Implementing Technology with Industrial Community: The SBIR Example

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Abstract— The Earth-Sun system Technology Office (ESTO) works with Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs to supplement its own technology development program. The SBIR/STTR program is a highly competitive program that encourages small business to explore their technological potential to fulfill technology needs identified by ESTO. SBIR program has three phases. The Phase 1 contracts last for 6 months with a maximum funding of $70,000, and Phase 2 contracts last for 24 months with a maximum funding of $600,000. For Phase 3, the small business must find funding in the private sector or other non-SBIR federal agency funding. During this phase ESTO evaluates Phase 2 graduates and selects those that need to be further developed for airborne or spaceflight demonstration and provides funding. This paper will discuss the all three phases in and role of ESTO in this program.

TABLE OF CONTENTS

1. INTRODUCTION

A technology program is strengthened when it draws upon industrial (small or large) and academic communities. In most cases, new capabilities and new infrastructure get developed. The Earth-Sun system Technology Office (ESTO) works with industry (small or large), academia, NASA centers, and other government's laboratories to develop technology [1]. ESTO has long been involved in SBIR & STTR programs, but for the first time involved in Phase 3 projects. This paper provides a summary of SBIR/STTR programs, a few examples of successes to date, and summarizes a recent experiment in Phase 3 projects.

2. SBIR PROGRAM

Established by U.S. Congress, the primarily goal of Small Business Innovation Research SBIR[2] program is to increase opportunities for smaller firms to participate in government research and technology. Each July NASA issues its annual SBIR and STTR solicitations. The Solicitation period is open for approximately two months and winners are announced about three months after its closing. The information of solicitation and schedule is available at the web site (sbir.nasa.gov). The programs have three phases:

Phase 1 contracts last for 6 months with a maximum value of $70,000 for SBIR and $100,000 and 1 year for STTR. The Phase 1 provides opportunity to establish the feasibility and technical merit of a proposed innovation.

Phase 2 allows the most promising of the Phase 1 projects to continue to develop. Selection criteria for Phase 2 include scientific and technical merit, expected value to NASA, and commercial potential. Both SBIR and STTR phase contracts are usually for a period of 2 years with maximum funding of $600K.

Phase 3 is the infusion of the Phase 2 results into NASA programs, other government agencies or the private sector. The funding of Phase 3 projects comes from source other than SBIR/STTR programs and there is no limit on the funds. The funding decision for Phase 3 projects depends on state of technology coming out of Phase 2. The procurement process for Phase 3 is expedited since federal competitions in contracting requirements have been met by the Phase 1 & 2 competitions.

NASA's SBIR and STTR programs are highly competitive. Historically, 13% of SBIR and 20% of STTR Phase I proposals submitted receive awards. About 40% of the completed Phase I projects receive funding for Phase 2 development.

ESTO has been the point of contact for SBIR program at NASA's Earth and Earth-Sun science programs. Each spring, NASA issues the solicitation development guidelines. ESTO coordinates the development of all the topics and subtopics description with NASA field centers. Typically, topic description contains high level objectives of a technology. For example, topic "Scientific Instruments/sensors" may describe type of instruments and what measurements could be made with those instruments. The subtopics that relate to topic define more specifics of technology need. For example, active microwave, which is a measurement technique, may define requirements such as band type, size of antenna, and etc. After the completion of development of the solicitation, it is issued to the public each July and it stays open for period of two months.

After the solicitation is closed, it takes about three months to evaluate and select the winners. During the evaluation process, NASA researches and engineers, working in the appropriate area of technology, apply a uniform set of criteria and procedures based on evaluation factors and other requirements found in solicitation. Each NASA field center prepares its priority ranking of the proposals recommended for awards by reviewers. The SBIR/STTR Source Selection Official at NASA Headquarters selects proposal for contract negotiations. Similar process is followed for Phase 2 selection. The following tables summarize the solicitation from the last 2 years for the former Earth Science Enterprise. The first column of table shows the topic and subtopics, the second column shows the number of proposal received in each subtopics, and the last two column show the awards given out for Phase 1 and Phase 2.

ESE SBIR Solicitation 2003 Subtopics	2003 Phase I Proposals	2003 Phase I Awards	2002 Phase II Awards
Instruments for Earth Science Measurements	**215**	**31**	**15**
Passive Optical	41	8	2
Lidar Remote Sensing	52	7	4
In Situ Sensor	47	5	3
Passive Microwave	12	3	0
Active Microwave	27	4	1
Passive Infrared - submillimeter	8	0	1
Thermal Control for Instruments (cryogenic with Code S)	30	4	4
Platform Technologies for Earth Science Measurements	**338**	**20**	**7**
Guidance Navigation and Control	31	2	1
Command and Data Handling	13	1	0
Advanced Communication Technologies for Near-Earth Missions	101	3	1
On-board Propulsion	34	5	1
Energy Storage Technologies	43	3	
Energy Convesion for Aerospace Applications	29	3	3
Power Management and Distribution	38	3	1
Structures and Materials (shared with Code S & T)	49	4	1
Advanced Information Systems Technologies	**121**	**6**	**4**
Knowledge Discovery & Data Fusion	33	0	0
Automation and Planning	20	2	0
High-Performance Computing & Networking	17	0	1
Distributed Information Systems & Numerical Simulation			
Geospatial Data Analysis processing and Visualization Technologies	25	3	2
Data Management and Visualization	17	1	1
On-Board Science for Decisions and Actions	9	0	0
Applying Earth Science Measurements	**33**	**5**	**2**
Innovative Tools and Techniques Supporting the Practical Uses of Earth Science Observations	11	2	1
Advanced Educational Processes and Tools	14	1	1
Wireless Technologies for Spatial Data Input, Manipulation and Distribution	8	2	
TOTALS	**707**	**62**	**28**

Table 1: Summary of SBIR 2003 Solicitation for former ESE

ESE SBIR Solicitation 2004 Subtopics	2004 Phase I Proposals	2004 Phase I Awards	2003 Phase II Awards
Instruments for Earth Science Measurements	**158**	**22**	**12**
Passive Optical	16	2	4
Lidar Remote Sensing	56	4	3
In Situ Sensor	17	2	2
Passive Microwave	9	2	2
Active Microwave	27	4	1
Passive Infrared - submillimeter	8	3	
Thermal Control for Instruments (cryogenic with Code S)	26	5	
Platform Technologies for Earth Science Measurements	**142**	**14**	**6**
Guidance Navigation and Control	21	2	1
Command and Data Handling	18	2	1
Advanced Communication Technologies for Near-Earth Missions	17	2	1
On-board Propulsion	16	2	1
Energy Storage Technologies	45	1	2
Energy Convesion for Aerospace Applications	25	3	
Power Management and Distribution	20	2	
Advanced Information Systems Technologies	**73**	**10**	**3**
Automation and Planning	16	4	
Distributed Information Systems & Numerical Simulation	14	1	
Geospatial Data Analysis processing and Visualization Technologies	22	3	
Data Management and Visualization	16	1	1
On-Board Science for Decisions and Actions	5	1	0
Applying Earth Science Measurements	**52**	**6**	**3**
Innovative Tools and Techniques Supporting the Practical Uses of Earth Science Observations	15	3	1
Advanced Educational Processes and Tools	11	1	
Wireless Technologies for Spatial Data Input, Manipulation and Distribution	6	2	2
TOTALS	**426**	**52**	**22**

Table 2: Summary of SBIR 2004 Solicitation for former ESE

3. SUCCESS STORIES

About 13% of proposals received for Phase 1 are awarded and about 40% of those 13% get Phase 2 funds and most of Phase 2 ended up being successful projects. NASA SBIR/STTR programs capture all the successful projects and highlight them on its website http://sbir.gsfc.nasa.gov/SBIR/success.htm . NASA calls these "success stories". One can browse or search for success stories by technology listing, firm name, and etc. Also, other success stories come from SBIR leveraging ESTO funded and ESTO leveraging SBIR funded technologies. An example (Figure 1) of that is PicoDyne that ESTO funded under its Advanced Information Technology (AIST) program in 1999 and in 2002, it received funding from SBIR program for Phase 2 work. This technology uses Ultra-Low Power CMOS process technology and radiation tolerant circuit method to a Field Programmable Gate Array (FPGA) compatible with tools from one of the leading FPGA producer. The SBIR 2002 Phase 2 projects will allow PicoDyne to incorporate these ultra-low power FPGAs with 32 bit microprocessor. This technology would significantly decrease the power consumption of Field Programmable Gate Array (FPGA) devices thus enhancing the lifetime of the devices and reducing the overall mission costs.

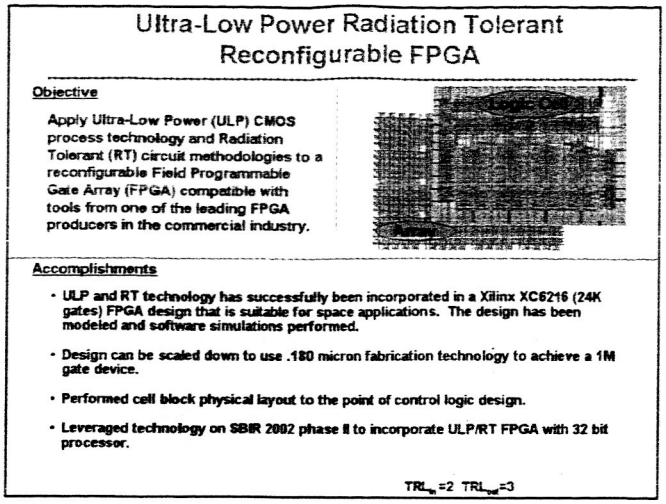

Figure 1: Example of SBIR leveraging ESTO funded technology

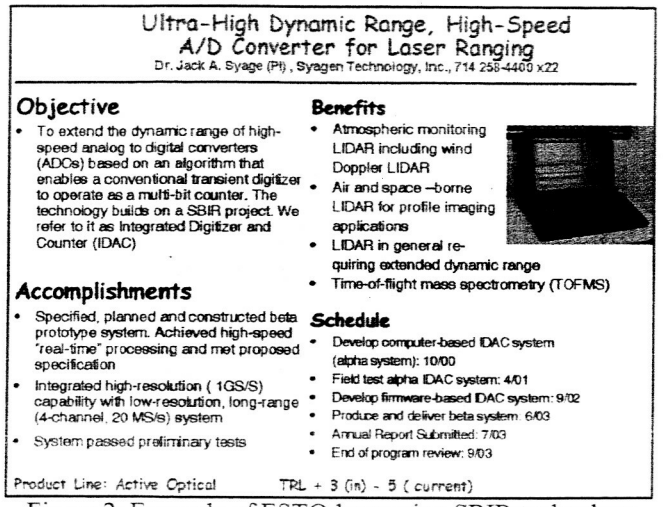

Figure 2: Example of ESTO leveraging SBIR technology

Another example (Figure 2) in which ESTO funded SBIR Phase I results in Advanced Component Technology (ACT) program. This technology would increase the dynamic range of high speed analog to digital converters that would result in better atmosphere monitoring and other LIDAR applications. Both of these example show how ESTO and SBIR leverage technology development. Next section will describe the Phase 3 process implemented by ESTO in 2004.

4. PHASE 3 PROCESS

In November 2003, ESTO initiated Phase 3 process and decided to review SBIR 2000 & 2001 Phase 2 projects that are either completed or about to be completed for funding them for further development. For evaluation and selection, ESTO established a two step process. In first step, ESTO peer reviewed all Phase 2 projects in instrument, platform, and information technology areas. We reviewed 29 instrument, 17 platform, and 8 information technology projects. 13 of 29 instruments technology projects received favorable reviews for Phase 3 consideration and none of platform and information technology projects were considered for Phase III because of unfavorable reviews. Selection criteria were established based on the science requirements and technology readiness level of the Phase II projects. 11 of 13 projects that were considered for Phase 3 received technical and cost proposals. These proposals were reviewed and ranked by ESTO and NASA earth science scientists. These proposals were evaluated and ranked based on technical merit, cost, and schedule. Five of 11 proposals were selected for Phase 3 contract negotiations. Below is the list of those that received Phase 3 contract from ESTO.

1. A Very Low Power, Highly-Integrated Multichannel Scaler; **ASRC Aerospace Corporation**
2. High-Power, Single-Frequency UV Laser Transmitter; **Lite Cycles, Inc.**
3. 349-nm Source for Direct Detection Measurement of Winds; **Q-Peak, Inc.**
4. A Compact Modular Airborne DIAL Sensor for Ozone Measurements; **Science & Engineering Services, Inc.**
5. Full Spectropolarimetric Vaidation and Performance Enhancements for the Hyperspectral Polarimeter for Aerosol Retrievals (HySPAR); **Aerodyne Research, Inc.**

The contract length of this Phase 3 varies form 6 months to 24 months. The total value of this Phase 3 is about $1.2M. These contracts are being managed through ESTO in coordination with NASA scientists who are the ultimate beneficiary of these technologies.

4. CONCLUSION

NASA's SBIR program spends well over $15M only on Earth and Earth-Sun science that is 1/3rd of the NASA's Science Mission Directorate. Working with SBIR/STTR programs, ESTO has established a very well coordinated technology development program. This allows ESTO to align its own technology development program with SBIR/STTR programs. Also, small business community can benefit from other ESTO technology development programs by submitting proposals when ESTO offers its own solicitations.

REFERENCES

[1] Robert bauer, Michael Pasciuto, "Organizing to Implement Technology in the NASA Science Organization", 2005 IEEE Aerospace Conference

[2] NASA/SBIR Web site sbir.nasa.gov

[3]NASA/ESTO Web site http://esto.nasa.gov/

BIOGRAPHY

Parminder Ghuman is a Technology Development Manger for NASA. He is responsible for coordination of technology development throughout the agency for Earth-Sun System Division of Science Mission Directoate. He supports the Agency Program Scientist, responsible for the Water and Energy Cycle focus area, in identifying, planning, and scheduling strategic technologies in support of future Agency missions. He has MS in Electrical Engineering from George Washington University and MS in Applied Physics from John Hopkins University