product or System Focus, Addressing Manufacturing Aspects of that Product
5. Primary objective of topic is to develop a system or weapon-specific capability.
6. Manufacturing, producibility, cost and yield are referenced but not the primary objective of the task
7. Manufacturing-related activities may be part of Phase II

- DARPA created the Open Manufacturing program to lower the cost and speed the delivery of high-quality manufactured goods with predictable performance. This program aims to create a manufacturing framework that captures factory-floor and materials processing variability and integrates probabilistic computational tools, informatics systems and rapid qualification approaches. These newly developed concepts and approaches will be used to characterize and reduce the risk of new manufacturing technologies.[1]

- DLA seeks drastically lower unit costs of discrete-parts support through manufacturing revolutions that also have applicability to low and high-volume production from commercial sales. This will result in an improvement in the affordability of these innovations to DLA and its customers and the development of cost effective methods to sustain existing defense systems while potentially impacting the next generation of defense systems.

Specific actions DOD has taken toward promoting and supporting manufacturing-related research projects.

DOD continues to take an active approach to promoting and supporting manufacturing-related research projects. This is done through attending outreach event, collaborations with various organizations and offices such as ManTech, etc. Some examples of this promotion are:

- The Army and Air Force SBIR/STTR programs publish and advertise success stories for outstanding manufacturing related projects. These websites bring together the small business communities, component researchers, Program of Record, prime contractors, and the ManTech community for possible collaboration on new and ongoing SBIR/STTR projects.

- Transition assistance is offered by various DOD components in support of their manufacturing related projects. Army SBIR/STTR employs transition assistance to firms whose proposals have met and/or exceeded all Army SBIR criteria. Transition assistance is available through Phase II Commercialization Readiness Program (CRP). Similarly, the DARPA Small Business Programs Office has contracted with Strategic Analysis, Inc. Technology Transition and Commercialization team (T2C Team) to implement the Transition and Commercialization Support Program (TCSP). The T2C Team is providing high level review companies' transition and commercialization strategy, transition and commercialization strategy, transition and

[1] http://www.darpa.mil/Our_Work/DSO/Programs/Open_Manufacturing_%28OM%29.aspx

commercialization planning support, identification and introduction to potential collaborators, potential partners, and potential sources of Phase III funding, and identification of thought leadership opportunities.

- Several components, including Army, OSD, DLA, work closely to incorporate the ManTech program during topic writing and Phase I and Phase II source selection processes.

- DOD Components regularly participate in manufacturing related conferences including: Beyond Phase II, Defense Manufacturing Conference (DMC), and Nanotechnology for Defense (NT4D). During these conferences, one-on-one discussions were conducted between SBIR program personnel and small business representatives to investigate application of their technologies to the mission and requirements of the DOD community.

- Almost the entire DOD community promotes EO 13329 through posting various links to manufacturing related documents and websites including:
    1. The Department of Commerce (DOC) “Manufacturing in America” article.
    2. Establishing a link to EO13329 on their respective SBIR/STTR public website.

Department of Education (DOE)

ED operates its SBIR program through two program offices: The Institute of Education Sciences (IES) and the National Institute on Disability and Rehabilitation Research (NIDRR). ED does not operate an STTR program.

The IES SBIR Program uses a contracts mechanism to provide up to $1,050,000 in funding ($150,000 for Phase I; $900,000 for Phase II) to small business firms and partners for the research and development (R&D) of commercially viable education technology products for use by students and teachers in education and in special education settings.

The NIDRR SBIR Program uses grants to provide up to $650,000 in funding ($75,000 for Phase I and $575,000 for Phase II) for the R&D of technologies that enhance access, health and function, community living and participation, and learning for individuals with disabilities.

Broadly speaking, ED's SBIR program is designed to support and encourage R&D in manufacturing through "environment or societal, and systems level technologies" (as defined by SBA, 2005). These projects encompass a range of manufacturing topics, such as artificial intelligence, information technology devices, software, systems, rehabilitation technology, assistive technology and devices, and product design.

In FY14, IES conducted a Phase I competition and a Fast-Track competition. These competitions had two priority areas. The first concerned the development of products (e.g. computer software, curriculum materials, etc.) for use by students in general and special education settings, and the second concerned products for use by teachers.

Attention was paid in identifying projects that were manufacturing-related. Of the 14 contracts awarded, each involve computer software R&D, which if demonstrated to be a feasible idea during could potentially be manufactured and commercialized on a broader scale during Phase III of the SBIR program.

NIDRR provides support for a comprehensive program of research and development designed to facilitate the rehabilitation of individuals with disabilities. In 2014, NIDRR held a Phase I SBIR competition that included five invitational priority topical areas related to innovative research utilizing new technologies (including nanotechnologies and biotechnologies) to address the needs of individuals with disabilities and their families. The specific priorities included the development of technology to:

1. Support access, promote integration, or foster independence of individuals with disabilities; (2) enhance sensory or motor function of individuals with disabilities;

2. Support transition into post-secondary education or employment settings for individuals with disabilities;
3. Foster accessible information technology including web access technology, unique software, and other systems and devices that promote access to information in education, employment and community settings, and voting technology that improves access for individuals with disabilities; and
4. Support independent access to health care services in the community. As shown, these priority areas encourage technically innovative projects in education with potential for manufacturing. In addition, NIDRR held a Phase II SBIR competition.

Examples of ED manufacturing-related SBIR/STTR projects

IES: Quantum Simulations, Inc., an IES SBIR awardee is an example of a manufacturing-related project. In 2002, 2006, and 2011 Quantum Simulations has received five SBIR awards, each focusing on the research and development (R&D) of artificial intelligence (AI) software to provide an online real-time tutoring and assessment program for student learning and teacher training. Quantum's most recent Phase II project focuses on the development of an AI tutoring system for individuals with impaired vision. Quantum's tutoring, assessment, and professional development software for students and instructors in middle school through college to improve science and math education. Students enter their own problems, show their own work and at any time during the Internet session receive personalized assistance and feedback by asking questions, requesting hints and receiving explanations of the next steps in solving a problem, similar to working with a human tutor This technology permits students to work and receive guidance based on their own ability and knowledge and is not intended as a replacement for teachers or human tutors per se. Rather, the Tutors and Assessment Advisors supplement classroom instruction, textbook reading, and, most importantly, provide assistance during at-home study when a teacher is not available. Research has demonstrated that the AI software can improve students' comprehension, problem solving skills, and test scores. Because of the SBIR funding, Quantum Simulations has developed several product lines that have been manufactured broadly, made available to the public through licensing contracts with established publishers and distributors in the U.S., and has been used in the past by hundreds of thousands of students around the country.

NIDRR: AnthroTronix, Inc., a human factors engineering and research and development company located in Silver Spring, MD, is working to leverage new and existing technologies to benefit children with disabilities. With support from a Phase II SBIR grant from ED/NIDRR, awarded in FY 2003, AnthroTronix has successfully developed and manufactured Cosmo's Learning Systems™ a unique family of innovative rehabilitation and learning tools focused on empowering and motivating children with disabilities to succeed in education and achieve their rehabilitation goals. The manufacturer is AT KidSystems™, which was established in 2005 to manufacture, market, and distribute children related products that emerge from the research and development initiatives of AnthroTronix, Inc. Cosmo's Learning Systems serves as an excellent motivator for physical, occupational, speech/language, and recreational therapy practices and special education segments of the rehabilitation market; thus

allowing children with disabilities to participate fully in the classroom, during therapy, at home, and with their peers without disabilities. Cosmo's Learning Systems™ features Mission Control™, a computer interface device that enables a child to interact with Cosmo's Play and Learn™ software, including CosmoBot™, a virtual robot that allows children to explore and enjoy a virtual playground. Cosmo's Learning Systems™ is compatible with both Windows and MAC computers. Cosmo's Learning Systems™ also enables the therapist to monitor therapy-game sessions remotely in the clinic or home setting and to evaluate the child's progress in meeting developmental goals over time. (For more information on this product line see: www.atinc.com and http://www.atkidsystems.com/products.aspx). The potential of Cosmo's Learning Systems™ to improve the future rehabilitation and educational landscape for children with disabilities was acknowledged in 2005 by AnthroTronix, Inc. being named a Tech Museum Awards Laureate for the prestigious Knight Ridder Equality Award, given by the Tech Museum of Innovation in San Jose, CA. AnthroTronix was selected from among a group of more than 300 applicants from 64 countries, with the other 25 Tech Awards Laureates coming from Brazil, Canada, Cuba, India, Malaysia, Pakistan, South Africa, the United Kingdom and the United States. According to Meredith Taylor, president of the Tech Museum, "the Tech Awards Laureates were founded to shine a spotlight on the innovative work of those who dedicate their lives to using technology to help others." (For more information on the awards and laureates, see: http://www.techawards.org).

AnthroTronix, Inc. was honored for exceptional achievement through its receipt of the 2006 Tibbetts Award (see "winners" at http://www.tibbettsawards.org/). This national recognition singles out companies and individuals that embody the true spirit behind the Small Business Innovation Research (SBIR) Program. For small businesses, the Tibbetts Award is an acknowledgement of significant achievement and demonstrates how the SBIR program serves as a major catalyst in transforming successful research and development (R&D) initiatives into commercial enterprises. The Learning System of the Cosmo Web is the first product line to emerge from AnthroTronix and has positively impacted children with disabilities since its availability in the marketplace. For more information contact: AnthroTronix, Inc., 8737 Colesville Road, Suite L203, Silver Springs, MD 20910.

Procedures and mechanisms ED used to date to give priority to manufacturing related projects.

In 2014, the ED SBIR program implemented the following procedures to give priority to manufacturing related projects:

- Placed a notice in FY14 SBIR program solicitations that: (a) describes Executive Order 13329; (b) provides a weblink to the Executive Order; and (c) provides a definition of manufacturing-related projects in education;
- Placed a forced-choice question in the FY14 SBIR program solicitations for applicants to indicate (yes or no) whether their proposed project is "manufacturing-related;"
- Placed language in the solicitation advising potential applicants that ED SBIR offices will give priority to manufacturing-related projects in the event of a tie in the award selection process.

(Note: This “tie-breaker” specification allows the ED SBIR program to apply an additional preference without compromising the quality standards or established criteria of the program).

Specific actions ED has taken toward promoting and supporting manufacturing-related research projects.

In 2014, the ED SBIR program used the following procedures and mechanisms to promote and support EO 13329:

1) Maintained the notice on the ED SBIR website that describes EO 13329, provides a definition of manufacturing-related projects in education, and provides a weblink to the EO;
2) Noted EO 13329 initiatives during conferences and meetings;
3) Continued tracking and reporting success stories demonstrating the impact of the SBIR programs on manufacturing-related projects; and
4) Placed a notice in 2014 SBIR program solicitations at IES and NIDRR that described EO 13329, provided a definition of manufacturing-related projects in education, and provided a web-link to the EO; 5) SBIR program officers at IES and NIDDR will continue to discuss how to best implement EO 13329 relating to manufacturing-related SBIR projects in education.

Department of Energy (DOE)

Examples of DOE manufacturing-related SBIR/STTR projects

Company Name	Project Title
AltaSim Technologies, LLC	Development of cloud based analysis of additive manufacturing process technology
Mold Dynamics	Mitigation of sand mold related metal casting defects through virtual manufacturing
Simmetrix Inc.	Automated Simulation of Selective Laser Melting Additive Manufacturing for Process Design
ET International, Inc.	A performance-improved implementation of ScaLAPACK implemented in Open Community Runtime
Cascade Technologies, Inc.	Web platform architecture for CFD simulations and real-time analysis on HPC resources
Charmworks, Inc.	An Object oriented parallel programming system with adaptive runtime
Tech-X Corporation	PTSolve: High-performance solvers for industry
Adroit Materials	Ion Implantation Processes in AlN for Wide Bandgap Semiconductor Power Devices
Agnitron Technology	Investigation of Donor and Acceptor Ion Implantation in AlN
SFP Works	Flash Processed Steel for Automative Applications
Advanced Renewable Technology International Inc.	Multiple-stage activated-char filtration
ALD NanoSolutions	Enhanced Capacitive Deionization using Carbon Electrodes Conformally Coated with Metal Oxides by Atomic Layer Deposition
Mainstream Engineering Corporation	High Ion-Accessible Surface Area CNT-Ultracapacitors for Groundwater Desalination
Reactive Innovations	Membraneless Water Desalination System
Boston Electrometallurgical Corporation	Innovative Process for Production of Neodymium Metal and Neodymium-Iron Master Alloy

Procedures and mechanisms DOE has used to date to give priority to manufacturing-related projects.

The Funding Opportunity Announcements include topics that seek manufacturing-related innovations in accordance with EO 13329, "Encouraging Innovation in Manufacturing." Topic areas were:

Increasing Adoption of HPC Modeling and Simulation in the Advanced Manufacturing and Engineering Industries: Turnkey HPC Solutions for Manufacturing and Engineering; HPC Support Tools and Services; Hardening of Research and Development Code for Industry Use; Other

Advanced Manufacturing: Manufacturing Improvements of Aluminum Nitride (AlN) for Wide Bandgap; Semiconductor Power Devices; Rapid Heat Treatment of Metals; Desalination without Membranes; Critical Materials for Clean Energy Technologies

Specific actions DOE has taken toward promoting and supporting manufacturing-related research projects.

The Advanced Manufacturing Office sought transformational manufacturing process technologies relating to AlN wide bandgap semiconductor power devices, rapid heat treatment of metals, desalination without membranes and improvements in the utilization of critical materials throughout their life cycle.

The following subtopics were included in the FY14 DOE SBIR/STTR Phase I Release 2 Funding Opportunity Announcement and resulted in eight Phase I awards.

Manufacturing Improvements of Aluminum Nitride (AlN) for Wide Bandgap Semiconductor Power Devices

Wide bandgap semiconductors (WBGS) – with bandgaps greater than 3 eV, such as silicon carbide (SiC) and gallium nitride (GaN) -- already commercialized in solid-state lighting applications — offer the opportunity for dramatic efficiency improvements in a variety of power electronic applications including industrial process and motor drives. Compared to today's silicon (Si) based technologies, devices using WBGS can operate at higher temperatures (e.g. function at ambient temperatures higher than 150^{o}C without external cooling), withstand greater voltages (>10's of kV) over time, and switch at much higher frequencies (10's of kHz to 10's of MHz). Industrial-scale motors, for example, which consume 69% of the electricity used in industry, could achieve reductions of up to 40% of consumption per motor by adoption of variable speed drive enabled by WBGS power devices.

While SiC and GaN-based power devices have matured and are now being commercialized for adoption in end-systems, the research in aluminum nitride (AlN) is still relatively recent. The wide bandgap of AlN, of ~6.1 eV, offers considerable advantages over GaN and SiC semiconductors such as higher breakdown field strength that permits higher voltage devices. AlN wafers are already available in 30 mm diameter from several sources, and AlN-based light emitting diodes (LED) with wavelengths between 200 – 300 nm are already being commercialized for water purification and other purposes. Schottky devices (for example using AlN at 10 kV) could be as much as 5x smaller than a similarly rated SiC Schottky diodes at 10-25 kV. Several challenges, however, need to be overcome in wafer manufacturing before AlN diodes can be manufactured. These include lack of conducting substrates, doping control during the boule and epitaxial growths, relatively deep donor and acceptor levels, ion-implantation and subsequent activation of donor and acceptor impurities.

Ion-implantation of donor and acceptor impurities and subsequent thermal activation is a basic building block for any semiconductor power device, which requires high dose implants to form ohmic contacts, floating guard rings and junction termination extension (JTE) regions, and grids for junction barrier Schottky (JBS) diodes. While research reports of Cd, Ag and Si

ions are available, to manufacture AlN epilayers on bulk AlN substrates for use by device manufacturers, more comprehensive studies are needed.

An area of particular interest is processes for ion-implantation and activation of donor and acceptor impurities.

Grant applications are sought that make improvements in ion-implantation and activation of donor and acceptor impurities in AlN epilayers on bulk AlN substrates and improve formation of ohmic contacts to both n+ and p+ implanted regions. Proposed work would conduct comprehensive studies of implantation of various species at elevated temperatures followed by activation at higher temperatures using a cap layer to preserve the surface quality, measurement of temperature dependent hall mobility and carrier concentrations, donor and acceptor energy levels and residual damage especially in high dose implants.

Rapid Heat Treatment of Metals

A large fraction of primary metal production in the United States comes in the form of thin gauge products. For example, about two thirds of the 90 million metric tons of US steel produced annually is rolled into coils of sheet and strip. These products often require various forms of heat treatment to achieve desired mechanical properties, to homogenize coatings, or to soften the material in between successive stages of cold rolling.

Advances in heating technologies, such as induction heating, have improved the ability to heat treat thin gauge metals rapidly, with reduced levels of surface oxidation, improved energy efficiencies, and smaller systems with lower capital costs. In addition to operating cost and energy reduction benefits, rapid heating provides new opportunities to control the structure and properties of metals. Rapid heat treatment processes can be exploited to control grain size, diffusion of alloying elements, precipitate sizes and distributions, and phase transformations. Such control can enable superplasticity or ultrahigh strengths in ways that were not previously obtainable.

The combination of reduction in surface oxidation, smaller systems with higher energy efficiencies and improved material performance can lead to a doubling in energy productivity –the target for SBIR projects. Embodied energy reductions include less material required, lifetime system energy use reductions due to light-weighting, and elimination of processing steps.

We seek grant applications to advance the technology of the rapid heat treatment of metals for significant reductions in embodied energy. Grant applications can focus on topics such as methods to substitute rapid heating for radiant energy technology, scale up of rapid heat treatment to larger product forms, advances in alloy compositions that exploit rapid heat treatment, and advances in processing. Embodied energy savings can include a combination of lifecycle performance, yield performance, and process energy savings. In all proposed projects, the required 50% embodied energy savings shall be demonstrated through the manufacture of exemplar parts or materials, with sufficient

experimental measurements and supporting calculations, to show that the savings can be achieved with practical economies of scale.

Desalination without Membranes

Contaminants in water can be eliminated in most cases using inexpensive, mature technologies. Removing small ions (e.g. desalination), however, requires more sophisticated processes such as reverse osmosis (RO). The RO process, however, requires the consumption of significant electrical energy to overcome the large osmotic pressure in saline sources using high pressures (5–8 MPa). RO membranes are also expensive and prone to fouling, especially when the feed water does not have consistent quality. In addition, the complicated machinery (e.g., high pressure pump and electricity generator) of RO processes, the maintenance of the RO membranes, and the reliance on fossil fuels complicate operations such as desalination for conventional applications, as well as for remote applications or disaster relief. Alternatives to RO membranes are sought.

An area of particular interest is novel, continuous water desalination processes. Grant applications are sought to for novel, continuous water desalination processes based on directional solvent extraction (DSE) that do not use membranes and are both highly efficient and can utilize low-temperature heat sources from waste heat or solar energy to minimize or even eliminate the dependence on fossil fuels for desalination and significantly increase their self-sustainability.

Critical Materials for Clean Energy Technologies

In 2008, the National Academy of Sciences Minerals, Critical Minerals and the U.S. Economy Study presented a methodology to assess material criticality based on supply risk and impact of supply restriction. The Department of Energy adapted this methodology and applied it to several clean energy technologies to determine if materials constraints could impact deployment of the clean energy technologies. Basic availability is not the only factor affecting a critical material's overall supply risk. Other factors include political or regulatory risks in countries that are major producers of critical materials; lack of diversity in producers; and a competing technology demand -- many consumer electronics like mobile phones, computers and TVs use materials essential to clean energy technologies.

After examining 16 elements across the periodic table, five rare earth metals (dysprosium, neodymium, terbium, europium, and yttrium) were assessed as critical. Dysprosium and neodymium are used in permanent magnets, important to wind turbines and electric vehicle motors. Terbium, europium and yttrium are used in energy-efficient lighting phosphors. Two other materials (lithium and tellurium) were assessed as near-critical. Lithium is used in batteries and energy storage applications and tellurium is used in photovoltaic thin-films.

The manufacturing of U.S. clean energy technologies is likely to be affected by constrained supplies. As clean energy technologies are deployed more widely in the decades ahead, their share of global consumption of rare earths is likely to grow from 7% in 2010 to 40% or more by 2025. This growth,

combined with non-clean energy demand, could result in supply constraints for clean energy technologies. Economic projections suggest certain critical materials could experience supply deficits of up to 30% by 2016.

There are opportunities throughout the lifecycle to develop more efficient processes to use existing supplies more effectively, reduce use and recycle and reuse at the end-of-life. Solutions to these challenges will help enable the continued deployment of clean energy technologies. This solicitation addresses three key elements across the lifecycle of critical materials:

1. Improved separation and processing of critical rare earth elements;
2. Advances in recovery and recycling of rare earth materials from manufacturing waste and end-of-life products; and
3. Novel production methods to enable advanced manufacturing of permanent magnets.

Areas of interest include diversifying supply through improved processing and increased recycling. In the United States, there is a significant gap in the rare earth metal supply chain in converting ores and oxides into metal. Current processes to convert rare earth materials to metals typically utilize oxide, chloride, or fluoride intermediates, which are then reduced to metal. These methods are generally considered inefficient, environmentally unfriendly, and unsustainable. Methods to investigate other intermediates beyond oxides, chlorides, and fluorides are of interest, including methods to avoid intermediates during processing.

In recycling of rare earth materials, there are two major categories that can be considered: 1) the reduction of manufacturing loss through recovering scrap materials, and 2) end-of-life recycling for commercial and consumer products. In rare earth permanent magnet manufacturing, it is estimated that approximately 30% of the magnetic material is lost during the machining process. Developing technologies to recover the rare earth materials from the machining sludge is of interest.

Lamps containing rare earth phosphors are routinely collected by lamp recyclers for removal of mercury or recycling other lamp components. However, most of the rare earth phosphor powders from end-of-life lamps are landfilled. Technologies that will enable downstream processing of the recovered powders are needed. Production of metal powders for additive manufacturing: Additive manufacturing could provide a more efficient route to rare earth magnetic materials. Additive techniques would reduce the waste associated with machining (e.g. shaping and cutting) bulk magnets, decreasing the sludge and swarf produced in the process. To enable more effective additive manufacturing of rare earth magnetic materials, metal powders with narrow size distribution are needed; however, the production process usually results in waste. More efficient production methods for metal powders, such as advanced atomization techniques, that produce narrower size distributions are of interest.

Department of Homeland Security (DHS)

Examples of DHS manufacturing-related SBIR/STTR projects

For the Physiological Monitoring and Environmental Scanning Technology topic area, Physical Optics Corporation (Torrance, CA) proposed to address the DHS need for a single wireless device that will monitor physiological and environmental conditions of and surrounding a first responder, and relay the information to the incident command, by developing a new Wireless Physiological and Environmental Monitoring (WiPEM) system incorporating four major components: (1) an array of physiological sensors, (2) an array of miniaturized environmental sensors, (3) processing and communication electronics, and (4) mechanical packaging.

For the Decontamination Technologies for Biological Agents topic area, TDA Research Inc. (Wheat Ridge, CO) proposed an innovative bio-agent decon technology that is particularly suitable for decon over wide areas, and proposed to adapt and demonstrate the product currently in commercial development to meet the needs for a national security biological warfare agent decontaminant. Zeteo Tech LLC (Ellicott City, MD) proposed to develop a benign, environmentally safe decontamination solution and demonstrate the potential to produce biocidal reactive oxygen and thermal effects via exposure to radio frequency directed energy at two frequencies to kill bacterial (Bacillus thuringensis) and mold (Penicillium sp.) spores.

For the Development of Cost-Effective Iterative Reconstruction Computing Platforms for Computed Tomography (CT)-based Explosive Detection Equipment topic area, INSTARECON Inc. (Urbana, IL) proposed an algorithmic acceleration methodology as an essential component of an iterative reconstruction system that can run at the required throughput on a modest hardware platform, making commercial deployment economically feasible.

Procedures and mechanisms DHS has used to date to give priority to manufacturing-related projects.

Of the 28 proposals submitted to the S&T Directorate's FY14 SBIR topic areas that self-certified that the efforts were manufacturing related, four contracts were awarded. The contracts were awarded in the following topic areas:

- Physiological Monitoring and Environmental Scanning Technology;
- Decontamination Technologies for Biological Agents; and
- Development of Cost-Effective Iterative Reconstruction Computing Platforms for Computed Tomography (CT)-based Explosive Detection Equipment

Specific actions DHS has taken toward promoting and supporting manufacturing-related research projects.

In FY14, 142 proposals were received in response to the DHS SBIR Phase I solicitations. Of these, 34 offerors self-identified that their proposed efforts were manufacturing-related. These 34 proposals were submitted in the following S&T Directorate topic areas: Mobile Footprint Detection; Mass Delivery of Countermeasure for High Consequence Diseases in Wildlife; System Simulation Tools for X-ray based Explosive Detection Equipment; Physiological Monitoring and Environmental Scanning Technology; Machine to Machine Architecture to Improve First Responder Communications;

Decontamination Technologies for Biological Agents; Development of Cost-Effective Iterative Reconstruction Computing Platforms for Computed Tomography (CT)-based Explosive Detection Equipment; Status Indicator for Downed Power Lines; and Field Detection and Analysis for Fire Gases and Particulates; and the following DNDO topics area: Smart Device Compatible Module for Radiation Identification, Categorization, and Quantification; and Miniaturization of Support Infrastructure for Non-Intrusive Inspection X-Ray Systems.

Department of Transportation (DOT)

Examples of DOT manufacturing-related SBIR/STTR projects

In FY14, DOT awarded four manufacturing-related SBIR Phase I contracts and four manufacturing-related Phase II contracts.

Procedures and mechanisms DOT has used to date to give priority to manufacturing-related projects.

DOT issued two manufacturing-related topics in FY14 linked to the Phase I awards mentioned above: Corrosion Resistant Prestressing Strand for Prestressed Concrete and Lightweight Portable System for Mid-Chord Offset Measurements of Railroad Rails. The Phase II awards originated from the topics SmartWorkZone (situational awareness messages received in the vehicle when driving through a work zone area and for tracking of heavy vehicles and estimating heavy load distribution across the highway system) and Weigh-In-Motion Calibration (pedestrian auto-enforcement program and transit safety).

Specific actions DOT has taken toward promoting and supporting manufacturing-related research projects.

DOT's SBIR Program Director discussed manufacturing topics during briefings and one-on-one meetings conducted at the National SBIR conferences. The SBIR Program Office also informed prospective DOT awardees of the assistance available through NIST's Manufacturing Extension Partnership (MEP) Program and the USA National Innovation Marketplace.

Environmental Protection Agency (EPA)

Examples of EPA manufacturing-related SBIR/STTR projects

In FY14, EPA awarded 21 new SBIR Phase I projects and 9 new Phase II projects. Six Phase I awards and five Phase II award are manufacturing-related awards under EO 13329. These awards are for unit process level technologies that create or improve manufacturing processes, machine level technologies that create or improve manufacturing equipment, systems level technologies for innovation in the manufacturing enterprise or environmental or societal level technologies that improve workforce abilities and manufacturing competitiveness.

The FY14 awards related to innovation in manufacturing were:

Firm Name	Project Title	Phase
Reactive Innovations, LLC	Micro Channel Electrochemical Production of Dimethyl Carbonate	I
NEI Corporation	Lithium-ion Batteries Based on Aqueous Electrolyte: A New Generation of Sustainable Energy Storage Devices	I
HJ3 Composite Technologies, LLC	Green Materials for Doubling the Life of Drinking Water Pipeline	I
MesoCoat	Development of Zinc Coatings on Steel by Cermaclad (TM) to Replace Pickling Lines	I
Grow Plastics, LLC	Process Development for Sandwich Core Structure PLA Thermoformed Objects	I
UltraCell Insulation, LLC	Advanced Cellulose Insulation	I
ArunA Biomedical, Inc.	Developmental Neurotox Assay using Scalable Neurons and Astrocytes in High Content Imaging	II
Compact Membrane Systems, Inc.	Processing of Green Solvents	II
Ecovative Design, LLC	Mycological Biopolymer as a Replacement for Expanded Plastic Foams	II
Instrumental Polymer Technologies, LLC	Soy-Capped Polycarbonate Dendrimers for Tough, Sustainable Water-Based Wood Coatings	II
National Recovery Technologies LLC	Automated Identification and Sorting of Rare Earth Elements in an E-waste Recycling Stream	II

Procedures and mechanisms EPA has used to date to give priority to manufacturing-related projects.

The EPA SBIR Program continues to make manufacturing a priority in its annual solicitations. Manufacturing is very important to the EPA's mission of protecting human health and the environment as it can impact many areas that have large environmental impact including water and energy use, toxicity, pollution, waste disposal, etc. The EPA considers these impacts when evaluating

proposals for selection. SBIR program solicitation includes an "Innovation in Manufacturing" topic shown below:

Green Manufacturing. Improvements in manufacturing efficiency typically result in environmental improvements, making manufacturing greener and more cost-effective. In addition, Executive Order 13329 directs EPA to assist the private sector in its manufacturing innovation properly and effectively to sustain a strong manufacturing sector in the US economy. Manufacturing-related research and development (R&D) encompasses improvements in existing methods or processes, or wholly new processes, machines, or systems. Technologies should improve manufacturing competitiveness. This year's focus area is:

- Manufacturing process changes that utilize green technology to improve process efficiency and reduce pollution. These technologies may include non-traditional reactors, novel processing methods, new feedstocks, bio-mimicry approaches, solvents, or chemical systems that improve production efficiency and performance while eliminating or minimizing the use or generation of harmful substances. Of special interest are processes and methods to reduce the use of/replace EPA action plan chemicals as listed in http://www.epa.gov/opptintr/existingchemicals/pubs/ecactionpln.html (For example, technologies to reduce/replace the use of Bisphenol A (BPA) in thermal paper)

Green Materials. Research is needed to develop new materials and products with minimal environmental and public health impacts over their life cycles. This year's focus area is:

- New materials, chemicals, processes, and systems with minimal environmental and public health impacts and reduced carbon footprints over their full lifecycles. Alternatives are needed to reduce emissions of air toxics (e.g. formaldehyde) and biological contaminants (e.g. mold).

Other solicitation topics also cover manufacturing-related needs. Air, water, and waste management programs cover new clean up technology and better manufacturing systems. Specific topics deal with automobile and chemical manufacturing, metal finishing and electronics manufacturing, green building products and water security and decontamination technologies and systems. The EPA SBIR solicitation emphasizes manufacturing-related opportunities and needs.

Specific actions EPA has taken toward promoting and supporting manufacturing-related research projects.

EPA's SBIR Program has emphasized manufacturing-related topics and priorities at National, regional, and state SBIR conferences, and webinars. Emphasis has been placed on opportunities for businesses to submit new critical manufacturing technologies that improve both the process efficiency and the environmental impact of the technology. Many of EPA's success stories have been in manufacturing (including multiple Tibbetts awards) and EPA frequently publishes these success stories and other communications pieces on its SBIR website, www.epa.gov/ncer/sbir.

Department of Health and Human Services (HHS)

Examples of HHS manufacturing-related SBIR/STTR projects

Following are examples of projects funded in FY14 that illustrate the beneficial impact that the HHS SBIR/STTR programs have on U.S. manufacturing:

Firm Name	Project Title	Related Awards
Microbiotix, Inc.	Novel Spectinamide Antibiotics for the Treatment of MDR/XDR Tuberculosis	2 R44 AI098271-03
Mynosys Cellular Devices, Inc.	Micro-Technology Enhanced Pediatric Lens Capsulotomy Device	5 R44 EY021023-03
DecImmune Therapeutics, Inc.	Humanized Antibody Therapeutic to Improve Cardiac Function; Myocardial I Related	2 R44 HL084821-04A1

Procedures and mechanisms HHS has used to date to give priority to manufacturing-related projects.

NIH SBIR announcements encourage development of new technologies as well as application of existing technologies. When appropriate, plans for manufacturing and clinical evaluation of developed technologies, drugs, devices, and innovative approaches should be included in the application.

a) NIH released in the NIH Guide for Grants and Contracts several funding opportunity announcements (FOA) for manufacturing-related research:

NIH Funding Opportunity Announcement (FOA):

SBIR Phase IIB Bridge Awards to Accelerate the Development of Cancer Therapeutics, Imaging Technologies, Interventional Devices, Diagnostics, and Prognostics Toward Commercialization (R44)

http://grants.nih.gov/grants/guide/rfa-files/RFA-CA-15-010.html

This solicitation includes broad topic areas for NIH that is considered relevant to manufacturing-related R&D. The additional solicitations were issued as noted below:

Announcement Number	Title
RFA-HL-15-004	Bioreactors for Reparative Medicine (R41/R42)
RFA-HL-15-008	Bioreactors for Reparative Medicine (R43/R44)
PAR-14-292	Blueprint Neurotherapeutics Network (BPN): Small Molecule Drug Discovery and Development for Disorders of the Nervous System (U44)

b) Manufacturing-related SBIR/STTR research projects funded in FY 2014 awards (370 records) that were made in response to these solicitations and in response to the Omnibus SBIR/STTR Program Solicitations are appended to this report.

January 2014 SBIR/STTR Program Solicitations - Included within an IC's topic listings, topic areas specific to manufacturing-related areas in the PHS Omnibus Solicitation of the NIH, CDC, and FDA SBIR/STTR Grant Solicitation.

Specific actions HHS has taken toward promoting and supporting manufacturing-related research projects.

The NIH focused on the following procedures and mechanisms to give priority to manufacturing-related SBIR/STTR projects.

- Ongoing: Outreach to raise awareness of EO 13329 to the small business research community - Ongoing as part of presentations to small business applicants across the United States.
- Ongoing: Promoting the manufacturing initiative through conferences, meetings, and website notices.
- Ongoing: Tracking and reporting success stories on the NIH SBIR website that show the impact of the SBIR/STTR programs on manufacturing. See SBIR and STTR Success Stories.

National Aeronautics and Space Administration (NASA)

Examples of NASA manufacturing-related SBIR/STTR projects

Phase I awards associated with these subtopics are listed below:

Firm Name	Proposal Title	Contract#
ORMOND, LLC	Manufacturing Advanced Channel Wall Rocket Liners	NNX14CM29P
Laser & Plasma Technologies, LLC	Monitoring Electron Beam Freeform Fabrication by Active Machine Vision	NNX14CL71P
Transition45 Technologies, Inc.	Higher Strength, Lighter Weight Aluminum Spacecraft Structures	NNX14CL67P
Ultramet	Laser-Directed CVD 3D Printing of Refractory Metal Rocket Propulsion Hardware	NNX14CC71P
COSM Advanced Manufacturing Systems, LLC	New methods of In-Situ Metrology and Process Control for EBF3 Additive Manufacturing	NNX14CL34P
NEI Corporation	Self-healing FRCs: A New Approach to Damage Tolerant Cryotanks	NNX14CL65P
Flightware, Inc.	Automated Ply Inspection (API) for AFP	NNX14CL39P
Cornerstone Research Group, Inc.	NONA Cure of Prepreg Structures	NNX14CM1
ATSP Innovations	Aromatic Thermosetting coPolyester Composites for High Temperature and Cryogenic Applications	NNX14CM10P
MER Corporation	Additive Manufacturing Synthesis of Novel Materials for 3000 Degree	NNX14CD10P
Thermacore, Inc.	Additive Manufacturing of Heat Pipe Wicks	NNX14CC90P
Voxtel, Inc.	Monolithic Gradient Index Phase Plate Array	NNX14CG41P
SURVICE Engineering Company, LLC	Innovative Non-Contact Metrology Solutions for Large Optical Telescopes	NNX14CG32P
OptiPro Systems, LLC	Figuring and Polishing Precision Optical Surfaces	NNX14CM23P
Optimax Systems, Inc.	Manufacture of Free-Form Optical Surfaces with Limited Mid-Spatial Frequency Error	NNX14CM22P
OptiPro Systems, LLC	Optical Metrology of Aspheric and Freeform Mirrors	NNX14CM21P
Plasma Controls, LLC	Additive Manufacturing of Ion Thruster Optics	NNX14CC64P
Liquidmetal Technologies, Inc.	Large-Scale Manufacturing of Bulk Metallic Glass Sheets and Fiber Metal Laminates	NNX14CP29P
Made in Space, Inc.	MicroCast: Additive Manufacturing of Metal Plus Insulator Structures with Sub-mm Features	NNX14CG55P
CFD Research Corporation	Multiple High-Fidelity Modeling Tools for Metal Additive Manufacturing Process Development	NNX14CM42P

Phase II awards made in FY14 associated with subtopics solicited for Phase I in FY13 include:

Firm Name	Proposal Title	Contract#
Analytical Services, Inc. (ASI)	Low-Cost Manufacturing Technique for Advanced Regenerative Cooling for In-Space Cryogenic Engines	NNX14CC21C
Schultz-Creehan Holdings Inc.	Additive Friction Stir Deposition of Aluminum Alloys and Functionally Graded Structures	NNX14CL08C

ITN Energy Systems, Inc.	Advanced Manufacturing of Intermediate Temperature, Direct Methane Oxidation Membrane Electrode Assemblies for Durable Solid Oxide Fuel Cell	NNX14CS60C
Deployable Space Systems, Inc.	Automated High-Volume Manufacturing of Modular Photovoltaic Panel Assemblies for Space Solar Arrays	NNX14CC17C
Vanguard Space Technologies, Inc	Low Cost Automated Manufacture of PV Array Technology (P-NASA12-007-1)	NNX14CC02C
ReliaCoat Technologies, LLC	Light Weight, Scalable Manufacturing of Telescope Optics	NNX14CM05C
ORMOND, LLC	Low Cost Method of Manufacturing Space Optics	NNX14CM01C

Procedures and mechanisms NASA has used to date to give priority to manufacturing-related projects.

NASA's SBIR/STTR commitment to American manufacturing is demonstrated to be both ongoing and significant, and is expected to continue in the future. The programs support the research and technology needs of the Agency's Mission Directorates – Science, Human Exploration and Operation, Aeronautics Research, and Space Technology. These needs include searching for novel concepts and advanced capabilities at ever improving levels of efficiency. New topics in NASA's solicitation for Phase I awards in FY 2014 that have future application to NASA' s mission needs, but also call out the need for advanced manufacturing related technology (including the development and production of new materials) included:

- H2.02 – In-Space Chemical Propulsion
- H5.01 – Additive Manufacturing of Lightweight Metallic Structures
- H5.03 – Advanced Fabrication and Manufacturing of Polymer Matrix Composite (PMC) Structures
- H5.04 – Hot Structures
- H8.02 – Space Nuclear Power Systems
- S2.04 – Optics Manufacturing and Metrology for Telescope Optical Surfaces
- S3.02 – Propulsion Systems for Robotic Science Missions
- T12.03 – Additive Manufacturing of metal Plus Insulator Structures with sub-mm Features
- T12.04 – Experimental and Analytical Technologies for Additive Manufacturing
- Z2.01 – Cross Cutting advanced manufacturing process for large scale bulk metallic glass systems for aerospace applications

Full Descriptions of these subtopics can be found at: http://sbir.gsfc.nasa.gov/solicit/52896/detail?data=ch9&s=52890 and http://sbir.nasa.gov/solicit/52896/detail?data=ch9&s=52891

Specific actions NASA has taken toward promoting and supporting manufacturing-related research projects.

In further support of manufacturing related efforts, NASA's Space Technology Mission Directorate (STMD) continues to invest in lower Technology Readiness Level (TRL) development of enhanced and novel manufacturing processes and tools. Manufacturing remains critical to all NASA missions and

STMD utilizes the SBIR/STTR program as one mechanism in achieving manufacturing affordability for complex components for our missions as well as providing an avenue for small businesses to push the envelope in developing multifaceted and critical materials and manufacturing tools and processes.

By leveraging NASA's in-house capabilities, industry can develop and use facilities and expertise as testing grounds and pathfinders for many of NASA technological needs. From the manufacturing feats on the Mars Curiosity Rover, James Webb Space Telescope, and "Composite Cryo tank" project to initiatives for Rocket Engine additive manufacturing, NASA has enhanced the manufacturing capabilities of small and large firms collaborated through many avenues, including SBIR/STTR. NASA's SBIR/STTR programs fulfill mandated requirements encouraging innovation in manufacturing. The annual Solicitations include the following text:

> *The solicitation complies with the EO directing Federal agencies that administer the SBIR and STTR programs to encourage innovation in manufacturing related research and development consistent with the objectives of each agency and to the extent permitted by law. In response to this Executive Order, NASA encourages the submission of applications that deal with some aspect of innovative manufacturing technology. If a proposal has a connection to manufacturing this should be indicated in the Part 5 (Related R/R&D) of the proposal and a brief explanation of how it is related to manufacturing should be provided.*

National Science Foundation (NSF)

Examples of NSF manufacturing-related SBIR/STTR projects

Firm Name	Award Title	Award Amount	Phase
Soraa, Inc., aka SJS Technologies	High quality, low cost bulk gallium nitride substrates	$99,935	I
Soraa, Inc., aka SJS Technologies	High quality, low cost bulk gallium nitride substrates	$1,047,999	II
MOHAWK INNOVATIVE TECHNOLOGY, INC.	Ultrahigh Speed Micromachining Spindle	$520,438	II
Persimmon Technologies Corporation	Spray-Formed Soft Magnetic Material for Efficient Hybrid-Field Electric Machines	$150,000	I
Persimmon Technologies Corporation	Spray Formed Soft Magnetic Material for Efficient Hybrid-Field Electric Machines	$1,027,658	II
Energid Technologies	Real-Time Roboting Grasping System	$100,000	I
Energid Technologies	Real-Time Roboting Grasping System	$1,249,200	II
Soraa, Inc., aka SJS Technologies	High quality, low cost bulk gallium nitride substrates	$1,047,999	II

Procedures and mechanisms NSF has used to date to give priority to manufacturing-related projects.

For more than 14 years NSF has explicitly included manufacturing under its solicitation topics. The current topic is entitled Advanced Manufacturing and Nanotechnology where manufacturing processes, machines and equipment and modeling simulation are featured. Other sub-topics with a strong connection to manufacturing innovation include Electronic Devices, Boards and Interfaces, Robotics in Agile Manufacturing, Co-Robots, Instrumentation for Detection, Actuation, Control, and Manipulation.

In these solicitations NSF has used manufacturing innovation as a tiebreaker in making funding decisions. In 2014 the NSF SBIR/STTR Program made 60 awards that specifically focused on manufacturing innovations.

Specific actions NSF has taken toward promoting and supporting manufacturing-related research projects.

NSF has expanded the number of manufacturing-related topic in the FY 2014 solicitations, as well as promoting these topics in outreach programs including the expanded use of webinars to reach a broader audience. NSF has also expanded its collaboration with the NIST Manufacturing Extension Partnership to leverage additional support for our grantees in the manufacturing area. An earlier SBA analysis of NSF SBIR/ STTR awards showed that ~40% of the NSF awards had a manufacturing innovation component when processing was considered along with materials development.