Revisiting the Department of Defense SBIR Fast Track Initiative

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REVISITING THE DEPARTMENT OF DEFENSE SBIR FAST TRACK INITIATIVE

Committee for
Capitalizing on Science, Technology, and Innovation:
An Assessment of the Small Business Innovation Research Program

Policy and Global Affairs

Charles W. Wessner, Editor

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Preface

Today's knowledge economy is driven in large part by the nation's capacity to innovate. One of the defining features of the U.S. economy is a high level of entrepreneurial activity. Entrepreneurs in the United States see opportunities and are willing and able to take on risk to bring new welfare enhancing, wealth generating technologies to the market. Yet, while innovation in areas such as genomics, bioinformatics, and nanotechnology present new opportunities, converting these ideas into innovations for the market involves substantial challenges.[1] The American capacity for innovation can be strengthened by addressing the challenges faced by entrepreneurs. Public-private partnerships offer one means of helping entrepreneurs bring new ideas to market.

The Small Business Innovation Research (SBIR) program is one of the largest examples of U.S. public-private partnerships. The underlying premise of the program is that small businesses are a strong source for new ideas, but that they often lack financial support in the early stages of product development. Founded in 1982, SBIR was designed to encourage small business to develop new processes and products and to provide quality research in support of the many missions of the U.S. government. By including qualified small technologically oriented businesses in the nation's R&D effort, SBIR grants stimulate innovative new technologies to help agencies meet the specific research and development needs of the nation in many areas, including health, the environment, and national defense.

[1]See Lewis M. Branscomb, Kenneth P. Morse, Michael J. Roberts, and Darin Boville, *Managing Technical Risk: Understanding Private Sector Decision Making on Early Stage Technology Based Projects,* Washington, DC: Department of Commerce/National Institute of Standards and Technology, 2000.

PROJECT ANTECEDENTS

This assessment of the SBIR Fast Track program at the Department of Defense follows directly from an earlier analysis of public-private partnerships by the National Research Council's Board on Science, Technology, and Economic Policy (STEP). Under the direction of Gordon Moore, Chairman Emeritus of Intel, the NRC Committee on Government Industry Partnerships prepared eleven volumes reviewing the drivers of cooperation among industry, universities, and government; operational assessments of current programs; emerging needs at the intersection of biotechnology and information technology; the current experience of foreign government partnerships and opportunities for international cooperation; and the changing roles of government laboratories, universities, and other research organizations in the national innovation system. [2]

The Moore Committee's analysis of public-private partnerships included reviews of the SBIR program. Drawing from expert knowledge at a 1998 workshop held at the National Academy of Sciences, the first report, *The Small Business Innovation Research Program: Challenges and Opportunities,* examined the origins of the program and identified some operational challenges critical to the program's future effectiveness.[3] The report also highlighted the relative paucity of research on this program.

THE 2000 ASSESSMENT OF FAST TRACK AT DoD

Following this initial report, the Department of Defense asked the NRC to assess the Department's Fast Track Initiative in comparison with the operation of its regular SBIR program. The resulting report, *The Small Business Innovation Research Program: An Assessment of the Department of Defense Fast Track Initiative,* was the first comprehensive, external assessment of the Department of Defense's program. [4] The study, which involved substantial case study and survey research, found that "the SBIR program is contributing to the achievement of the Department of Defense mission goals."[5] It also found that DoD's Fast Track Initiative was achieving its objective of greater commercialization and recommended that the program be continued and expanded where appropriate.[6] The report also recommended that the SBIR

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[2]For a summary analysis of best practice among U.S. public-private partnerships, see National Research Council, *Government-Industry Partnerships for the Development of New Technologies: Summary Report*, Charles W. Wessner, ed., Washington, DC: The National Academies Press, 2003.
[3]See National Research Council, *The Small Business Innovation Research Program: Challenges and Opportunities,* Charles W. Wessner, ed., Washington, DC: National Academy Press, 1999.
[4]See SBIR Reauthorization Act of 2000 (H.R. 5667, Section 108).
[5]See National Research Council, *The Small Business Innovation Research Program: An Assessment of the Department of Defense Fast Track Initiative,* Charles W. Wessner, ed., Washington, DC: National Academy Press, 2000, p. 32.
[6]See National Research Council, *The Small Business Innovation Research Program: An Assessment of the Department of Defense Fast Track Initiative,* op. cit. Given that virtually no published

program overall would benefit from further research and analysis, a perspective adopted by the U.S. Congress.

SBIR REAUTHORIZATION AND THE CONGRESSIONAL REQUEST FOR REVIEW

As a part of the 2000 reauthorization of the SBIR program, Congress called for a review of the SBIR programs of the agencies that account collectively for 96 percent of program funding. As noted, the five agencies meeting this criterion, by size of program, are the Departments of Defense, The National Institutes of Health, the National Aeronautics and Space Administration, the Department of Energy, and the National Science Foundation.

HR 5667 directed the NRC to evaluate the quality of SBIR research and evaluate the SBIR program's value to the agency mission. It called for an assessment of the extent to which SBIR projects achieve some measure of commercialization, as well as an evaluation of the program's overall economic and noneconomic benefits. It also called for additional analysis as required to support specific recommendations on areas such as measuring outcomes for agency strategy and performance, increasing federal procurement of technologies produced by small business, and overall improvements to the SBIR program.

To guide this study, the National Research Council drew together an expert committee that includes eminent economists, small business men and women, and venture capitalists. The membership of this committee is listed in the front matter of this volume. The Steering Committee in turn drew on a distinguished team of researchers to, among other tasks, administer surveys and case studies, and to develop statistical information about the program. The Front Matter to this volume lists the membership of this research team.

A SECOND "SNAPSHOT" OF FAST TRACK

Capitalizing on the ongoing assessment, and partway through the study, the Department of Defense requested the NRC to conduct a follow up assessment of its SBIR Fast Track program. The NRC accordingly developed and deployed a survey that drew on and refined the methodology developed in its 2000 study of SBIR Fast Track.[7] This report thus captures a second snapshot of the contributions of the Department of Defense Fast Track program.

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analytical literature existed on SBIR, this Fast Track study pioneered research in this area, developing extensive case studies and newly developed surveys.

[7]See National Research Council, *The Small Business Innovation Research Program: An Assessment of the Department of Defense Fast Track Initiative,* op. cit.

Statement of Task

This report presents the NRC review of the operation of the goals, operations, and achievements of the SBIR Fast Track program in operation at the Department of Defense. Building on the results of a 2000 NRC report on the DoD Fast Track program and drawing on survey and case study analysis, the NRC Committee will assess the Fast Track program in light of its goals, taking into account the program's administrative and other costs, and possible alternatives (e.g., Phase II Enhancement). The report, including empirical analysis and case study results, provides the basis for the Committee's findings and recommendations.

While the text of the original statement of task (above) refers to Fast Track and the Phase II Enhancement programs as alternatives, it is important to note that they are in fact complements. The Fast Track program is designed to improve commercialization by reducing significant gaps in funding between Phases I and II for SBIR projects. The Phase II Enhancement program is designed to encourage the transition of SBIR research into DoD acquisition programs and/or into the private sector after Phase II. This report, therefore, does not seek to determine if the Fast Track program is better than the Phase II Enhancement program or vice-versa. The report recognizes that these two initiatives are designed to address different needs and determines whether each of them provides measurable benefits to the DoD SBIR program.

This report complements a series of reports being published by the National Academies in response to the congressional request. The series includes reports on the Small Business Innovation Research Program at the Department of Defense, the National Institutes of Health, the Department of Energy, the National Aeronautics and Space Administration, and the National Science Foundation—the five agencies responsible for 96 percent of the program's operations.[8] This series is capped by an Overview Report that summarizes the program's operations across the federal government.[9] Other reports in the series include a summary of the 2002 conference that launched the study, and a summary of the 2005 conference on *SBIR and the Phase III Challenge of Commercialization* at the Department of Defense and NASA.[10]

[8]See especially National Research Council, *An Assessment of SBIR at the Department of Defense*, Charles W. Wessner, ed., Washington, DC: The National Academies Press, 2009.
[9]See National Research Council, *An Assessment of the Small Business Innovation Research Program*, Charles W. Wessner, ed., Washington, DC: National Academies Press, 2008.
[10]National Research Council, *SBIR and the Phase III Challenge of Commercialization,* Charles W. Wessner, ed., Washington, DC: The National Academies Press, 2007.

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On behalf of the National Academies, we express our appreciation and recognition for the insights, experiences, and perspectives made available by the survey respondents. We are also indebted to Jeffrey Bond, the former SBIR Program Administrator at the Department of Defense and, in particular, to Michael Caccuitto who was until recently the SBIR Program Manager for the Department of Defense, for their encouragement, assistance, and patience during the course of this study.

The Committee specially recognizes Pete Cahill of BRTRC, Inc., for his key role in preparing this report. His valuable insights were important contributions to this analysis. Thanks are also due to Rosalie Ruegg of TIA Consulting for her work on the case studies.

NATIONAL RESEARCH COUNCIL REVIEW

This report has been reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise, in accordance with procedures approved by the National Academies' Report Review Committee. The purpose of this independent review is to provide candid and critical comments that will assist the institution in making its published report as sound as possible and to ensure that the report meets institutional standards for objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the process.

We wish to thank the following individuals for their review of this report: William Bean, College of William & Mary; Jeffrey Bond, Association for Manufacturing Technology; Robert M. Groves, University of Michigan; Bruce Held, RAND Corporation; ML Mackey, Beacon Interactive Systems; Julia Melkers, Georgia Institute of Technology; David Roessner, Georgia Institute of Technology; and Todd Watkins, Lehigh University.

Although the reviewers listed above have provided many constructive comments and suggestions, they were not asked to endorse the conclusions or recommendations, nor did they see the final draft of the report before its release. The review of this report was overseen by Robert Frosch, Harvard University. Appointed by the National Academies, he was responsible for making certain that an independent examination of this report was carried out in accordance with institutional procedures and that all review comments were carefully considered. Responsibility for the final content of this report rests entirely with the authoring committee and the institution.

Jacques S. Gansler Charles W. Wessner

Summary

BACKGROUND OF THE STUDY

In October 1995, the Department of Defense launched a Fast Track initiative to attract new firms and encourage commercialization of SBIR funded technologies throughout the department.[1] The goal of the Fast Track initiative is to improve commercialization through preferential evaluation and efforts to close the funding gap that can occur between Phase I and II of the SBIR program. Reducing this funding gap can help small innovative businesses maintain their momentum while crossing the early-stage funding *Valley of Death*, a term that describes the period of transition when a developing technology is deemed promising, but too new to validate its commercial potential and thereby attract the capital necessary for its continued development.[2]. The time-lag between the conclusion of Phase I and the receipt of Phase II funds can create cash-flow problems for small firms. The Fast Track initiative seeks to address the gap by providing expedited review and essentially continuous funding from Phase I to Phase II as long as applying firms can demonstrate that they have obtained third-party financing for their technology.

Shortly after initiating the Fast Track program, the Department of Defense asked the National Research Council (NRC) to assess this initiative in

[1]As early as 1992, DoD's Ballistic Missile Defense Organization (BMDO) began to reward applications whose technologies demonstrated commercial potential. This BMDO initiative called "co-investment" was effectively an informal "fast track" program. Under this approach, the evaluation process for Phase II proposals gave preference to applicants who could demonstrate that they would commit internal funding or that they had financial or in-kind commitments from third parties to bring the technology to market in Phase III. With that commitment, applicants received essentially continuous funding from Phase I to Phase II.

[2]See Lewis Branscomb and Philip Auerswald, "Valleys of Death and Darwinian Seas: Financing the Invention to Innovation Transition in the United States," *The Journal of Technology Transfer*, 28(3-4), August 2003.

comparison with the operation of its regular SBIR program. The resulting report, *The Small Business Innovation Research Program: An Assessment of the Department of Defense Fast Track Initiative,* was the first comprehensive, external assessment of the Department of Defense's SBIR program.[3] The study, which involved substantial case study and survey research, found that the SBIR program was achieving its legislated goals. It also found that DoD's Fast Track Initiative was achieving its objective of greater commercialization and recommended that the program be continued and expanded where appropriate.[4]

In 1999, the Department of Defense initiated the Phase II Enhancement program (in the Army and OSD—Phase II Plus)[5] as a three year pilot program.[6] The goal of Phase II Enhancement was to concentrate SBIR funds on those R&D projects most likely to result in viable new products that DoD and others will buy.

As a part of the 2000 reauthorization of the SBIR program, Congress called for a review of the SBIR programs at the Department of Defense, the National Institutes of Health, the Department of Energy, the National Aeronautics and Space Administration, and the National Science Foundation. Capitalizing on the ongoing assessment, the Department of Defense requested the NRC to conduct a follow up assessment of its SBIR Fast Track program. The NRC accordingly developed and deployed a survey that drew on and refined the methodology developed in its 1999 study of SBIR Fast Track.[7]

This report presents the NRC review of the operation of the goals, operations, and achievements of the SBIR Fast Track program in operation at the Department of Defense. Building on the results of a 2000 NRC report on the DoD Fast Track program and drawing on survey and case study analysis, the NRC Committee will assess the Fast Track program in light of its goals, taking into account the program's administrative and other costs, and possible alternatives (e.g., Phase II Enhancement). The report, including empirical analysis and case study results, provide the basis for the Committee's findings and recommendations.

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[3]See SBIR Reauthorization Act of 2000 (H.R. 5667, Section 108).

[4]See National Research Council, *The Small Business Innovation Research Program: An Assessment of the Department of Defense Fast Track Initiative,* Charles W. Wessner, ed., Washington, DC: National Academy Press, 2000. Given that almost no published analytical literature existed on SBIR at that time, this Fast Track study pioneered research in this area, developing extensive case studies and newly developed surveys.

[5]Although both Army and OSD SBIR name their Phase II Enhancement programs Phase II Plus, DoD refers to the overall program as Phase II Enhancement in their solicitations, hence this report uses the term Phase II Enhancement to include all DoD components that participate.

[6]Although the Phase II Enhancement program was announced in 1999 in solicitation 99.2, the first few awards were made on Phase II that had been awarded their Phase II contracts in 1997. The first Phase II Enhancement that was let on a topic contained in Solicitation 99.2 was not awarded until 2002. In general, a Phase II Enhancement awarded this year is a modification to the Phase II contract that was let two years ago.

[7]See National Research Council, *The Small Business Innovation Research Program: An Assessment of the Department of Defense Fast Track Initiative,* op. cit.

BOX S-1
SBIR Fast Track and the Phase II Enhancement Programs at DoD

The Fast Track Program: Closing the Gap between Phase I and Phase II

Initiated in 1995, DoD's Fast Track program seeks to improve commercialization by reducing significant gaps in funding between Phases I and II for SBIR projects. The time lag between the conclusion of Phase I and the receipt of Phase II can create cash flow problems for small firms. Fast Track addresses this gap by providing expedited review and essentially continuous funding from Phase I to Phase II as long as applying firms can demonstrate that they have attracted outside investors who will match Phase II funding, contingent on the project's selection for Phase II award. Projects that qualify for the Fast Track receive interim funding of $30,000 to $50,000 between Phases I and II.

The Phase II Enhancement: Transitioning Beyond Phase II

Since 2000, DoD Components have developed policies to further encourage the transition of SBIR research into DoD acquisition programs and/or the private sector. Under this policy, DoD Components provide an eligible firm with additional Phase II SBIR funding (up to $500,000) to match investment funds that the firm is able to obtain from non-SBIR sources (such as DoD acquisition programs or the private sector.) Among the DoD Components, the Navy and Army focus on funding additional research and development, and the Air Force focuses on overcoming unforeseen technological barriers. All three services and the Missile Defense Agency direct their enhancement programs to transition into acquisition programs.

While the text of the original statement of task refers to Fast Track and the Phase II Enhancement programs as alternatives, it is important to note that they are in fact complements. The Fast Track program is designed to improve commercialization by reducing significant gaps in funding between Phases I and II for SBIR projects. The Phase II Enhancement program is designed to encourage the transition of SBIR research into DoD acquisition programs and/or into the private sector after Phase II. This report, therefore, does not seek to determine if the Fast Track program is better than the Phase II Enhancement program or vice-versa. The report recognizes that these two initiatives are designed to address different needs and determines whether each of them provides measurable benefits to the DoD SBIR program.

KEY CONCLUSIONS

The current National Research Council's (NRC) evaluation of two Department of Defense (DoD) Small Business Innovation Research (SBIR) Program initiatives—Fast Track and Phase II Enhancement—indicates that, from the perspective of the participants, both programs are effective.[8] Firms that have participated in either Fast Track or Phase II Enhancement are glad they did. Ninety percent of Fast Track and 95 percent of Phase II Enhancement reported satisfaction with their decision.[9]

Fast Track Attracts New Firms

Firms that apply for Fast Track tend to be new to the program and younger than average SBIR firms.[10] They have had far fewer Phase II awards than the overall population. Sixty-four percent of surveyed firms are first time Phase II award winners.[11] The average annual firm revenue for Fast Track applicants is less than average SBIR firms. Fast Track is successful in involving firms with no prior SBIR experience. The number of Fast Track awards is small, however, lessening the significance of this effect.

This is a very good outcome of the Fast Track initiative. It means that the program effectively reaches out to new companies and new investors. This influx of new firms sustains the competitive nature of DoD innovation, encouraging commercially focused, high-quality entrepreneurs to participate in defense procurement.

Fast Track Drawbacks for Firms

Fast Track presents two significant drawbacks for firms. The first drawback is that it requires firms to obtain funding commitments prior to completing Phase I, which in turn means attempting to find such funding before or very early in Phase I—i.e., before the demonstration of feasibility is completed. The second related drawback, which applies whenever the third-party investor is not a federal program, is that many small innovative firms are reluctant to part with equity that is often demanded by private sector investors. In the first year of Fast Track, 80 percent of the third party investors were from the private sector. In the most recent four years of the program, only one third of the third party investors were from the private sector.

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[8]It is important to note that this report does not seek to compare Fast Track with the Phase II Enhancement program, as these are different programs with different objectives.

[9]See Figure 2-20. Source: NRC Project Survey 2006, Questions 28 and 30, Appendix C.

[10]Only 2.5 percent of Phase II awards are Fast Track. The survey indicates 64 percent of Fast Track participants are first time Phase II awardees. However, for the other 97.5 percent of the DoD Phase II program, 37 percent are first time Phase II. Thus, only 4 percent of all first time Phase II awards are on Fast Track proposals.

[11]See Figure 2-4. Source: NRC Project Survey 2006, Question 19, Appendix C.

Fast Track Drawbacks for the Agency

There are also drawbacks to Fast Track from the agency viewpoint. For SBIR program managers, the Fast Track program requires additional administrative effort because Fast Track operates outside the normal SBIR selection process. Recognizing the positive value of gap funding under Fast Track, however, program managers initiated procedures for additional funding after Phase I to firms that submitted a Phase II proposal, reducing the attraction of Fast Track.[12]

Analysis of DoD SBIR awards presented in this volume indicates that as more firms pursue Phase II Enhancement, participation in Fast Track, never large, has declined. Since the origination of Fast Track, participation has declined from 7 percent of all Phase II awards in DoD to 2.5 percent, driven by choices made by individual firms.[13] However, there is no direct relationship between the percentage of firms applying for Fast Track and the realization of overall SBIR goals.

Early Acquisition: A Source of Survey Bias

The most successful Fast Track firms may, in fact, be absent from the survey. In some cases, the infusion of private-sector third-party funding for early Fast Track firms appears to have led to their acquisition and thus limited the number responding to the survey.[14] Some of these firms were known to have been highly successful in sales, yet these sales are not reported in the survey.[15] Some of the least successful firms may have been unwilling to respond or may have gone out of business. There are therefore sources for bias for the most successful firms and the least successful firms.[16]

Funding Gaps Remain

Fast Track continues to be successful in nearly eliminating the funding gap between Phases I and II; however, the percent of Fast Track awards

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[12]The Air Force issues a nine-month Phase I, but accepts Phase II proposals after six months. Other components have procedures for three or four months of bridge funding after Phase I at the rate of Phase I funding.

[13]DoD Submissions Database.

[14]Early acquisition encourages entrepreneurship through infusing innovation to the established channels within the services and agencies in the Department of Defense (e.g. Prime Contractors). It is also a proven tool to help bring new products to broader commercial markets.

[15]See Figures 2-10 and 2-11. One firm, Digital Systems Resources, Inc., which received 16 of the 248 Fast Track awards made during the surveyed period, was acquired by General Dynamics in September of 2003. At the time of acquisition, DSR had received 40 Phase II SBIR awards and had reported $368 million in resultant sales and investment.

[16]For a discussion of multiple sources of bias in survey responses, see Box 2-1 in Chapter 2 of this volume.

reporting no gap has decreased and the average gap has increased in recent years.[17]

The Phase II Enhancement Program

The Phase II Enhancement program has grown each year since its inception. Of projects receiving their Phase II award in 2002, almost 20 percent received a subsequent Phase II Enhancement.[18] This growth appears to reflect the advantages of this program.

Advantages of the Phase II Enhancement are, first, that it does not require evaluation of the Phase II proposal outside of the DoD component's normal evaluation process. Second, the Phase II Enhancement also employs criteria established by the DoD component to meet their priorities, making the Phase II Enhancement program responsive to the needs of the units making the awards. Third, the Enhancement program provides firms additional time to locate third party investors and places less of a burden on firm management. Proposals are not due until late in Phase II and, thus, provide time (normally one additional year) to obtain additional SBIR funding to the firm. Finally, based on a project's technical achievement, Phase II Enhancement also provides the opportunity to leverage acquisition program funding to increase the level of funding available; i.e., an acquisition program has its R&D investment in Phase II Enhancement matched by SBIR funding, thereby achieving more with its programmed funding.[19]

These innovations in SBIR program operations at DoD reflect well on its management. Both programs were designed to provide additional support to promising firms able to attract additional private or public sector interest and investment. The growth of the Phase II Enhancement suggests that additional measures may be warranted to transition the most promising technologies to the warfighter.

[17]See Figures 2-24 and 2-15.
[18]DoD Submissions Database.
[19]See Chapter 1, section on "DoD Initiatives to Improve Commercialization: The Phase II Enhancement," in this volume.

1

Assessing the SBIR Fast Track and Phase II Enhancement Programs at the Department of Defense

This assessment of the operation of the goals, operations, and achievements of the SBIR Fast Track program and the Phase II Enhancement program at the Department of Defense builds on the results of a 2000 NRC report on the DoD Fast Track program and on a broader 2009 assessment of the SBIR program at DoD.[1] Drawing on survey and case study analysis, this study assesses the Fast Track and Phase II Enhancement programs in light of their goals.

This chapter describes the two key Department of Defense (DoD) initiatives—the Fast Track program and the Phase II Enhancement program—designed to improve the commercialization of innovative products and services supported by DoD Small Business Innovation Research (SBIR) awards. It begins with a sketch of the operation of the SBIR program within DoD, drawing on related NRC studies of SBIR and also describes the growing emphasis on commercialization as an objective of the DoD SBIR program as a background to the Fast Track and Phase II Enhancement programs.[2]

KEY FEATURES OF THE SBIR PROGRAM

The Small Business Innovation Research (SBIR) program was created in 1982 by the Small Business Innovation Development Act. SBIR is designed to stimulate technological innovation among small private-sector businesses

[1]See National Research Council, *An Assessment of the SBIR Program at the Department of Defense*, Charles W. Wessner, ed., Washington, DC: The National Academies Press, 2009. See also National Research Council, *The Small Business Innovation Research Program: An Assessment of the Department of Defense Fast Track Initiative*, Charles W. Wessner, ed., Washington, DC: National Academy Press, 2000.

[2]See National Research Council, *An Assessment of SBIR at the Department of Defense*, op. cit. See also National Research Council, *The Small Business Innovation Research Program: An Assessment of the Department of Defense Fast Track Initiative*, op. cit.

while providing the government new technical and scientific solutions to challenging mission problems that are cost-effective. SBIR is also designed to help to stimulate the U.S. economy by encouraging small businesses, including woman- and minority-owned small businesses, to market innovative technologies in the private sector.[3]

Eleven federal agencies are currently required to set aside 2.5 percent of their extramural research and development budget exclusively for SBIR contracts. As the agency with the largest R&D budget, DoD provides half of the total federal SBIR funding—in fiscal year 2007, the budget for the DoD's SBIR budget was $1.13 billion.[4]

Each year these agencies identify various R&D topics, representing scientific and technical problems requiring innovative solutions, for pursuit by small businesses under the SBIR program. These topics are bundled together into individual agency "solicitations" - publicly announced requests for SBIR proposals from interested small businesses.[5]

A qualifying small business can identify an appropriate topic it wants to pursue from these solicitations and, in response, propose a project for an SBIR award.[6] The required format for submitting a proposal is different for each agency. Proposal selection also varies, though peer review of proposals on a competitive basis by experts in the field is typical. Each agency then selects the

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[3]The SBIR legislation drew from a growing body of evidence, starting in the late 1970s and accelerating in the 1980s, which indicated that small businesses were assuming an increasingly important role in both innovation and job creation. This evidence gained new credibility with the Phase I empirical analysis by Zoltan Acs and David Audretsch of the U.S. Small Business Innovation Database, which confirmed the increased importance of small firms in generating technological innovations and their growing contribution to the U.S. economy. See Zoltan Acs and David Audretsch, *Innovation and Small Firms*, Cambridge, MA: MIT Press, 1990.

[4]Testimony of Michael Caccuitto, DoD SBIR Program Administrator, before the House Committee on Science and Technology, June 26, 2007. Access at *<http://www.dod.mil/gc/olc/docs/testCacciutto070626.pdf>*.

[5]The Department of Defense's SBIR solicitations are posted on the Web at *<http://www.acq.osd.mil/osbp/sbir/solicitations/>*.

[6]To be eligible for an SBIR award, the DoD SBIR Solicitation states that a small business must:

- Be independently owned and operated, is not dominant in the field of operation in which it is proposing, has a place of business in the United States and operates primarily within the United States or makes a significant contribution to the U.S. economy, and is organized for profit.
- Be (a) at least 51 percent owned and controlled by one or more individuals who are citizens of, or permanent resident aliens in, the United States or (b) it must be a for-profit business concern that is at least 51 percent owned and controlled by another for-profit business concern that is at least 51 percent owned and controlled by one or more individuals who are citizens of, or permanent resident aliens in, the United States.
- Have, including its affiliates, an average number of employees for the preceding 12 months not exceeding 500, and meets the other regulatory requirements found in 13 CFR Part 121. Business concerns are generally considered to be affiliates of one another when either directly or indirectly, (a) one concern controls or has the power to control the other; or (b) a third-party/parties controls or has the power to control both

Source: The Department Of Defense Small Business Innovation Research (SBIR) Program Solicitation FY06.3, p. 4.

proposals that are found best to meet program selection criteria, and awards contracts or grants to the proposing small businesses. The resulting SBIR funding agreements include any contract, grant, or co-operative agreement entered into between a federal agency and any small business for the performance of experimental, developmental, or research work funded in whole or in part by the federal government.

As conceived in the 1982 Act, SBIR program's award-making process is structured in three phases:

- **Phase I awards.** These awards essentially fund feasibility studies in which award winners undertake a limited amount of research aimed at establishing an idea's scientific and commercial promise. The 1982 legislation anticipates Phase I awards as high as $100,000.
- **Phase II awards.** These awards are larger—typically about $750,000—and fund more extensive R&D to develop the scientific and commercial promise of research ideas further.[7]
- **Phase III.** During this phase, companies do not receive further SBIR awards. Instead, award recipients should be obtaining additional funds from a procurement program at the agency that made the award, from private investors, or from the capital markets. The objective of this phase is to move the technology from the prototype stage to the marketplace.

Obtaining Phase III support is often the most difficult challenge for new firms to overcome. In practice, agencies have developed different approaches to facilitate SBIR awardees' transition to commercialization. Commercial sales and transition to acquisition programs are the principal goals of SBIR Phase III at DoD. The purpose of both Fast Track and Phase II Enhancement is to increase the number and magnitude of Phase III transitions resulting from DoD SBIR awards.

The law calls on the Small Business Administration (SBA) to issue policy directives for the general conduct of the SBIR programs within the federal government. These policy directives include such elements of the program as simplified, standardized, and timely SBIR solicitations; a simplified, standardized funding process; and minimization of the regulatory burden for small businesses participating in the program. Federal agencies are required to report key data to SBA, which in turn is supposed to publish annual reports on the progress of the program.

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[7]The recent NRC study recommended that the amounts for SBIR Phase I and Phase II be increased to $150,000 and $1 million respectively. See National Research Council, *An Assessment of the SBIR Program*, Charles Wessner, ed., Washington, DC: The National Academies Press, 2008. See Recommendation I in Chapter 2. In making these recommendations, the NRC Committee stressed that recommendations are intended as guidance for standard award size. The SBA should continue to provide the maximum flexibility possible with regard to award size and the agencies should continue to exercise their judgment in applying the program standard.

THE SBIR PROGRAM AT DOD

Under the supervision of the Under Secretary of Defense for Acquisition, Technology and Logistics (AT&L), the Office of Small Business Programs (OSBP) in the Office of the Secretary of Defense (OSD) coordinates the overall DoD SBIR program.[8] SADBU provides oversight and sets policy concerning the SBIR program in coordination with the Director of Defense Research and Engineering (DDR&E).

The SBIR program at DoD is decentralized. It is administered by the three services (Army, Navy, Air Force), seven agencies (Defense Advanced Research Project Agency (DARPA), the Missile Defense Agency (MDA), Chemical Biological Defense (CBD), the Defense Threat Reduction Agency (DTRA), the US Special Operations Command (USSOCOM), and National Geospatial-Intelligence Agency (NGA)), and the Defense Logistics Agency (DLA), and one staff element (the Office of Secretary of Defense (OSD)) with R&D budgets meeting the legislated requirements.[9] This decentralization provides each DoD component the opportunity to adapt the program its particular mission and technological needs. In turn, this implies that the program is not identically administered across DoD.

The SBIR program at DoD is also large. The Air Force SBIR program is, on its own, larger than all of the SBIR programs at nine of the ten other federal agencies that participate in SBIR. The Army, Navy, DARPA and MDA SBIR programs each exceed the size of seven of the nine other federal agencies. Given the size of the DoD SBIR program, the performance of the DoD SBIR program has a major impact on how well the overall SBIR program meets its goals.

A Combined Solicitation Process

Three times a year DoD issues a combined research solicitation for its ten component programs, indicating each program's R&D needs and interests and inviting R&D proposals from small companies. DoD-wide solicitations announce the topics and provide directions and formats for submission of proposals. Each DoD SBIR component makes its own determination as to which of the solicitations that it wishes to participate in. The OSD OSBP provides the opportunity for every component to participate in whichever solicitation best supports its needs and mission requirements.

Prior to 2004 DoD generally conducted two SBIR solicitations a year, the first closing in January and the second closing in July. Currently DoD has

[8]The Office of Small Business Programs (OSBP) was previously known as the Office of Small and Disadvantaged Business Utilization (SADBU)

[9]DLA participates in SBIR since 2008, but is not a part of the 2001 or current NRC studies and does not participate in the SBIR Fast Track or Phase II Enhancement programs.

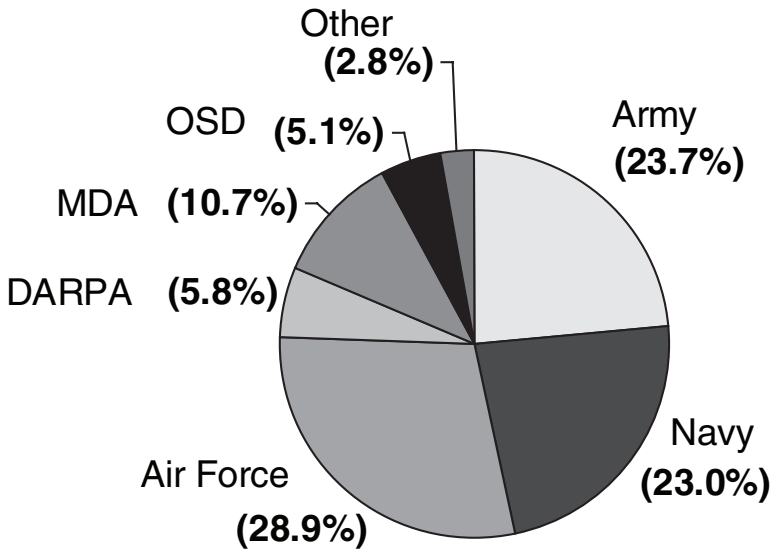

FIGURE 1-1 DoD SBIR budget by component for FY 2008.
SOURCE: DoD SBIR Web site, <*http://www.acq.osd.mil/osbp/sbir/overview/index.htm*>. Accessed on December 18, 2008.
NOTE: The DoD SBIR program, funded at approximately $1.14 billion in FY 2008, is made up of 12 participating components: Army, Navy, Air Force, Missile Defense Agency (MDA), Defense Advanced Research Projects Agency (DARPA), Chemical Biological Defense (CBD), Special Operations Command (SOCOM), Defense Threat Reduction Agency (DTRA), National Geospatial-Intelligence Agency (NGA), Defense Logistics Agency (DLA), Defense Microelectronics Activity (DMEA), and the Office of Secretary of Defense (OSD).

three SBIR solicitations each year. The Air Force always participates at least in the first SBIR solicitation. The Army participates only in the second. The Navy generally participates in every SBIR solicitation. Other components are less predictable as to how many and which SBIR solicitation they use. In 2006, the Navy participated in all three, the Air Force and SOCOM in two and the other seven components in a single SBIR solicitation.

Companies apply first for a six-month[10] Phase I award of up to $100,000 to test the scientific, technical, and commercial merit and feasibility of

[10]Air Force Phase I awards are nine months in duration.

a particular concept. If Phase I proves successful, the company may be invited to apply for a two-year Phase II award of up to $750,000 to further develop the concept, usually to the prototype stage. Proposals are judged competitively on the basis of scientific, technical, and commercial merit. Following completion of Phase II, small companies are expected to obtain Phase III funding from the private sector or non-SBIR military customers to develop the concept into a product for sale in military and/or private sector markets.

Multiple Administrative Variables

There is considerable variety within and among the DoD agencies in how SBIR is administered. These include how topics are selected and proposals evaluated, the degree of involvement of procurement officials in topic generation, the speed of evaluation and contract award, the potential for awards larger than the nominal dollar limit, the availability and amount of gap funding between phases, availability and constraints on Phase II Enhancement funding, and the availability of follow on Phase III Research and Development (R&D) funding. All of these factors, which may impact commercialization, vary among the DoD component SBIR programs.

Commercialization success can be affected by these variables. For example, the specificity of the topic may limit proposals and innovative approaches, which may reduce the private sector appeal of proposals in response to a very specific DoD topic. On the other hand, such specificity may indicate a well understood need that will result in DoD procurement of the solution to that need. Broad topics give more latitude to the proposing firm to propose something with private sector appeal; however, the agency may not select the proposal if they see no clear payoff to DoD.

Multiple Missions

As noted above, the program administration of SBIR is decentralized in, reflecting the fact that R&D is decentralized at DoD. In turn, R&D is decentralized because each of the agencies conducting R&D has a different mission, structure and R&D focus. While each service has the mission to recruit, train, organize and equip forces for deployment under joint commanders, the differences in equipment needs between Army Divisions, Navy Carrier Groups and Air Force Wings are often dramatic. These differences lead to differences in the kinds of topics, and in the way the services have structured their own acquisition organizations and the research, development and engineering organizations that support acquisition.

Certain needs common to all services have been made the responsibility of a single service, whose needs and capabilities are predominant. For example, among the Army's lead R&D responsibilities are small arms, food, clothing, and wheeled vehicles. Each service has R&D organizations at various locations supported by contracting offices. Services conduct basic and advanced

research, develop and demonstrate technology, and develop and engineer systems in their areas of interest. Most of this effort is accomplished through universities and defense contractors.[11] The services also must provide life cycle support in maintaining and upgrading equipment that is already in the field.

- **The Defense Advanced Research Project Agency (DARPA)** focuses on high risk, high payoff critical defense technologies that may support any of the services or other DoD needs. Most of their focus is on technology development and demonstration. They make use of service R&D organizations and contracting agencies to evaluate and support their efforts, which are largely contracted. Much of the DARPA organization is transient. The services and other agencies provide people to work at DARPA as program managers for two to four years (often less than the life cycle of SBIR from topic generation to completion of phase II). DARPA gauges success of an R&D project (including SBIR projects) on whether at the end of the project, the technology transitions into one of the services or agencies in DoD. By their very nature, many DARPA projects will not succeed and move forward.
- **The Missile Defense Agency (MDA)** has the mission to develop the capability to defend forces and territories of the United States, its allies and friends against all classes and ranges of ballistic missile threats. Much of its R&D is coordinated from Huntsville, Alabama, home of one of the Army's principal Research, Development & Engineering Centers. MDA is advancing several state-of-the-art technologies in seeking to develop an effective missile shield. A larger, more structured and focused organization than DARPA, MDA also uses the services to help execute its R&D mission.
- **The Defense Threat Reduction Agency (DTRA)** mission is to safeguard America and its allies from Weapons of Mass Destruction (chemical, biological, radiological, nuclear, and high-yield explosives) by providing capabilities to reduce, eliminate, and counter the threat, and mitigate its effects. DTRA R&D focuses on the effects of Nuclear, Chemical and Biological weapons (the latter two for defense against such weapons). They do not actually develop or procure weapons; thus limiting the potential for government funded SBIR Phase III of their topics. Private sector sale of SBIR Phase II results tends to be limited to occasional spin-offs of the actual technology in the SBIR.
- **The Chemical and Biological Defense (CBD)** Program's mission is to ensure that the U.S. military has the capability to operate effectively and decisively in the face of biological or chemical warfare threats at home or abroad. Technologies developed under the SBIR program

[11]DoD often sets objectives for defense contractors for the involvement of small businesses, and contractors often support small businesses in their SBIR efforts.

have the potential to transition to the Joint Program Executive Office for Chemical and Biological Defense (JPEO-CBD) if the appropriate level of technology maturity has been demonstrated. The Army serves as executive agent for the SBIR portion of the CBD Program.

- **The National Geospatial-Intelligence Agency (NGA)** mission is to provide timely, relevant, and accurate Geospatial-Intelligence in support of national security. The NGA R&D budget is too small to require a separate SBIR program, but the agency chose to have one because of the potential for SBC in the critical NGA field of information technology. NGA makes only two or fewer Phase II awards per year. NGA is the only DoD component that participates voluntarily in the SBIR Program because they see the potential benefits of leveraging this powerful program.
- **USSOCOM** has a small R&D program focused on near term needs of Special Operating Forces provided by the services.
- **The Office of the Secretary of Defense** (OSD) DDR&E has a small SBIR program, which has attempted to establish topics with a high potential for dual use.

Multiple Operational Processes

The SBIR process within a Service must operate within the organization and Research, Development and Acquisition (RDA) processes used by that Service. In decentralized systems such as employed by the Navy, SBIR procedures vary among the Systems Commands. In general, SBIR is integrated into the R&D Programs of each Systems Command.

- **Navy.** The Navy allocates the money rather than the topics, allowing each Command to determine how it will be spent. As a result, the Navy's Acquisition Program Executive Officers (PEO) have a significant role in topic generation and selection of proposals, especially for Phase II. Acquisition Program Offices frequently fund Phase III or provide additional Phase II funding. The usefulness of the SBIR results to the Navy is an important part of the selection process. In many cases this may lead to selection of more mature technologies and less risk taking, trading a higher probability of success for a lower potential payoff.
- **Air Force.** The Air Force also manages SBIR in a decentralized way. The program is managed within each of the technical Directorates in the Air Force Research Laboratory, Test Centers and Logistic Centers that are located across the country. Proposal approval is decentralized to the Directorate level. The Air Force awards Phase I for $100,000 for nine months rather than the nominal $75,000 for six months. The extra time and dollars, ceteris paribus, helps bridge to Phase II.

- **Army.** The Army, by contrast, centralizes topic, Phase I, and Phase II proposal selection; this centralized process began with FY92 Topics and Phase I proposals. The Army calculates how much of the annual SBIR funding will be needed to fund the first year of new Phase II awards and to pay for the second year of Phase II awards approved the prior year. It then determines how many Phase I awards can be awarded with the remaining funds. The Laboratories, which are allocated topics based on relative size of their R&D budget, are also allocated backup topics in the event their primary topics do not survive the Army's centralized selection process. The Army's ten senior Scientists/Technologists, who receive input from evaluators and managers at the laboratories, head the centralized selection of topics and proposals. The Director of the Army Research Office heads the Source Selection Board for Phase I. The Army SBIR process recently reinvigorated its connectivity to the acquisition community by allowing each PEO to author two topics each year.
- **DARPA.** In DARPA, topic selection and proposal decisions have usually been decentralized to the Technical Office Directors. The individual technical project officers who author the topics have had considerable input to proposal evaluation and to decisions to invite a Phase II.
- **DTRA.** In DTRA, the technical Directorates control the topics, but the proposal decisions are made by a board composed of the deputies from each directorate.
- **MDA.** The Missile Defense Agency's predecessor, the Ballistic Missile Defense Organization (BMDO) had an open process for 18 years that allowed companies to submit a Phase II whenever they were ready. However, when BMDO became MDA in 2001, that open process was stopped. Starting with the 2002 solicitation, MDA began to conduct an "invitation process" in much the same way that the three Service (Army, Navy, Air Force) components administer their Phase II award process—that is, by only inviting those companies that they want to have Phase II to submit a proposal. Also, while BMDO had a single Source Selection Authority for all SBIR awards—The SBIR Program Manager—that selection decision is now made at MDA by a committee and steering groups.

A GROWING EMPHASIS ON COMMERCIALIZATION

The 1992 Reauthorization

The 1992 SBIR reauthorization resulted in an increase in the portion of the agency extramural R&D budget set-aside for the SBIR program from 1.25 percent to 2.5 percent. This increase was consistent with a recommendation

from the National Research Council to increase SBIR funding as a means to improve the U.S. economy's ability to adopt and commercialize new technologies.[12] By 1992, the SBIR program had also become politically popular, in part through the advocacy of small businesses. In conjunction with the emergence of innovative small start-ups in computing, biotechnology, and advanced materials, there was ample support for program expansion in 1992.[13]

The increase in the percentage of R&D funds allocated to the program was accompanied by a stronger emphasis on encouraging the commercialization of SBIR-funded technologies. The 1992 reauthorization explicitly highlighted commercial potential as a criterion for awarding SBIR awards.[14] For Phase I awards Congress directed SBIR program administrators to assess whether projects have "commercial potential" in addition to scientific and technical merit when evaluating SBIR applications. With respect to Phase II, evaluation of a project's commercial potential would consider the existence of second-phase funding commitments from the private sector or from non-SBIR sources and the existence of third-phase, follow-on commitments within procurement agencies, along with other indicators of commercial potential.[15]

Furthermore, the reauthorization directed that a small business's record of commercialization be taken into account when considering the Phase II application. To further reinforce the emphasis on commercialization, the 1992 reauthorization moved the goal "to increase private sector commercialization" from fourth to second in the list of SBIR program goals. The reauthorization did not provide specific guidelines as to how much weight should be given to commercialization as compared with the program's other goals, such as technological innovation or importance to the agency mission.

The 1992 GAO Study

As a prelude to the 1992 Reauthorization, the General Accounting Office (GAO) conducted a study of SBIR programs across all federal agencies (including DoD) to evaluate the aggregate commercial trends of products in the

[12]National Research Council, *The Government Role in Civilian Technology: Building a New Alliance*, Committee on Science, Engineering, and Public Policy, Washington, DC: National Academy Press, 1992, p. 29.

[13]For an account of the evolution of the SBIR program, see George Brown and James Turner, "The Federal Role in Small Business Research," *Issues in Science and Technology,* Summer, 1999, p. 53.

[14]Robert B. Archibald and David H. Finifter, "Evaluation of the Department of Defense Small Business Innovation Research Program and Fast Track Initiative: A Balanced Approach," in National Research Council, *The Small Business Innovation Research Program: An Assessment of the Department of Defense Fast Track Initiative*, op. cit.

[15]In many cases, SBIR technologies (such as those related to missile defense or space applications) have limited or no commercial potential, except for follow-on orders from the respective agencies. That is, these agencies themselves must be the "commercial client." Moreover, these agencies often do not provide subsequent orders for Phase III products and services. For example, technologies developed for the NASA's Mars Rover have a very limited market.

third phase of SBIR.[16] The survey questionnaire sent out in 1991 to all the Phase II awardees from the first 4 years (1984 through 1987). GAO said that they chose the earliest recipients because studies by experts that they had consulted on technology development concluded that five to nine years are needed for a company to progress from a concept to a commercial product. Their rationale for not including Phase II recipients from 1988 or later was that, in most cases, those project recipients had not had sufficient time to "make or break" themselves in Phase III.

Responses to the GAO study indicated that 10 percent of the projects studied had not completed Phase II and even the earliest projects studied had inadequate time to mature. Although upbeat about the overall early indications of commercialization, GAO expressed some concern over the rate of commercialization in DoD.

DoD INITIATIVES TO IMPROVE COMMERCIALIZATION

In the aftermath of the 1992 Reauthorization, DoD initiated program changes designed to improve the rate of SBIR commercialization.

The Fast Track Initiative

Initiated with the 1996 SBIR solicitations, as a two-year pilot policy—the SBIR "Fast Track" allowed SBIR projects that attracted matching funds from third-party investors during the Phase I award period to receive a significantly higher probability of a Phase II SBIR award, as well as expedited processing to reduce the delay in reaching the market.

Toward the end of a small company's Phase I SBIR project, the company and its investor submit a Fast Track application. In the Fast Track application, the company and investor state that the investor will match both interim and Phase II SBIR funding, in cash, contingent on the company's selection for Phase II award. The matching rates needed to qualify for the Fast Track are as follows:

- For small companies that have never before received a phase II SBIR award from DoD or any other federal agency, the matching rate is 25 cents for every SBIR dollar.
- For all other companies, the matching rate is 1 dollar for every SBIR dollar.

The matching funds may pay for additional R&D on the company's SBIR project or, alternatively, they may pay for other activities such as

[16]U.S. General Accounting Office, *Small Business Innovation Research Shows Success but Can Be Strengthened*, GAO/RCED-92-37, Washington, DC: U.S. Government Printing Office, March 1992.

BOX 1-1
Prioritizing Commercialization in the 1992 SBIR Reauthorization

The Small Business Innovation Reauthorization Act of 1992 both raised the percentage of research expenditures dedicated to the SBIR Program and increased the importance of the goal of private-sector commercialization for SBIR projects. The 1992 act that reauthorized the SBIR Program listed the following objectives of the program:

(A) Expand and improve the program;
(B) Emphasize the program's goal of increasing the private sector's commercialization of technology developed through federal R&D;
(C) Increase small business' participation in federal R&D, and
(D) Improve the federal government's dissemination of information about the program.

The initial goal "to stimulate technological innovation" although not explicitly specified in the 1992 reauthorization is implicitly maintained by the SBIR Programs as being a critical element of its implementation. However, the goal of private-sector commercialization moved from being listed fourth in 1982 to second in 1992.

Over the years, some DoD components have argued that these goals are in order of priority while others have suggested that these goals should be weighed on an equal basis. Still others have argued that each SBIR Program can decide for itself the priority that it can place on each of these goals independent of any input from Congress. This again emphasis the diverse processes that exist within the DoD SBIR Program.

The change in the 1992 legislative priorities is reflected in the language describing the selection process. Specifically, the original language describing a SBIR Phase I proposal for selection and award was:

(A) a first phase for determining, insofar as possible, the scientific and technical merit and feasibility of ideas submitted pursuant to SBIR program solicitations: (96 Stat. 218).

This language was amended as follows (the added language is <u>underlined</u> and **bolded**):

(A) a first phase for determining, insofar as possible, the scientific and technical merit and feasibility of ideas **<u>that appear to have commercial potential as described in subparagraph (B)(ii),</u>** submitted pursuant to SBIR program solicitations: (106 Stat. 4250).

For a SBIR Phase II the change was much more dramatic and purposeful. The original 1982 language was:

(B) a second phase to further develop the proposed ideas to meet the particular program needs, the awarding of which shall take into consideration the scientific and technical merit and feasibility evidenced by the first phase and where two or more proposals are evaluated as being of approximately equal scientific and technical merit and feasibility, special consideration shall be given to those proposals that have demonstrated third phase, non-Federal capital commitments; (96 Stat. 218)

This language was changed in 1992 to read:

(B) a second phase, to further develop proposal which meet particular program needs, in which awards shall be made based on the scientific and technical merit and feasibility of the proposal as evidenced by the first phase considering, among other things, the proposal's commercial potential, as evidenced by:

(i) the small business concern's record of successfully commercializing SBIR or other research;
(ii) the existence of second phase funding commitments from private sector or non-SBIR funding sources;
(iii) the existence of third phase, follow-on commitments for the subject of the research; and
(iv) the presence of other indicators of the commercial potential of the idea. (106 Stat. 4251)

These changes reflect a mandate from the Congress to change the selection processes by increasing the importance of private-sector commercial potential. Under the 1982 legislation, ties between projects deemed to be of equal scientific and technical merit could be broken in favor of projects that were more likely to be commercially successful. The likelihood of private-sector commercialization was clearly a secondary concern. This one aspect of the SBIR Program was very purposefully changed by the Congress with the 1992 legislation, which placed private-sector commercialization on an equal footing with scientific and technical merit. However, the DoD components do not implement this is exactly the same and equal way.

marketing that further the development and/or commercialization of the technology.[17]

[17]Drawn from the DoD SBIR Web site at <*http://www.dodsbir.net/fasttrack/form.html#participate*>. Accessed on April 3, 2009.

This initiative drew on a 1992 scheme by the Ballistic Missile Defense Organization (BMDO) to reward applications whose technologies demonstrated commercial potential. This BMDO scheme called "co-investment" was effectively an informal "fast track" program. Under this approach, the evaluation process for Phase II proposals gave preference to applicants who could demonstrate that they would commit internal funding or that they had financial or in-kind commitments from third parties to bring the technology to market in Phase III. With that commitment, applicants received essentially continuous funding from Phase I to Phase II.

In launching a broader Fast Track initiative, DoD sought to attract new firms and encourage commercialization of SBIR funded technologies throughout the Department. The principal ways in which Fast Track seeks to improve commercialization is through preferential evaluation and efforts to close the funding gap that can develop between Phase I and Phase II awards. The time lag between the conclusion of Phase I and the receipt of Phase II funds can create cash-flow problems for small firms. The Fast Track pilot sought to address the gap by providing *expedited review* and essentially continuous funding from Phase I to Phase II as long as applying firms can demonstrate that they have obtained third-party financing for their technology.

In this context, third-party financing means that another company or government agency has agreed to invest in or purchase the SBIR firm's technology; it can also mean that a venture capitalist has committed to invest in the firm or that other private capital is available. The expedited review process for the Phase II award is justified from the agency's perspective because outside funding validates the commercial promise of the technology. More broadly, the Fast Track program addresses the need to shorten government decision cycles in order to interact more effectively with small firms focused on rapidly evolving technologies.

The Fast Track Implementation Cycle

The first DoD solicitation for a calendar year closes in early January. Most SBIR solicitations are issued as a prerelease 45 days prior to release and released as a formal solicitation 30 days before closing. All proposals are due prior to closing. A firm may begin working on its proposal during prerelease, although there is a possibility a topic might change or be withdrawn at release.

The life cycle for timely processing of an SBIR project from the FY 2001 solicitation is shown in Figure 1-2. The figure shows the prerelease and release timeframe for both the first and second solicitation of FY01. The evaluation award and execution displayed apply only to proposals resulting from

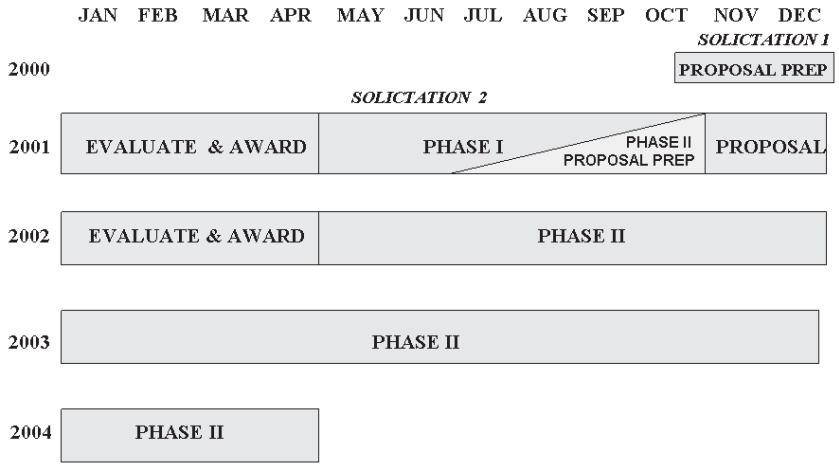

FIGURE 1-2 The Fast Track cycle: SBIR award and execution FY 2001 cycle. SOURCE: Department of Defense.

the first solicitation. Firms prepare most Fast Track Phase II proposals while executing Phase I.

Early submission of the Phase II proposal and prompt evaluation eliminates some of the gap that occurs in the standard SBIR program between the end of Phase I and the start of Phase II. Submission of a Fast Track proposal also results in four months of gap funding at the rate of the Phase I funding to allow efforts to continue while the Phase II proposal is being evaluated.

Some Drawbacks of Fast Track

As noted above, the purpose of the DoD Fast Track policy is to focus SBIR funds on those R&D projects most likely to result in viable new products that DoD and others will buy. From a firm perspective, the advantage of Fast Track is faster processing and, since third party financing is prima facie proof of commercialization potential, a higher probability of award. Fast Track does not provide additional SBIR funding or time for Phase II. The promise of Phase II under Fast Track helped attract third party funding, thereby increasing the total funding for the Phase II effort.

However, Fast Track presents two significant drawbacks for firms. The first drawback is that it requires that firms obtain funding commitment prior to completing Phase I. This means that firms must seek such funding before or very early in Phase I; i.e., before technological feasibility has been demonstrated. The second drawback, which applies whenever the third-party

BOX 1-2
A User's Perspective of Fast Track

The third-party financing requirement of Fast Track was instrumental in obtaining an SBIR Phase II award, according to AvPro's President. In a case study interview, he noted that without Fast Track's third-party financing requirement, his company would likely not have been able to obtain the Phase II award because of (what he considered) a "negative response of academic reviewers to technical challenges associated with manufacturing and process innovations."

In another case study, Picolight's President praised Fast Track as being particularly helpful in helping him secure financing from third-party investors and leverage the SBIR award into a much larger investment amount.

Thus, in the case of AvPro, Fast Track's major significance was in obtaining SBIR funding, whereas for Picolight, Fast Track's major significance was in obtaining the third-party financing. The case studies can be found in Appendix D of this volume.

investor is not a federal program, is that many small innovative firms are reluctant to part with equity, often demanded by private sector investors. In the first year of Fast Track, 80 percent of the third party investors were from the private sector. In the most recent four years of the program, only one third of the third party investors were from the private sector.

There are also drawbacks to Fast Track from the agency viewpoint. For SBIR program managers, the Fast Track program requires extra administrative effort. Recognizing the positive value of gap funding under Fast Track, however, program managers initiated procedures for additional funding after Phase I to firms that submitted a Phase II proposal, reducing the attraction of Fast Track.[18]

The Phase II Enhancement

Phase II Enhancement (in the Army and OSD—Phase II Plus)[19] programs was initiated in 1999 as three year pilot program.[20] Each component

[18]The Air Force issues a nine-month Phase I but accepts Phase II proposals after six months. Other components have procedures for three or four months of bridge funding after Phase I at the rate of Phase I funding.

[19]Although both Army and OSD SBIR name their Phase II Enhancement programs Phase II Plus, DoD refers to the overall program as Phase II Enhancement in their solicitations, hence this report uses the term Phase II enhancement to include all DoD components that participate.

[20]Although the Phase II Enhancement program was announced in 1999 in solicitation 99.2, the first few awards were made on Phase II that had been awarded their Phase II contracts in 1997. The first Phase II Enhancement that was let on a topic contained in Solicitation 99.2 was not awarded until

set its own rules on the potential source of third party funding, the matching rate and the maximum size of the Phase II Enhancement award. The goal of Phase II Enhancement was to concentrate SBIR funds on those R&D projects most likely to result in viable new products that DoD and others will buy—i.e., achieve the purpose of Fast Track while overcoming its drawbacks.

Based on the potential demonstrated during the first year of a Phase II, a firm may be invited to submit a Phase II Enhancement proposal. If selected for a Phase II Enhancement, the Phase II contract will be modified to add additional time and funding. In contrast to Fast Track, the Phase II Enhancement offers several advantages: The Phase II Enhancement:

- Does not require evaluation of the Phase II proposal outside of the DoD component's normal evaluation process.
- Employs criteria established by the component to meet the priorities of the component.
- Allows DoD components to opt out; i.e., some components do not have a Phase II Enhancement.
- Provides firms extensive time to locate a third party investor since proposals are not due until late in Phase II.
- Emphasizes use of acquisition program offices as the third party investor
- Provides additional time (normally one additional year) and additional SBIR funding to the firm.
- Leverages acquisition program funding; i.e., an acquisition program has its R&D investment in Phase II Enhancement matched by SBIR funding, thereby achieving more with its programmed funding.

ASSESSING THE FAST TRACK INITIATIVE

The Initial NRC Assessment of Fast Track

At the conclusion of the initial pilot period for Fast Track in 1998, the Under Secretary of Defense for Acquisition and Technology (USD (A&T)) extended the Fast Track pilot for two additional years, and directed an independent analysis of Fast Track. The Under Secretary's request focused on three issues:

1. Whether Fast Track projects are achieving, or appear likely to achieve, greater success in SBIR than comparable non-Fast Track projects;

2002. In general, a Phase II Enhancement awarded this year is a modification to the Phase II contract that was let two years ago.

BOX 1-3
SBIR Fast Track and the Phase II Enhancement Programs at DoD[a]

The Fast Track Program

Initiated in 1995, DoD's Fast Track program seeks to improve commercialization by reducing significant gaps in funding between Phases I and II for SBIR projects. The time lag between the conclusion of Phase I and the receipt of Phase II can create cash flow problems for small firms. Fast Track addresses this gap by providing expedited review and essentially continuous funding from Phase I to Phase II as long as applying firms can demonstrate that they have attracted outside investors who will match Phase II funding, contingent on the project's selection for Phase II award. Projects that qualify for the Fast Track receive interim funding of $30,000 to $50,000 between Phases I and II.

The Phase II Enhancement

Since 2000, DoD Components have developed policies to further encourage the transition of SBIR research into DoD acquisition programs and/or the private sector. Under this policy, DoD Components provide an eligible firm with additional Phase II SBIR funding (up to $500,000) to match investment funds that the firm is able to obtain from non-SBIR sources (such as DoD acquisition programs or the private sector). Among the DoD Components, the Navy and Army focus on funding additional research and development, and the Air Force focuses on overcoming unforeseen technological barriers. All three services and the Missile Defense Agency direct their enhancement programs to transition into acquisition programs.

While the Phase II Enhancement has the same objectives as Fast Track, it tries to overcome some of Fast Track's apparent limitations by:

- **Lowering Administrative Overhead**. It does not require evaluation of the Phase II proposal outside of the component's normal evaluation process.
- **Providing More Time**. Phase II Enhancement gives firms more time to locate a third party investors by extending an existing Phase II contract for up to one year.
- **Focusing on Acquisition**. Phase II Enhancement also seeks to leverage acquisition program funding to increase the level of funding available.

[a]Drawn from the DoD SBIR Web site *<http://www.acq.osd.mil/osbp/sbir/overview/index.htm>*. Accessed on December 17, 2008.
[b]This additional Phase II SBIR funding varies with each DoD component. In addition, not every component participates.

2. Whether Fast Track projects progress at different rates than non-Fast Track projects;
3. What companies perceive as advantages and disadvantages of Fast Track participation.

At the time, the National Academies' Committee for Government-Industry Partnerships for the Development of New Technologies—under the leadership of its chairman, Gordon Moore—was completing a review of the SBIR program, its operation, and current challenges.[21] At the request of the DoD, the Moore Committee undertook a review of the operation of the SBIR program at Defense, and in particular the role played by the Fast Track Initiative.[22]

Given the virtual absence of academic research on the SBIR program, the Moore Committee decided to commission field research on the program with a special emphasis on the Fast Track initiative. To this end, the NRC assembled a research team to examine the SBIR program awards and the Fast Track initiative through survey research, case studies, and empirical analysis. The survey questionnaire used in this review was derived from the one used the 1992 GAO study.[23]

The short time frame from the solicitation for Fast Track to the completion of the survey had the expected result that most Fast Track projects had not yet completed Phase II. Implementation of the Fast Track program began with the 1996 DoD solicitations. Since Phase I and Phase II normally last 6 and 24 months respectively, and since the DoD goal for proposal evaluation and award of those two phases is 4 and 6 months respectively, completion of Phase II of an SBIR project can be expected to take at least 40 months from the closing date of the solicitation. Thus the earliest FY 2001 projects could be expected to have completed Phase II 40 months after the January 2001 closing of the first solicitation (i.e., Phase II ending in May 2004). As a result, the 2000 NRC study of Fast Track determined that only 16 percent of the 1996 Fast Track projects (most of which were awarded Phase II in 1997) had completed Phase II by the spring of 1999.[24]

Nonetheless, the NRC's 2000 study of Fast Track suggested that this initiative was meeting its goals of encouraging commercialization and attracting new firms to the program. Consequently, the Moore Committee recommended that Fast Track be continued and expanded where appropriate. The Moore Committee did not recommend that Fast Track be applied to the entire SBIR

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[21]National Research Council, *SBIR: Challenges and Opportunities*, Charles W. Wessner, ed., Washington, DC: National Academy Press, 1999.

[22]The resulting report, published in 2000, was at the time the largest and most thorough review of an SBIR program. National Research Council, *The Small Business Innovation Research Program: An Assessment of the Department of Defense Fast Track Initiative,* op. cit.

[23]U.S. General Accounting Office, *Small Business Innovation Research Shows Success But Can Be Strengthened*, op. cit.

[24]National Research Council, *The Small Business Innovation Research Program: An Assessment of the Department of Defense Fast Track Initiative*, op. cit., p. 59.

program at DoD. To do so, they argued, might put at risk other goals, such as research and concept development. Following the NRC recommendations, the Under Secretary of Defense A&T made Fast Track a permanent part of DoD in 2001.

The 2000 study of Fast Track at DoD also drew attention to the importance of additional research to validate these results over time, noting that "continued research on the impact of the Fast Track Program is required."[25]

The Current Fast Track Update

This 2008 update of Fast Track coincides with the NRC's comprehensive study of SBIR, as mandated under Section 108 of the 2000 SBIR reauthorization legislation. As a part of this comprehensive assessment, NRC is examining the SBIR programs at the Department of Defense, the National Institutes of Health, the National Aeronautics and Space Administration, the Department of Energy, and the National Science Foundation, which are the five largest SBIR programs. This comprehensive assessment, published in 2008, focuses on the quality of the research projects being conducted under the SBIR program, the commercialization of that research, and the SBIR contribution to accomplishing agency missions.[26] Although much broader based than the 1999 review, the 2008 NRC study, "Capitalizing on Science, Technology, and Innovation: An Assessment of the Small Business Innovation Research Program," employs similar case study and empirical analysis as well as survey questionnaires that are based on those used by the NRC in its 2000 report.

Capitalizing on this ongoing assessment, DoD in 2006 requested the NRC to conduct a follow up assessment of its SBIR Phase II Enhancement programs. This report, thus, includes a survey that draws on and refines the methodology developed in a 1999 study of Fast Track to capture a second snapshot of the contributions of the program.

Areas for Future Research

While this study addresses the Committee's Statement of Task, some of the NRC reviewers identified additional areas of analysis and inquiry that are potentially fruitful, but were beyond the scope of this study. These topics, some of which may be explored in subsequent analyses by the National Research Council, include:

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[25]Ibid, p. 38.

[26]The National Research Council has published an assessment of the SBIR program at each of the five major agencies. See for example, National Research Council, *An Assessment of SBIR at the Department of Defense,* op. cit. The NRC has also published an overview report of the program. See National Research Council, *An Assessment of the SBIR Program*, op. cit.

- Analysis of whether the funding gap between Phase I and Phase II has changed over the years.
- Analysis of SBIR commercialization.
  - Analysis of how DoD acquisition programs support SBIR Phase III efforts, including interviews of DoD managers for their perspectives on Fast Track and Phase II Enhancement.
  - Comparison of commercialization rates of Fast Track and Phase II Enhancement projects to the overall DoD SBIR commercialization rate.
  - Micro-level analysis of the implementation and outcomes of Fast Track and Phase II Enhancement programs at different DoD components.
- Statistical Analysis.
  - Statistical analysis of the survey response data.
  - Multivariate analysis of whether firms that received high levels of SBIR funding before their IPO showed higher sales or employment growth.
  - Correlation of firms winning multiple Phase I awards and their participation in Fast Track.

2

Survey Analysis[1]

As we have seen in the previous chapter, the Fast Track and Phase II Enhancement programs at the Department of Defense, while sharing the common objective of supporting SBIR commercialization, are different programs with largely different objectives. The analysis in this chapter thus focuses on two separate comparisons based on surveys of DoD SBIR awards: that between Fast Track award winners and a control group, and that between Phase II Enhancement award winners and a control group.[2]

2.1 SUMMARY OF SURVEY FINDINGS

The NRC survey generated a range of useful data related to characteristics and outcomes for FT and PIIE projects in relation to the control group:

1. Demographics of each group.
2. Outcomes from awards.
3. Gap reduction.

[1]The survey methodology for this update of the DoD Phase II Enhancement program is described in Appendix A.

[2]This chapter presents an exposition and analysis of the survey responses for the three sample groups: Fast Track, Phase II Enhancement, and the population matched control group. The control group refers to subjects that did not participate in the Fast Track or Phase II Enhancement programs, but in all other respects were treated in the same way as the experimental group. Appendix B contains the questions on the Firm Survey and a summary of the individual responses. The 232 respondents answered 18 questions, many containing multiple parts; thus the complete data display is 232 by 72 fields and includes some answers (fields) that are at least one sentence long. Hence, summaries are the only reasonable way to publish the data. Appendix C contains the questions on the Project Survey and a summary of the individual responses. The 240 respondents answered 36 questions, many containing multiple parts. The NRC surveyed all companies receiving Phase II awards during the study period. Firms with multiple awards received more than one project survey. As a result, there are more project surveys than firm surveys.

2.1.1 Survey Demographics

The survey aimed to reach projects that fell into three groups:

- **Fast Track (FT).** The survey sought responses from the 217 FT awards made from 1997-2002.
- **Phase II Enhancement (PIIE) awards**. The survey selected a sample of 210 PIIE awards. (The sample was weighted to adjust for the year of award). Thirty-four also received FT awards.[3]
- **PIIE and FT.** The survey also addressed 34 projects that received both FT and PIIE awards.[4]
- **Control group (neither FT nor PIIE).** The sample of 376 was weighted to ensure that the number of awards per year and the source of awards by DoD service was similar to those for the FT and PIIE projects samples combined.[5]

Thus, in total, 837 (217+210+34+376=837) projects were surveyed. Responses are provided in the Table 2-1.

TABLE 2-1 Survey Response Rates by Category

	Award Surveys				
Award Category	Email Contact (Number)	Could Not Contact (Number)	Completed Survey (Number)	Overall Response Rate (%)	Contacted Response Rate (%)
Fast Track	156	61	50	23	32
Phase II Enhancement	198	12	69	33	35
Both Fast Track and Phase II Enhancment	32	2	14	41	44
Control Group	331	45	107	28	32

SOURCE: NRC Project Survey 2006.

NOTE: Fourteen responses were received from projects that received both FT and PIIE awards. In aggregating the data, responses from these projects were added to both the FT and PIIE categories.

[3]See Appendix A, footnote 5, for details.
[4]For a description of the sample selection, see Appendix A.
[5]The control group sample was larger to account for the possibility that these projects might generate a lower response rate.

BOX 2-1
Multiple Sources of Bias in Survey Response

Large innovation surveys involve multiple sources of bias that can skew the results in both directions. Some common survey biases are noted below.[a]

- **Successful and more recently funded firms are more likely to respond**. Research by Link and Scott demonstrates that the probability of obtaining research project information by survey decreases for less recently funded projects and it increased the greater the award amount.[b] Nearly 40 percent of respondents in the NRC Project Survey began Phase I efforts after 1998, partly because the number of Phase I awards increased, starting in the mid 1990s, and partly because winners from more distant years are harder to reach. They are harder to reach as time goes on because small businesses regularly cease operations, are acquired, merge, or lose staff with knowledge of SBIR awards.
- **Success is self-reported**. Self-reporting can be a source of bias, although the dimensions and direction of that bias are not necessarily clear. In any case, policy analysis has a long history of relying on self-reported performance measures to represent market-based performance measures. Participants in such retrospectively analyses are believed to be able to consider a broader set of allocation options, thus making the evaluation more realistic than data based on third party observation.[c] In short, company founders and/or principal investigators are in many cases simply the best source of information available.
- **Survey sampled projects at firms with multiple awards**. Projects from firms with multiple awards were under-represented in the sample, because they could not be expected to complete a questionnaire for each of dozens or even hundreds of awards.
- **Failed firms are difficult to contact**. Survey experts point to an "asymmetry" in their ability to include failed firms for follow-up surveys in cases where the firms no longer exist.[d] It is worth noting that one cannot necessarily infer that the SBIR project failed; what is known is only that the firm no longer exists.
- **Not all successful projects are captured**. For similar reasons, the NRC Project Survey could not include ongoing results from successful projects in firms that merged or were acquired before and/or after commercialization of the project's technology. The survey also did not capture projects of firms that did not respond to the NRC invitation to participate in the assessment.
- **Some firms may not want to fully acknowledge SBIR contribution to project success**. Some firms may be unwilling to acknowledge that they received important benefits from participating in public programs for a

variety of reasons. For example, some may understandably attribute success exclusively to their own efforts.

- **Commercialization lag**. While the NRC Project Survey broke new ground in data collection, the amount of sales made—and indeed the number of projects that generate sales—are inevitably undercounted in a snapshot survey taken at a single point in time. Based on successive data sets collected from NIH SBIR award recipients, it is estimated that total sales from all responding projects will likely be on the order of 50 percent greater than can be captured in a single survey.[e] This underscores the importance of follow-on research based on the now-established survey methodology.

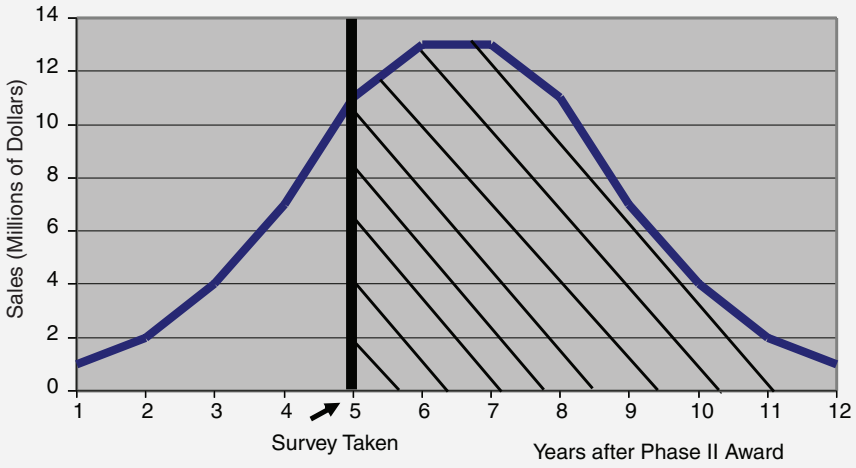

FIGURE B-2-1 Survey bias due to commercialization lag.

These sources of bias provide a context for understanding the response rates to the NRC Survey conducted for this study.

continued

- **Limited statistical analysis**. Owing to the constraints imposed in some cases by low sample size, more sophisticated statistical analysis could not be performed. Accordingly, while the analysis below compares a control group of projects with Fast Track and Phase IIE projects respectively, different outcomes may not always be statistically significant.

[a]For a technical explanation of the sample approaches and issues related to the NRC surveys, see Appendix A.
[b]Albert N. Link, and John T. Scott, *Evaluating Public Research Institutions: The U.S. Advanced Technology Program's Intramural Research Initiative,* London: Routledge, 2005.
[c]While economic theory is formulated on what is called "revealed preferences," meaning individuals and firms reveal how they value scarce resources by how they allocate those resources within a market framework, quite often expressed preferences are a better source of information especially from an evaluation perspective. Strict adherence to a revealed preference paradigm could lead to misguided policy conclusions because the paradigm assumes that all policy choices are known and understood at the time that an individual or firm reveals its preferences and that all relevant markets for such preferences are operational. See {1} Gregory G. Dess and Donald W. Beard, "Dimensions of Organizational Task Environments," *Administrative Science Quarterly*, 29:52-73, 1984; {2} Albert N. Link and John T. Scott, *Public Accountability: Evaluating Technology-Based Institutions*, Norwell, MA: Kluwer Academic Publishers, 1998.
[d]Albert N. Link, and John T. Scott, *Evaluating Public Research Institutions: The U.S. Advanced Technology Program's Intramural Research Initiative,* op. cit.
[e]Data from NIH indicates that a subsequent survey taken two years later would reveal very substantial increases in both the percentage of firms reaching the market, and in the amount of sales per project. See National Research Council, *An Assessment* of *the SBIR Program at the National Institutes of Health*, Charles W. Wessner, ed., Washington, DC: The National Academies Press, 2008.

2.1.2 Firm and Project Characteristics[6]

Phase II Enhancement (PIIE) and Fast Track (FT) are aimed at different objectives and have different requirements, so it is not surprising that the characteristics of firms in these programs were also different.

Fast Track Projects

Firms that tended to be smaller and founded more recently than the control group and also to have less SBIR experience undertook these projects.

- **Employees**. Forty-three percent of Fast Track respondents reported having five employees or fewer at the time of the award, about a quarter more than the 36 percent in this category for the control group.[7]

[6]All data provided in this report refer to NRC Fast Track and Phase II Recipient survey respondents in a particular category, not all awardees, unless specifically noted otherwise.
[7]See Figure 2-2, NRC Project Survey 2006, Question 16, Appendix C.

- **Foundation year**. The median year of foundation was 1995 for Fast Track recipients and 1988 for the control group. More than 2/3rds of the Fast Track firms were founded after 1992, compared with less than a third of the control group.[8]
- **Prior Phase II awards**. Almost half (48 percent) of FT winners reported zero prior Phase II awards, compared to 23 percent of control group firms.[9]
- **Size of awards**. FT projects received about $100,000 more in SBIR funding than did the control groups projects.[10]

Phase II Enhancement Projects

Overall, firms with PIIE were more closely aligned with the experience profile of the control group:

- **Employees**. PIIE firms reported that only 24 percent of firms had five or fewer employees. This is one third less than the control group.[11]
- **Foundation year**. PIIE firms were slightly younger than the control group, with a median foundation year of 1990 (compared with 1998).[12]
- **Prior SBIR experience**. PIIE and control group firms had almost identical prior SBIR experience, with about 24 percent having received zero prior SBIR Phase II awards, and 17-20 percent having received more than five prior Phase II awards.[13]
- **Size of awards**. As one important feature of PIIE is the provision of up to $500,000 in matching funds from SBIR, it is not surprising that on average PIIE projects received about $400,000 more than control group projects.[14]

Thus, the data indicate that younger firms with fewer employees have tended to utilize Fast Track, while PIIE firms are quite similar in profile to control group. Both received more funding than the control group, PIIE firms considerably more.

[8]See Table App-A-3 in Appendix A
[9]See Figure 2-4, NRC Project Survey 2006, Question 19, Appendix C.
[10]See DoD Awards Database.
[11]See Figure 2-5, NRC Project Survey 2006, Question 16b, Appendix C.
[12]NRC Firm Survey 2006. Part A, Question 7, of the Firm survey asked firms the year their company was founded.
[13]See NRC Project Survey 2006, Question 19. See Appendix C.
[14]See DoD Awards Database.

2.1.3 Project Outcomes

The NRC methodology identified a number of metrics that can be used to develop an assessment of project outcomes for SBIR. These include:

- Employment effects.
- Sales revenues.
- Sales by sector.
- Additional investments.
- The project initiation decision.
- Project delays absent SBIR.
- Knowledge effects.

2.1.3.1 Employment

Responding firms from all three groups showed substantial employment gain between the time of the award and the time of the survey.

- **FT** firms started from a much lower employment profile. They grew larger firms at about the same rate as the control group, but also rapidly reduced the share of firms with 1-5 employees, from 43 percent to 16 percent.[15]
- **PIIE**. Starting from about the same base, PIIE firms grew about twice as fast as the control group in the largest employment category (firms with 50 or more employees). Forty percent of responding PIIE firms were in this category at the time of the survey.[16]

2.1.3.2 Revenues

The survey asked firms to attribute sales revenues (as well as expected sales and sales by licensees) to the related SBIR project. Given the high degree of skew in reported sales, where a few projects report very large positive results, it is important to ascertain both the overall level of projects that reach the market, and also their distribution.

Reaching the market. All three groups reached the market at approximately the same rate[17], which suggests that ceteris paribus, neither FT nor PIIE had a significant effect in enhancing the sales rate experienced by the control group's projects (sales rate is defined as the percentage of projects that sold at least $1 in the marketplace).[18]

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[15]See Figure 2-5, NRC Project Survey 2006, Question 16b. See Appendix C.
[16]Ibid.
[17]See DoD Awards Database.
[18]Use of the sales rate is valid only as one benchmark among many to capture the numerous dimensions of commercialization. However, it is still an important metric.

Expected sales. FT and control group projects surveyed each reported that about 55 percent of those without sales to date still anticipated reaching the market at some point. About 66 percent of PIIE projects reported similar expectations.[19]

However, a comparison of expected sales from the previous (2000) survey and actual sales later reported indicates that firm descriptions of expected sales were highly optimistic, which suggests that expected sales reported in the current survey should be treated with caution.

Distribution of sales by size. Given the high degree on skew in SBIR outcomes, in which a few projects account for a substantial share of total revenues generated by SBIR projects, it is important to review the distribution of sales by size.

- **FT.** The distribution of sales for the Fast Track and Control Groups are quite similar. FT did not report a project with sales greater than $10 million, but it did report more projects with sales between $5 million and $10 million. [20]
- **PIIE.** The PIIE group generated two awards with more than $10 million in cumulative revenues, and six with revenues of $5 million to $10 million, compared to on**e** and two respectively for the control group.[21]

Given the very small numbers of awards involved, caution should be employed when drawing conclusions from these data. They are however suggestive**.**

Sales by sector. One of the primary missions of the DoD SBIR program is to provide technology for use within DoD. Consequently, sales to DoD itself and to prime contractors for DoD are an important metric that the program is meeting its objectives. The survey reports substantial differences between the groups. In both cases, FT and PIIE projects are more likely to generate sales to DoD and its prime contractors than are the control group firms.

- **FT.** About 70 percent of surveyed FT project sales by value were made to DoD and its primers. In contrast, this sector generated about 38 percent of sales for the control group. About 1/3rd of total revenues for FT projects came from direct sales to DoD, compared with 25 percent for the control group.[22]
- **PIIE**. Similarly, 65 percent of PIIE project revenues were from DoD and the primes. Direct sales to DoD in this case accounted for about 45 percent of the total.[23]

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[19]See NRC Project Survey 2006, Question 9. See Appendix C.
[20]Ibid.
[21]Ibid.
[22]See NRC Project Survey 2006, Question 4. See Appendix C.
[23]Ibid.

2.1.3.3 Additional Investments

Many projects require additional investment after Phase II before they can reach the market. These investments are therefore an additional metric that progress is being made with the project. Both the FT and PIIE programs require additional third party investment as a condition of the award, although the precise requirements are different. Consequently, both FT and PIIE projects generated much higher rates of additional investment than the control group. In this case then, the scale of additional investment may be significant.

- **FT**. On average, FT projects attracted about $300,000 more in development funding than the control group. Interestingly, FT projects attracted smaller amounts of federal development funding, and considerably more private sector funding.[24] This likely reflects the fact that FT projects must attract third party funding very early in the project cycle, when federal technology development funding is less available.

  Almost 35 percent of FT projects reported some kind of negotiations for the sale of equity, compared with 4 percent of the control group. And 14 percent had completed agreements at the time of the survey, compared with 1 percent of the control group.[25]
- **PIIE**. On average, PIIE projects generated just under $1 million in additional non-SBIR investment, in comparison with about $500,000 for the control group.[26] That difference is entirely accounted for by the relative success of PIIE firms in attracting non-SBIR federal R&D funding (averaging just over $500,000 per project).

2.1.3.4 The Project Initiation Decision

Firms were asked whether they would have undertaken the project absent the SBIR award in question, and also whether the SBIR. Data from the survey indicates that neither FT nor PIIE had a significant effect on this decision.

- **FT**. Firms report that about the 66 percent of FT projects (66 percent) would certainly or probably not have been started without SBIR funding. This is approximately the same percentage as for the control group (70 percent).[27]

[24]See NRC Project Survey 2006, Question 23. See Appendix C
[25]See NRC Project Survey 2006, Question 12. See Appendix C.
[26]See NRC Project Survey 2006, Question 23. See Appendix C.
[27]See NRC Project Survey 2006, Question 13. See Appendix C.

- **PIIE**. Here 75 percent of firms reported that the certainly or probably would not have started the project without SBIR—again, similar to results for the control group (70 percent).[28]

2.1.3.5 Project Delays

Firms that believed their project would have proceeded without SBIR funding were further surveyed to determine whether those projects would have been significantly delayed without SBIR.

- **FT respondents** indicated that on average their projects would have been delayed by 13 months, in comparison to 6 months for the control group.[29] This is a substantial difference, which suggests that FT participants saw a particular value in the improved PI-PII transition offered via the FT program.
- **PIIE projects** would have been delayed by 5 months, which is less than the control group.[30] This relatively low anticipated delay may be based on the availability of the funding that was eventually used to make the PIIE match, which might have allowed rapid forward movement on the project even without SBIR.

2.1.4 Phase I-Phase II Funding Gap and Fast Track

FT was designed explicitly to help reduce the funding gap that can occur between the end of Phase I funding and the beginning of Phase II.

Survey data indicates that for responding projects, FT had a substantial impact in reducing funding gaps relative to those experienced by the control group.

- **Likelihood of funding gap**. Survey data indicate that only about 35 percent of FT projects experienced a funding gap between PI and PII, in comparison with 70 percent of control group projects.[31]
- **Length of funding gap**. The average PI-PII funding gap for all FT projects was just over 1 month, compared with just under 6 months for the control group. For projects with some gap, FT projects averaged a gap of 4 months compared with more than 8 months for the control group.[32]

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[28]Ibid.
[29]See NRC Project Survey 2006, Question 15a. See Appendix C.
[30]Ibid.
[31]See NRC Project Survey 2006, Question 31. See Appendix C.

[32]Ibid.

- **Impact of the gap**. Just under 20 percent of FT respondents reported that the funding gap had caused them to stop work on the project, compared to 40 percent of the control group projects.[33]
- **Trends**. Data from DoD indicates that the size of the gap has increased and the percentage of projects reporting a gap has increased in recent years.[34]

2.2 DETAILED SURVEY RESULTS

In order to ensure that appropriate comparisons are made, this section is divided into two: the first part addresses comparisons between the Fast Track projects and the control group; the second compares responses from the Phase II Enhancement group and the control group.

2.2.1 Phase II Completion

Respondents were asked to categorize the status of the efforts resulting from the surveyed Phase II awards. Some had already discontinued the effort, but most had realized some level of commercialization or were in post-Phase II (development of the technology) phase. Although all Phase II awards in the three sample groups[35] had been made by the end of 2002, by the summer of 2006, 15 of the 240 responses had not yet completed Phase II. Two of these 15 had garnered both a Fast Track award and a Phase II Enhancement. The status chart (Figure 2-1) shows that firms benefiting from the Phase II Enhancement awards appeared more likely than the control group to have products, services, or processes in use by the target population.[36] Fast Track projects were not more likely to be in the comem4rcialization stage than the control group.

[33]See NRC Project Survey 2006, Question 33. See Appendix C.

[34]Information from the DoD Fast Track Database.

[35]Fast Track awards that subsequently received a Phase II Enhancement were analyzed in both groups; thus, Fast Track analyzed 64 responses and Phase II Enhancement, 83 responses.

[36]The chart shows the percentage of each response from each sample. The low number of responses and the relatively small differences in responses for each sample does not support strong conclusions for this question

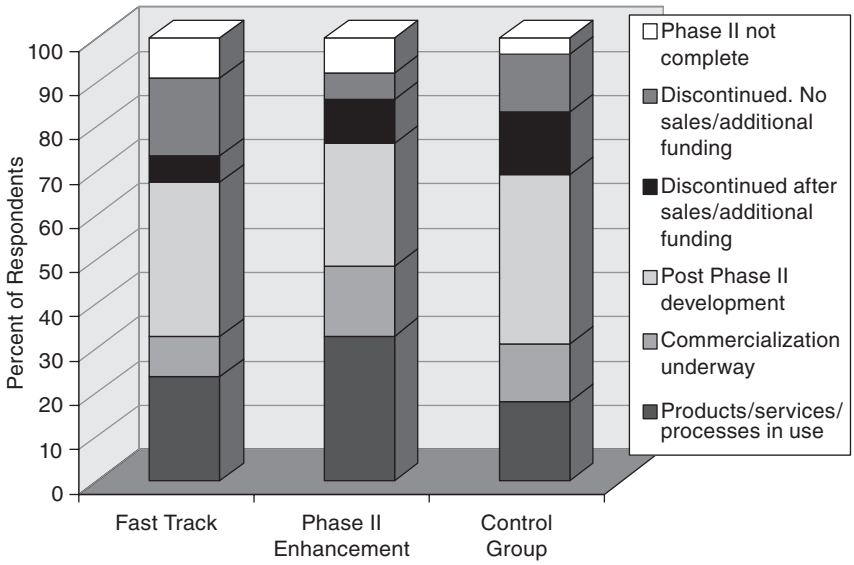

FIGURE 2-1 Status of Phase II awards.
SOURCE: NRC Project Survey 2006, Question 1. See Appendix C.

2.2.2 Comparison of Firm Metrics

The firm survey examined several factors that might influence firm success in SBIR. These include the size and age of the firm and its prior experience in SBIR. Two of the factors used in sample selection were number of Prior Phase II awards and size of the firm. Firm size was examined both in terms of number of employees and annual revenue.

2.2.2.1 Demographics: FT firms were Smaller and Younger

Among firms responding to the survey, Fast Track award winners were smaller, younger, and with less SBIR experience at the time of the surveyed Phase II award than the control group.

- **Fast Track** As shown in Figure 2-2, 43 percent of the Fast Track firms reported five or fewer employees at the time of award, compared with 36 percent of the control group.[37]

[37]See NRC Firm Survey 2006, Question 6, in Appendix B.

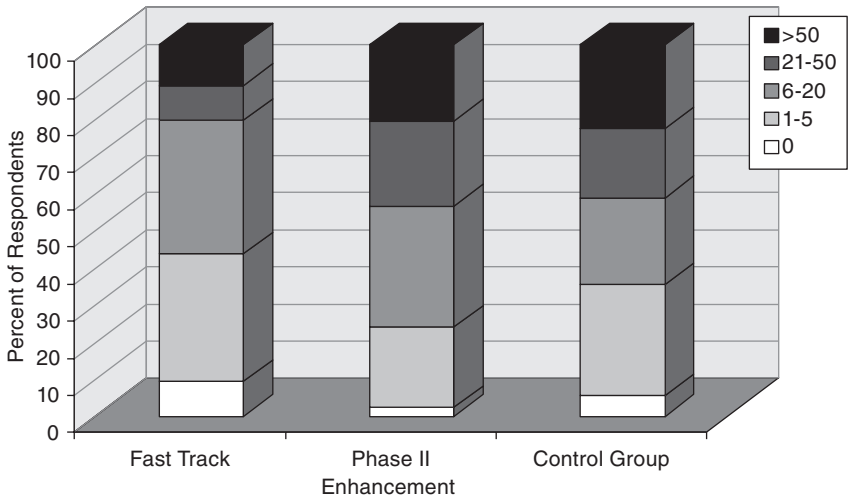

FIGURE 2-2 Firm size when Phase II proposed: Number of employees.
SOURCE: NRC Project Survey 2006, Question 16a. See Appendix C.

- Twenty percent of Fast Track had more than 20 employees at the time of award, compared with 41 percent of the control group.[38]
- The median founding date reported by the Fast Track awardees was 1995. Two-thirds of these firms reported that they were founded after 1992, compared with a median founding date of 1988 for the control group. Less than a third of these firms were founded after 1992.[39]
- **PIIE**. Twenty-four percent of the Phase II Enhancement reported five or fewer and 36 percent of the firms responding for control group awards who reported five or fewer employees.[40]
- Forty-three percent of the Phase II Enhancement awards reported a firm size of more than 20 employees at the time of award, compared with 41 percent for the control group.[41]
- For Phase II Enhancement the median founding date was 1990. Only 37 percent of the firms responding for Phase II Enhancement reported a founding date after 1992. The control group reported a median founding date of 1988. Less than a third of these firms were founded after 1992.[42]

[38]Ibid.
[39]NRC Firm Survey 2006. Part A, Question 7, of the Firm Survey asked firms the year their company was founded. This paragraph summarizes 232 responses.
[40]See NRC Firm Survey 2006, Question 6, in Appendix B.
[41]Ibid.
[42]NRC Firm Survey 2006. Part A, Question 7, of the Firm Survey asked firms the year their company was founded. This paragraph summarizes 232 responses.

2.2.2.2 Prior SBIR experience

Fast Track

Overall, the firms with Fast Track awards reported that they had significantly less prior experience with both Phase I and Phase II SBIR awards, including both awards related to the specific award being surveyed and other awards.

Figure 2-3 shows that 48 percent of Fast Track surveys reported that they had no Phase I awards prior to the award that led to the Fast Track Phase II, compared with 23 percent for the control group. Nine percent of the Fast Track surveys reported that the firm had received more than five Phase I awards prior to the surveyed Fast Track Phase I. four times as many projects in the control group reported that they had received more than five Phase I awards prior to the surveyed Phase I.[43]

Only 36 percent of Fast Track responses reported a prior Phase II and only six percent reported receiving more than five prior Phase II awards.[44] The high percentage of Fast Track awards to firms who had no prior Phase II is not surprising. Such firms need only obtain one matching third-party dollar for four dollars of SBIR funds. Firms with one or more prior Phase II must find dollar for dollar matching funds to be eligible for Fast Track.[45]

Phase II Enhancement

These projects reported prior experience with SBIR that was similar to that of the control group (see Figure 2-3 and 2-4). Seventy percent of the Phase II Enhancement surveys and 63 percent of the control group surveys reported receiving a prior Phase II award. As shown in figure 2-4, substantially more firms in these groups reported receipt of five or more prior Phase II awards.[46]

2.2.2.3 Growth in the Number of Employees

The average firm in each group reported a larger number of current employees than at the time of the surveyed award. (See Figures 2-2 and 2-5.)

Fast Track

The number of firms reporting more than twenty employees doubled between the time of the award and the time of the survey, while the percentage reporting more than 50 employees grew from 11 to 20 percent. The percentage

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[43]See NRC Project Survey 2006, Question 19. See Appendix C.
[44]Ibid.
[45]In the past, some DoD components, like BMDO, in some cases allowed a company with fewer than five Phase II awards to get a two for one match. Also in the past, some companies were able to get more than two 4:1 matching Phase II Fast Track awards of the Fast Track application. In some cases the companies that had multiple Phase I awards in their first solicitation participation were able to get multiple Fast Track awards at very competitive matching rates.
[46]See NRC Project Survey 2006, Question 19. See Appendix C.

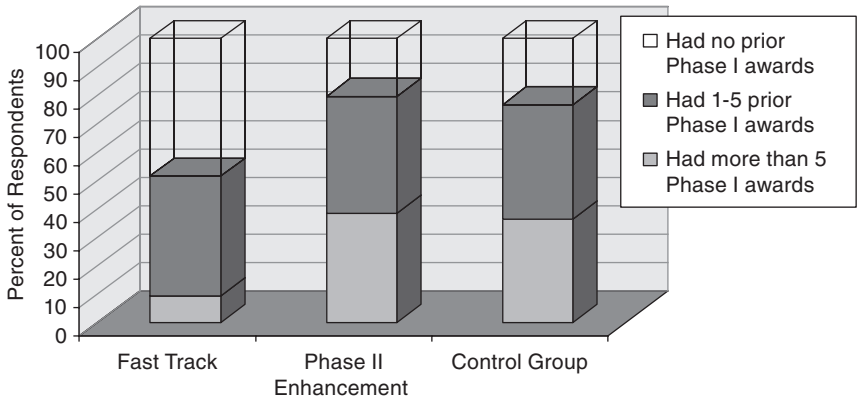

FIGURE 2-3 Prior Phase I experience: Number of prior Phase I awards.
SOURCE: NRC Project Survey 2006, Question 19. See Appendix C.

of Fast Track responses currently reporting five or fewer current employees has dropped from 43 percent to 16 percent durign that period.[47]

Control group employment has grown more slowly than FT, with thirty-one percent of Control Group firms reporting more than 50 employees, up from 22 percent at the time of the surveyed award. The percentage of Control Group firms reporting fewer than five employees has declined from 36 percent to 21 percent.[48]

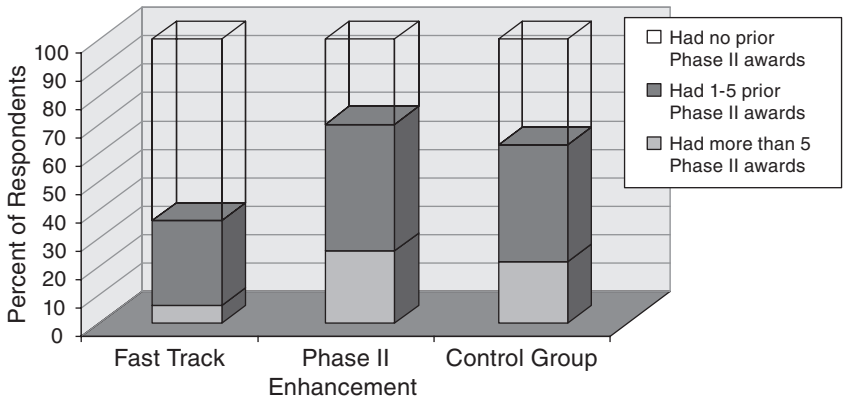

FIGURE 2-4 Prior Phase II experience: Number of prior Phase II awards.
SOURCE: NRC Project Survey 2006, Question 19. See Appendix C.

[47]Ibid.
[48]See NRC Project Survey 2006, Question 16. See Appendix C.

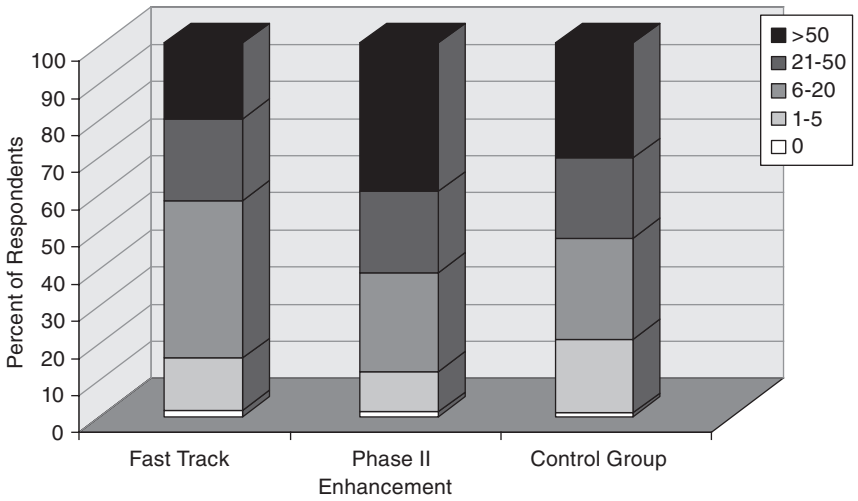

FIGURE 2-5 Current firm size: Number of employees.
SOURCE: NRC Project Survey 2006, Question 16b. See Appendix C.

Thus FT firms have closed some of the gap with the Control Group in building larger firms, with 20 percent now reportign at least 50 employeedm, compared with 31 percent for the CG. The FT has dramatically reduced the number of very small firms, and now has fewer such firms than the Control Group (26 percent vs. 21 percent). It is worth noting that the smaller percentage of FT firms that responded to the sdurvey may indicate a higher percentage for firms that are out of business (and hence have zero employees).

Phase II Enhancement

These firms were larger at the time of award (see above). Still, the percentage of responses currently reporting more than 50 employees (40 percent) has nearly doubled since the receipt of the surveyed award (22 percent). The number of PIIE firms reporting fewer than five employees has declined from 24 percent to 11 percent.[49]

PIIE firms now have a bigger share of large firms (more than 50 employees) than do the Control Group (40 percent vs. 31 percent). This was not the case at the time of the award, when both groups had simialr shares. The share of firms reporting fewer than five emopoloyees has declined at about the same rate for PIIE and Control Group firms.[50]

[49]Ibid.
[50]Ibid.

2.2.2.4 Firm Sales and Revenues

Along with employment, respondents also identified firm size using the metric of annual sales. Firms were asked whether they had ever applied for Fast Track and whether they had ever applied for Phase II Enhancement. Fifty-four of the 204 responding firms had not applied for either. Thirty-five applied only for Fast Track and 63 applied only for Phase II Enhancement. Forty-eight firms had applied for both programs. The four pie charts in Figure 2-6 show the average firm annual revenue for each group.[51]

Figure 2-6 shows that the annual revenue for largest percentage of firms in each group is $1,000,000 to $5,000,000.

- The group that applied only for Fast Track has the smallest percentage over $5,000,000 in annual revenue and the highest percentage under $500,000.
- The group that applied for both Fast Track and Phase II Enhancement has the highest percentage over $5,000,000 in annual revenue.
- The Phase II Enhancement only group has the second highest percentage of firms with annual revenue in excess of $5,000,000. Survey results suggest that larger firms are more likely to apply for Phase II Enhancement and smaller firms more likely to apply for Fast Track.

2.2.2.5 Participation by Women and Minorities

The original 1982 SBIR legislation specifically identifies "participation by minority and disadvantaged persons in technological innovation" as an objective of the program. Participation by women was not addressed in the legislation until the reauthorization in 1992; hence, the 1992 GAO study did not address woman-owned firms.[52] Since the 1999 NRC study was specific to Fast Track, it did not consider firm ownership.[53]

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[51]Firms are grouped by their responses as to whether they applied, not by whether they received the award. It would not be appropriate to categorize the firms solely by their projects in the sample as, for example, a firm might have won a Phase II Enhancement that was not sampled or won either a Fast Track or an Enhancement after 2002. Revenue was as reported for 2005, not at the time of award.

[52]U.S. General Accounting Office, *Small Business Innovation Research Shows Success But Can Be Strengthened*, GAO/RCED-92-37, Washington, DC: U.S. Government Printing Office, March 1992.

[53]Neither the initial legislation, nor the 1992 reauthorization, established percentage goals for SBC that are minority- or woman-owned. Legislation focused on encouraging participation and dissemination of information. PL 102-564 states as a purpose "to improve the Federal Governments dissemination of information concerning the small business innovation research program, particularly with regard to program participation by woman-owned small business concerns and by socially and economically disadvantaged small business concerns."

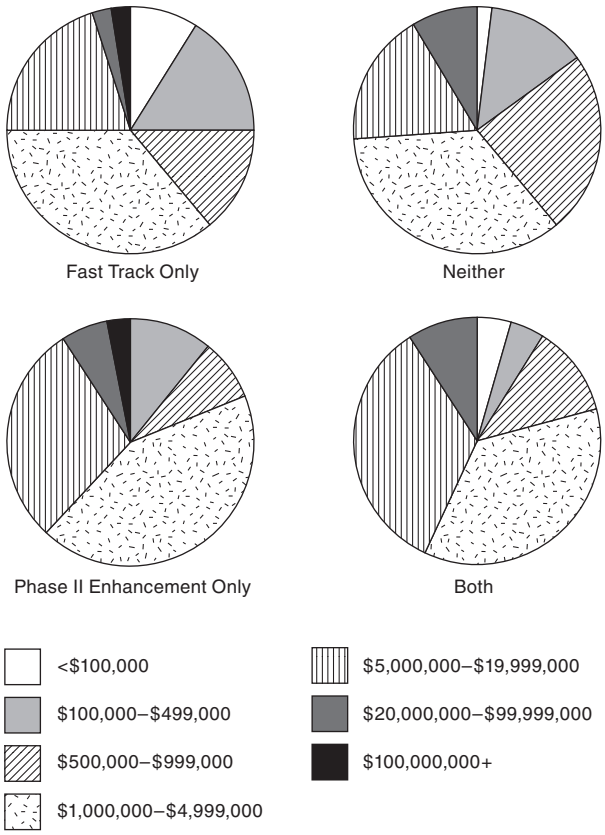

FIGURE 2-6 Firm annual revenue.
SOURCE: NRC Firm Survey 2006, Question 8. See Appendix B.

The analysis below identified firms by woman and minority ownership through analysis of the DoD Submissions Database. It then analyzed survey response in light of those data.

TABLE 2-2 Ownership of Firm

	Survey Responses: Minority Status (Number)				
Program	Woman	Minority	Both	Neither	Total
Control Group	10	7	1	89	107
Fast Track	9	2	3	50	64
PHII Enhancement	7	5	0	70	82
Total	26	14	4	209	253

	Survey Responses: Percentage of Awards in Category				
Program	Woman	Minority	Both	Neither	Total
Control Group	9.3	6.5	0.9	83.2	100.0
Fast Track	14.1	3.1	4.7	78.1	100.0
PHII Enhancement	8.5	6.1	0.0	85.4	100.0

SOURCE: DoD SBIR Submissions Database.
NOTE: The DoD SBIR Submissions Database, which contains proprietary information on the firms, was made available to NRC on a nondisclosure basis. Note also that the fast Track and Phase II Enhancement categories each also include first that received both fast Track and PIIE awards.

- **Ownership.** Since ownership by women and minorities could be a discriminator, the current NRC assessment determined if the owner was a woman or a member of a minority group. (See Table 2-2.)

  Fast Track
  Given the limited number of responses in each category, there were no significant differences between FT and the Control Group in terms of woman and minority ownership overall, although FT awards were less likely than the control group to go to minority-owned firms and more likely to go to woman-owned firms.

  PIIE
  PIIE firms closely tracked the control group in terms of woman and minority ownership.

- **Principal Investigators**. Ownership is not the only means of participation in SBIR. The current survey also examined the Phase III performance of projects where women and minorities had the opportunity to serve as Principal Investigators (PI) on the Phase II awards. Figure 2-7 displays whether the PI was a woman or minority.

Although there is no information concerning which cases where the owner was the PI, a cross comparison of the ownership with the PI question shows that women and minorities are more likely to be the PI in a firm that is owned by a woman or a minority than in one where the ownership is neither woman nor minority. The small percentage of women and minorities as owners or PI did not support a detailed analysis of responses by firms that are owned by members of a minority group or by women.[54]

2.2.3 Would Small Firms Have Commercialized Without SBIR?

When we attribute sales or other economic activity to SBIR, we must assess whether these sales would have occurred in the absence of SBIR. To do so, we asked the companies. Figure 2-8 displays responses to the question of whether the company would have undertaken the project in the absence of SBIR. Firms could respond that they definitely or probably would have undertaken the research had they not received the SBIR award, or that they probably or definitely would not have done the research without SBIR. The fifth possible response was that they were not certain what they would have done.

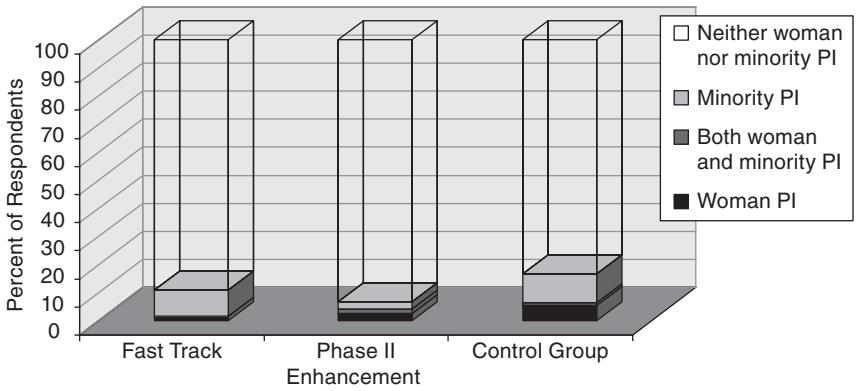

FIGURE 2-7 Principal investigators: Participation by women and minorities. SOURCE: NRC Project Survey 2006, Question 17. See Appendix C.

[54]DoD SBIR Submissions Database cross-referenced with NRC Project Survey 2006, Question 17.

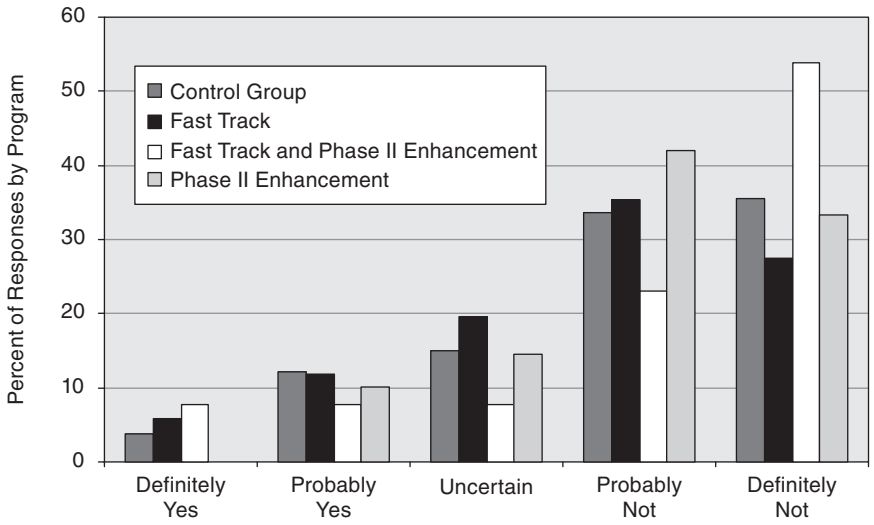

FIGURE 2-8 Commercializations absent the SBIR award.
SOURCE: NRC Project Survey 2006, Question 13. See Appendix C.
N= 107 (control group), 51 (Fast Track), 13 (FT and PIIE), 69 (PIIE)

Fast Track

As shown in Figure 2-8, two-thirds (66 percent) of the Fast Track award recipients surveyed reported that they definitely or probably would not have undertaken the project without SBIR. Seventeen percent of the Fast Track respondents said that they definitely or probably would have undertaken the project in the absence of the SBIR. This percentage is surprisingly low given that all Fast Track award winners surveyed were able to raise third-party funding for their projects during or before Phase I. The large number of uncertain answers for Fast Track may indicate that they were not sure the third-party would have invested without the SBIR award. These data are closely comparable to the 70 percent of the control group that reported that they would not have undertaken the project absent SBIR funding.

Phase II Enhancement

Seventy-five percent of the Phase II Enhancement group report that they would not have undertaken the project absent SBIR funding. Sixteen of the 84 Project Survey respondents who said that they definitely would not have undertaken the work in the absence of SBIR, reported sales of more than $1 million resulting from the SBIR effort.[55]

[55]Cross-reference of individual survey responses to NRC Project Survey 2006, Questions 9a and 13. See Appendix C.

2.2.3.1 Delay in the Absence of a Phase II

Awardees who responded that they would have or probably would have undertaken the research and development if they had not received the SBIR award were asked about the impact of that undertaking had they not received the Phase II award.[56] All groups reported that the start of the work would have been delayed.

- **Fast Track** participants anticipated a 13-month delay. This compares with 6 months for the control group. This again is surprising, as FT respondents might have been able to access the matching funds they had already generated.[57]
- **Phase II Enhancement** participants predicted an average delay of 5 months, while the control group anticipated a 6-month delay.[58]

2.2.4 Actual and Expected Sales in Phase III

2.2.4.1 Defining a Sale

The survey definition of sales attempted to cover all of the possible types of sales and customers that a small business might develop in Phase III.[59]

- As defined in the questionnaire, sales included all sales of products(s), process(es), service(s), or other sales to federal or private sector, or to other customers, resulting from the technology associated with the specific Phase II project.
- A sale could also include the sale of technology or rights, which was counted as part of the total sales activity. Additionally firms were asked to report licensee sales, when that information was known.

2.2.4.2 Sales to Date

The initial question simply concerns the percentage of projects reporting that they reached the commercial market-place—that they recorded at least $1 in sales. They survey asked this question both directly and indirectly by asking about total dollar sales to date.

Fast Track

Data from the latter question indicates that the sales rates for the FT and the Control Group are sufficiently similar that it is not possible to identify any significant differences, as illustrated in Figure 2-9. Forty-seven percent of

[56]See NRC Project Survey 2006, Question 15. See Appendix C.
[57]Ibid.
[58]Ibid.
[59]See NRC Project Survey 2006, Question 3. See Appendix C.

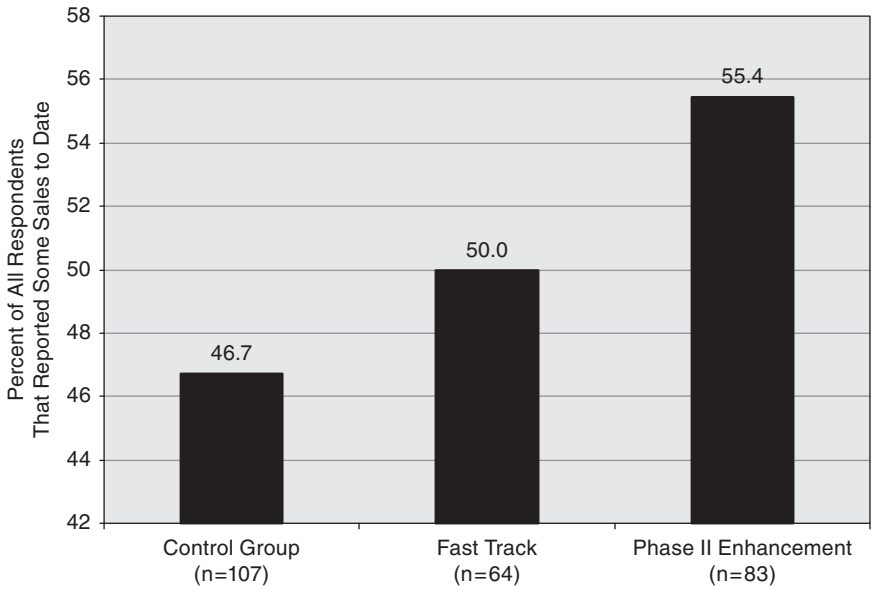

FIGURE 2-9 Percentage of all responding projects reaching the market. SOURCE: NRC Project Survey 2006, Question 4. See Appendix C.

Control Group projects reached the market, while 50 percent of FT projects did so.

Phase II Enhancement

The same data do suggest that there may be an association between PIIE and an increased sales rate, reflecting a higher percentage of projects that reached the market, as measured by this metric: 55 percent of PIIE projects reported some sales, while 47 percent of Control Group projects did so.

2.2.4.3 Expected Sales

Two-thirds of the Phase II Enhancement awards that do not yet have sales, expect to achieve sales. For the other two groups, about 55 percent of those without sales expect to achieve sales.[60]

[60]Ibid.

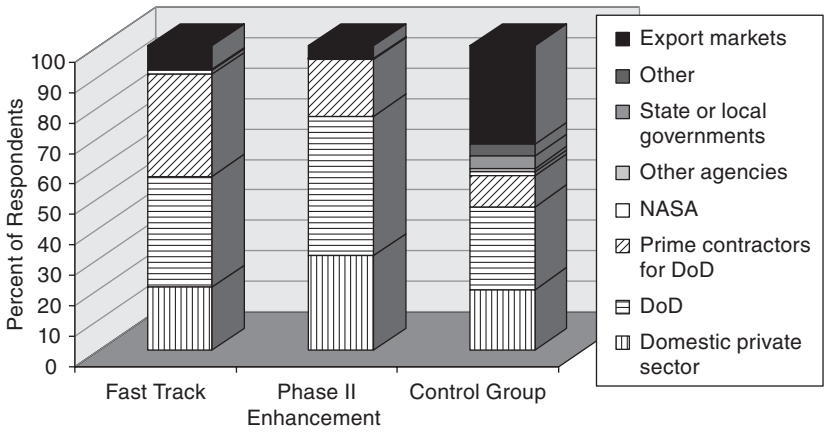

FIGURE 2-10 Distribution of sales: Percent of Phase III sales going to each sector.
SOURCE: NRC Project Survey 2006, Question 4. See Appendix C.

2.2.4.4 Sales Distribution by Size of Sales

Overall, approximately 54 percent of the projects responding to the survey reported sales.[61] They reported $268.5 million in actual sales through August 2006.[62] This amounts to an average sale of $1,118,600 for the 240 responding projects.[63] Given the high degree of skew in SBIR outcomes, it is important to review the distribution of sales by size in order to make relevant comparisons.

Fast Track

The distribution of sales for the Fast Track and control groups are—as Figure 2-11 indicates—quite similar. FT did not report a project with sales greater than $10 million, but it did report more projects with sales between $5 million and $10 million.

Phase II Enhancement

The distribution of awards by size indicates that the PIIE group generated more awards with larger revenues, as reflected in Figure 2-12.

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[61]Ibid.
[62]See NRC Project Survey 2006, Question 4, in Appendix C. The percentages going to each sector are percentages based on sales by the firm. Firms were not asked about sector sales by their licensees as it was felt that they would not have good information on the customers of licensees. Sales by the firm, depicted in Figure 2-11 totaled $231 million. Sales by licensees, not depicted in Figure 2-11 totaled $37 million.
[63]NRC Project Survey 2006, Question 4. See Appendix C.

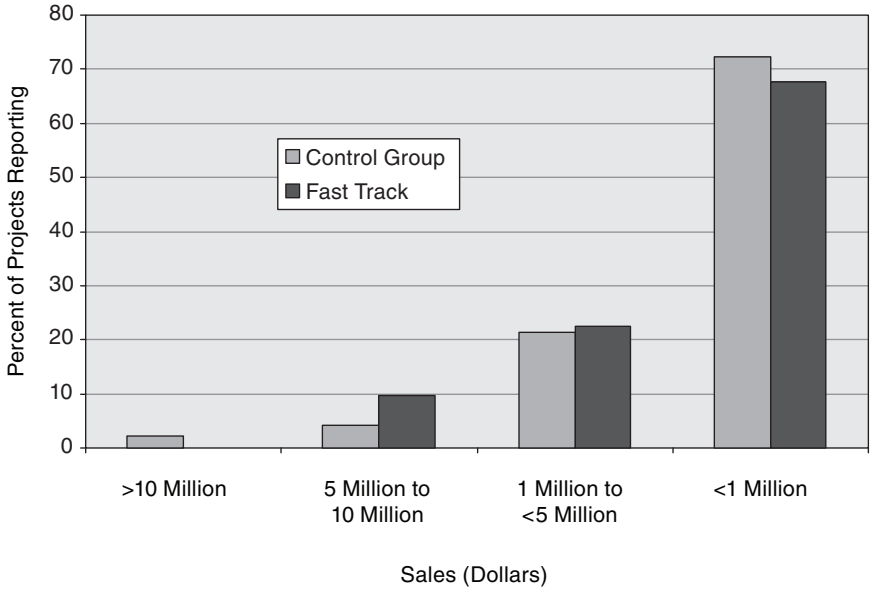

FIGURE 2-11 Distribution of sales by size, Fast Track and control group.
SOURCE: NRC Project Survey 2006, Question 4. See Appendix C.
N=31 (Fast Track), n=47 (control group).
NOTE: Data for the Fast Track group includes the six projects that were awarded both FT and PIIE.

The PIIE group generated two awards with more than $10 million in cumulative revenues, and six with revenues of $5 million to 10 million, compared to one and two respectively for the control group. Given the very small numbers of awards involved, caution should be employed when drawing conclusions from these data. They are however suggestive.

2.2.4.5 Sales Distribution by Customer Sector

Figure 2-13 shows the distribution of total sales achieved by SBIR Phase II projects to key customers as of August 2006.

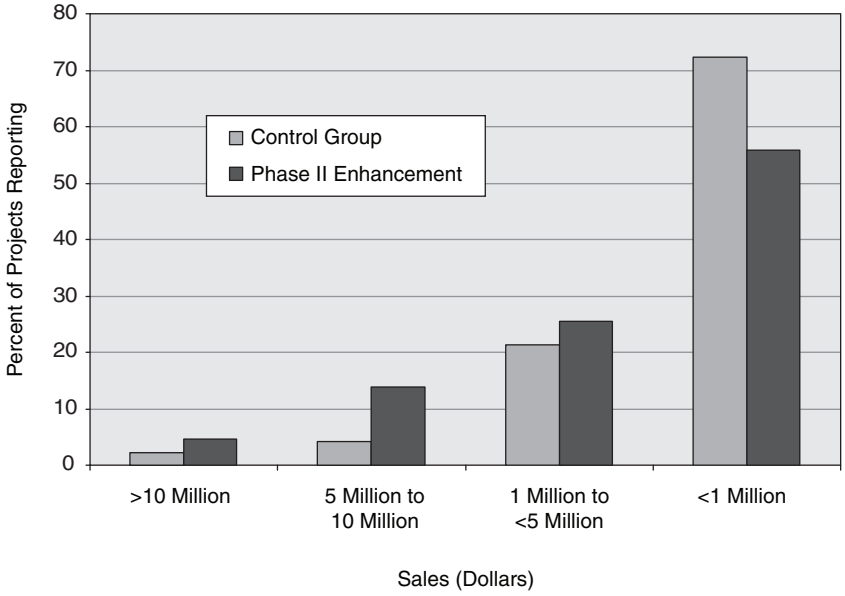

FIGURE 2-12 Distribution of sales by size, Phase II Enhancement and control group.
SOURCE: NRC Project Survey 2006, Question 4. See Appendix C.
N=43 (PIIE), n=47 (control group).
NOTE: Data for the PIIE group includes the six projects that were awarded both FT and PIIE.

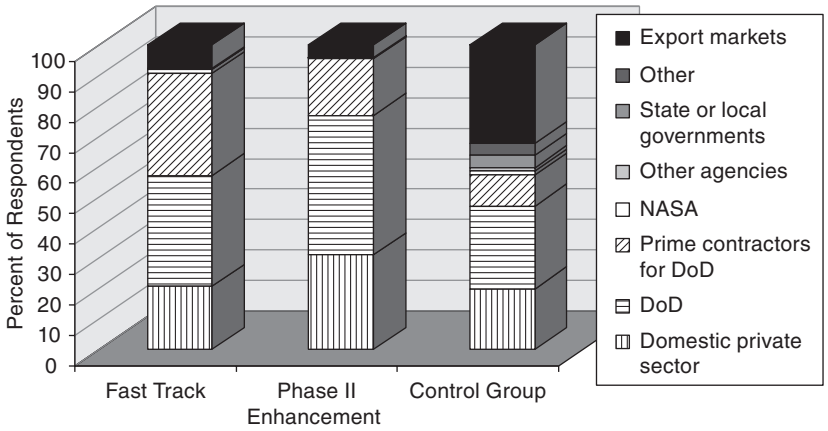

FIGURE 2-13 Distribution of sales: Percent of Phase III sales going to each sector.
SOURCE: NRC Project Survey 2006, Question 4. See Appendix C.

Customers purchasing the result of SBIR activity in Phase III included the private sector, export markets, DoD, DoD Primes[64], NASA, other federal agencies, and other public sector such as state and local governments. The information on the distribution of sales to these customers relates to both the achievement of private-sector commercialization and to meeting agency R&D needs in Phase III. "Other" customers identified included educational, medical, and research institutions.[65]

2.2.4.6 Expected vs. Realized Sales

It is interesting to compare the reported sales for Fast Track in the current survey to the expected sales for Fast Track reported in the first NRC study.[66]

- In the first survey, Fast Track awardees responded that they expected average sales in 2001 (four years after the Phase II award) to be in excess of $8 million.[67]
- All current Fast Track respondents have had at least four years since their Phase II award, some as many as nine years,[68] but the average reported sales is only slightly more than $1 million.[69]

This suggests that when asked to indicate expected sales, Fast Track companies (and probably all SBIR companies) tend to take a highly optimistic view.

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[64]The category "DoD Primes" was not used in the 1991 GAO survey. It was added in 1999 for the NRC Fast Track study to differentiate between sales made directly to DoD and those made to private contractors largely for incorporation into products ultimately sold to DoD. The term is used in gathering commercialization data on the DoD SBIR submission site. In 1991, these sales may have been categorized as private sector or DoD.

[65]See NRC Project Survey 2006, Question 4, in Appendix C. The high percentage of sales to the export market for the control group merits explanation. The survey response, which reported the largest company sales ($35 million), was a control group award, which reported 65 percent of its sales to the export market. The sales from this award were more than double the next highest reported sales for any award. The export share of the sales from this award amounted to $22.7 million of the $29 million in export sales reported by the control group.

[66]See National Research Council, *The Small Business Innovation Research Program: An Assessment of the Department of Defense Fast Track Initiative*, Charles W. Wessner, ed., Washington, DC: National Academy Press, 2000.

[67]See Figure 15 in Peter Cahill, "Fast Track: Is It Speeding Commercialization of the Department of Defense Small Business Innovation Research Projects?" in National Research Council, *The Small Business Innovation Research Program: An Assessment of the Department of Defense Fast Track Initiative*, op. cit.

[68]Only 10 of the 45 Fast Track awards that responded in 1999 responded to this survey. Many of the non-responding firms no longer exist. Some firms, which were apparently successful, were acquired by larger firms that did not respond to the survey. 1999 survey results are reported in National Research Council, *The Small Business Innovation Research Program: An Assessment of the Department of Defense Fast Track Initiative*, op. cit.

[69]NRC Project Survey 2006, Question 4. See Appendix C.

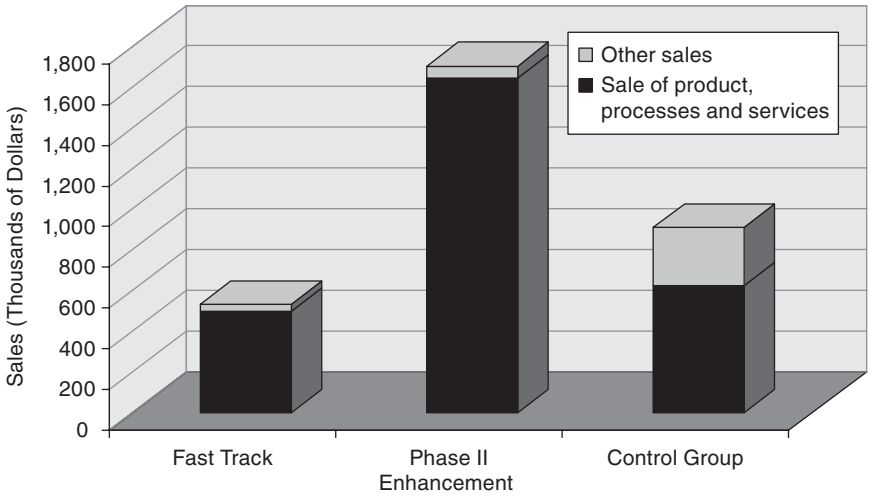

FIGURE 2-14 Near-term expected sales: Expected sales through end of 2007. SOURCE: NRC Project Survey 2006, Question 9. See Appendix C.

2.2.4.7 Projected Sales

Projects that reported sales or reported that they expected their first sale to occur before the end of 2007 were asked to estimate the amount of sales they expected between the completion of the survey and the end of 2007. (See Figure 2-12.) Other sales were defined as including rights to technology and sale of spin-off companies. Based on the survey conducted for the 2008 NRC SBIR study, it is not unreasonable to project eventual average sales of in excess of one and a half million dollars per DoD SBIR project. To expect the above levels of average additional sales in the next year and a half is optimistic. Such optimism, however, is normal among SBIR participants. Optimism about projected SBIR sales also appeared in the 1991 GAO study and was found again in the 1999 NRC study.[70]

2.2.4.8 Initial Public Stock Offerings (IPO)

Three surveyed firms made IPO, which they attribute to the SBIR program. One of these firms made their IPO in 1996, prior to the Fast Track and Phase II Enhancement initiative. That firm completed surveys on two subsequent Phase II Enhancement awards. Another firm had an IPO in 2000, which was after the control group award—that is, an award that is selected for

[70]See National Research Council, *The Small Business Innovation Research Program: An Assessment of the Department of Defense Fast Track Initiative*, op. cit.

analysis and neither a Fast Track nor a Phase II Enhancement award—and before the Phase II Enhancement award on which they completed surveys. The third firm, which had a 2005 IPO, completed a survey on a control group award. Each of these three firms had over a dozen Phase II awards before its IPO.[71]

2.2.4.9 Skew in Outcomes

SBIR sales are typically dominated by a few awards that produce most of the sales. Sixty-four percent of the total sales estimated between 2006 and 2007 were estimated for nine awards. These nine highest estimates (all at least $10 million) were in the Phase II Enhancement or the Control group.[72] These high estimates seemed credible in that four of five Phase II Enhancement projections and two of four of the control group highest estimates had reported a high level of completed sales. Firms were asked about the basis for their estimates with choices ranging from market research, consultants, educated guesses, and past experience to ongoing negotiations, existing contracts and projection from current sales. All of the high estimated sales were based on existing contracts or projections from current sales.[73]

2.2.5 Impact of Funding Gaps

Begun in 1996, Fast Track was an initiative of the 1995 DoD Process Action Team on the SBIR Program. Fast Track was one of two reforms that affected the funding gap between Phase I and Phase II.

The requirement for a Fast Track contractor to submit his Phase II proposal during Phase I and for the agency to expedite evaluation and award of Fast Track proposals was designed to reduce the Fast Track funding gap between the two phases. The second reform affecting the gap was the establishment of a new standard of six months for the average time interval between receipt of SBIR proposal and award in Phase II.

Long gaps in funding make it difficult for a small company to keep its research team together. Studies have shown that delay in time to market decreases the value of an innovation.[74] The funding gap is addressed on three charts. Figure 2-14 compares the percentage of Fast Track firms that experienced a gap with those from the Control Group. Figure 2-13 shows the magnitude of the gap, and Figure 2-15 shows the number of firms experiencing a gap and how the firms dealt with the gap.

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[71]NRC Firm Survey 2006, Question 12. Cross-reference with Question 4. See Appendix B.
[72]See NRC Project Survey 2006, Question 9. See Appendix C.
[73]Ibid. Individual responses to Question 9a were cross-referenced to responses to Question 9c.
[74]Innovation speed can confer a significant competitive advantage to a firm. See H. Sonnenberg, Balancing Speed and Quality in Product Innovation, *Canadian Business Review*, 17(3):19-22, 1993. Also see Gideon D. Markman , Peter T. Gianiodis, Phillip H. Phan, and David B. Balkin, "Innovation Speed: Transferring University Technology to Market," *Research Policy*, 34(7):1058-1075, September 2005.

BOX 2-2
Funding the Gap Between Phase I and Phase II

Normally there are three components to the gap between Phase I and II of an SBIR award. These are:

- The time required by the firm to prepare and submit a proposal;
- The time needed by agencies or services to evaluate and select proposals; and
- The period needed for the federal contracting process, which includes the time for the firm to provide additional information and certifications, DCAA audit of the firm, contract negotiations and, finally, the award.

During contracting process, the Navy provides bridge funding for up to six months and the Army for four months. The Air Force funds all Phase I for an additional three months.

The survey responses suggest that the Fast Track Program has had an impact in reducing the percentage of firms experiencing a delay between Phase I and Phase II.

2.2.5.1 The Size of the Gap

Figure 2-16 displays the average funding gap (in months) reported for each group, for those projects that reported experiencing a funding gap. For Fast Track, only 22 of the 64 respondents experienced a gap[75]; thus, the average gap for all Fast Track respondents was only 1.5 months; however, the number reporting no gap has decreased and the average gap has increased in recent years.[76]

This coincides with a general relaxation by DoD components in how soon the Phase II proposal must be submitted. When Fast Track originated in 1996, proposals for Fast Track Phase II had to be submitted within five months of the Phase I award. The general deadline for Fast Track proposals is now six months after award of Phase I, and Army, CBD, DARPA, and OSD allow even more time.

For the Control group, 33 projects reported no gap in funding, resulting in an average gap for all Control group respondents of six months.[77]

Responses to the gap by firms in each of the three groups are shown in Figure 2-17.

[75] See NRC Project Survey 2006, Question 31, in Appendix C.
[76] Information from the DoD Fast Track Database.
[77] See NRC Project Survey 2006, Question 31, in Appendix C.

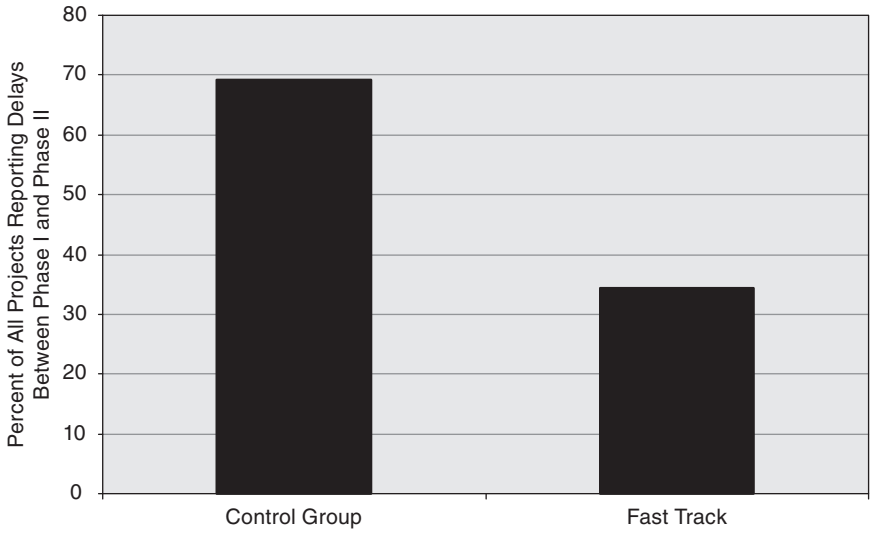

FIGURE 2-15 Funding gap between Phase I and Phase II: Percentage of firms experiencing delays.
SOURCE: NRC Project Survey 2006, Question 31. See Appendix C.
N=64 (FT) and n=107 (CG).

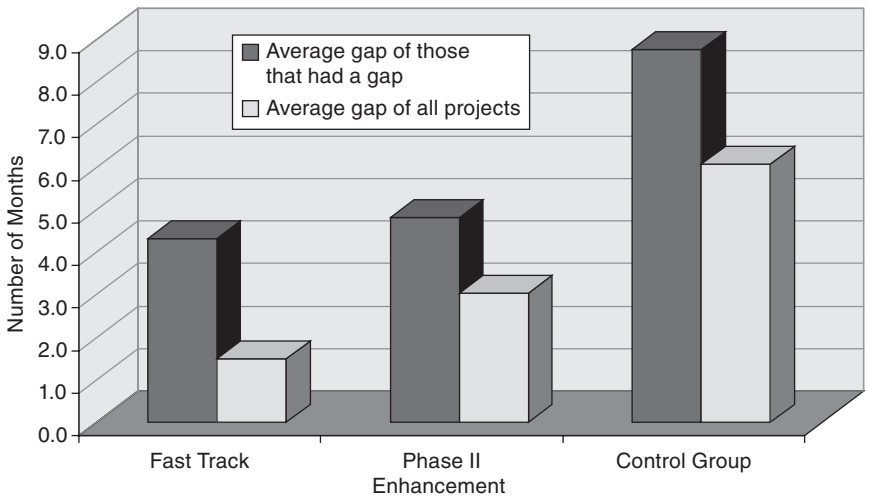

FIGURE 2-16 Funding gap between Phase I and Phase II: Average length of funding gap in months.
SOURCE: NRC Project Survey 2006, Question 31. See Appendix C.

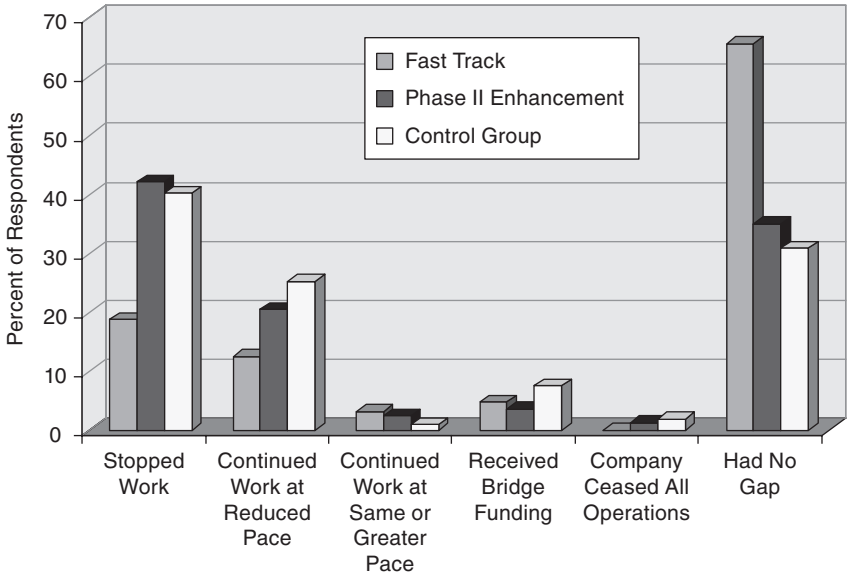

FIGURE 2-17 How firm coped with funding gap.
SOURCE: NRC Project Survey 2006, Question 33. See Appendix C.

As shown in Figure 2-14, only 12 Fast Track projects (19 percent) reported that the funding gap caused them to stop work. This compares to 40 percent for the control group. The significant number of projects still experiencing a gap, and the number stopping work due to the gap, may indicate that the agency should consider increasing the duration of gap funding.

2.2.5.2 Limits to Reducing the Gap

Agencies typically create a gap between submission of the Phase II proposal and the award of the Phase II contract by fixing the times when a company can submit a Phase II proposal.[78] Some of the gap, however, is due to the time the firm takes to submit the proposal.

A question in the project survey asked for the date that the Phase I award period ended and the date the Phase II proposal was submitted.[79] Almost half of the respondents left the dates blank. Only 33 percent of the

[78]The DoD components usually control when the company can submit a Phase II proposal. SDIO/BMDO was the only component that had an open submission for Phase II awards and allowed companies to submit for a Phase II award at the company's discretion. As such, any delay that occurred between Phase I and the submission of a Phase II proposal was driven by the company and not the government.
[79]NRC Project Survey 2006, Question 32. See Appendix C.

Fast Track sample could identify these dates. Both the Control Group (68 percent) and the Phase II Enhancement (64 percent) samples were more responsive.

Eighteen percent of the respondents claimed to have submitted their Phase II proposals the same day as they completed Phase I. Thirty-three percent reported that they had submitted their Phase II proposals prior to completion of Phase I work. Phase II proposals reported to be submitted prior to the end of Phase I work ranged from an average of 68 days early for the Control group to 94 days early for Fast Track. (Some of these were probably reporting errors.)[80]

Air Force Phase I awards last for nine months, but require a report at the sixth month. The other agencies provide six-month Phase I awards with the report due at the end of the 6th months. Proposal evaluation cannot be accomplished until the Phase I report has been received. In general a proposal submission prior to the end of Phase I will not speed the Phase II decision.

Half of the proposals were reported to have been submitted after Phase I was completed. This self imposed funding gap appeared to range from 197 days for Phase II-Enhancement proposals to 232 days for the Control group. This part of the funding gap is largely under the firm's control. The agency cannot begin the evaluation and award process until the proposal is submitted.[81]

2.2.6 Additional Developmental Funding

SBIR does not provide federal funds to commercialize a product.[82] And many projects require further development, testing, standardization, producibility, engineering, Beta testing of software, and similar activities after Phase II. Activities related to market research, trade show attendance, advertising and sales are not allowable costs under SBIR. Thus additional funding may be an important component of commercialization, and its presence is therefore a good indicator that commercialization is under way.

It is not unusual for an SBIR firm to use a Phase II developed prototype to attract investors or customers who place an order for the further development and delivery of a product. Some needed development activities may occur

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[80] Ibid.

[81] It should be noted that some of the data that used to compute the delay is limited and, in some cases, may be flawed. Seven projects reported submission over one year after Phase I. Normally, only the Army would allow this much delay and none of these projects were Army awards. For example, the longest reported delay (5 years between Phase I completion and Phase II proposal) is probably erroneous in that the Phase I was reported as being completed four years prior to the topic year that was identified.

[82] The purpose of Phase II Enhancement funding is to encourage the transition of SBIR research. Navy and Army focus on funding additional research and development, and the Air Force focuses on overcoming unforeseen technological barriers. All three services and MDA direct their enhancement programs to transition into acquisition programs.

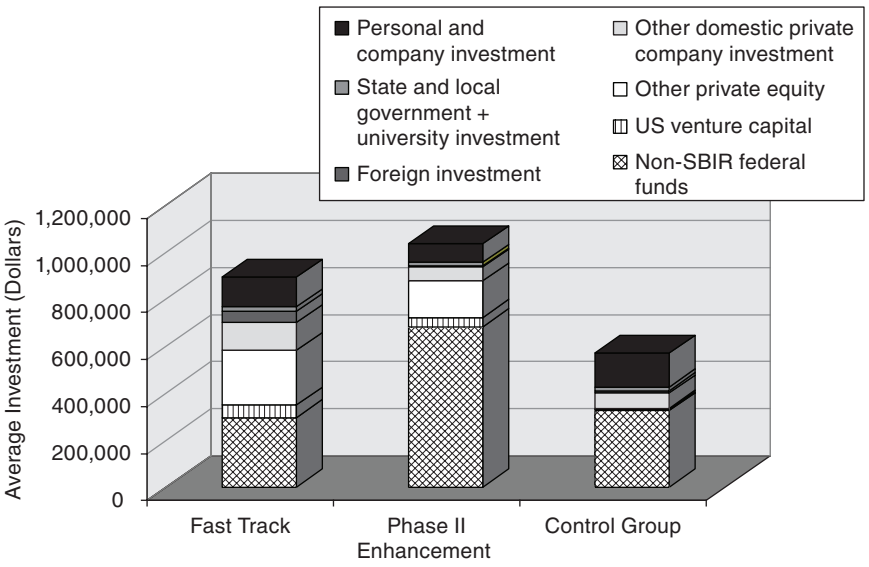

FIGURE 2-18 Average non-SBIR investments.
SOURCE: NRC Project Survey 2006, Question 23. See Appendix C.

concurrently with early sales, with the revenue used to upgrade later versions of the product: however, most additional investment must happen early in the sales cycle. The reported additional non-SBIR development funding to date is shown in Figure 2-18.

2.2.6.1 Non-SBIR Investments

Most private additional developmental funding is invested in anticipation of a return on investment. Thus, the additional investment is a leading indicator of ultimate commercial sales.[83] Similarly early additional funding by non-SBIR federal funds is generally an indicator of Service interest in the technology of the award and is a leading indicator of sales to DoD or its primes.

Greater investment in Fast Track projects and Phase II Enhancement projects than in the control group ought to be a foregone conclusion at this point in the projects. Fast Track projects had to bring third-party money to the table and have it invested early in Phase II. Phase II Enhancement projects brought in third-party money and matching funds. The control group projects did not. It would appear that in addition to occurring earlier, the ultimate investment in

[83]See Peter Cahill, "Fast Track: Is it Speeding Commercialization of Department of Defense Small Business Innovation Research Projects?" op. cit., p. 68.

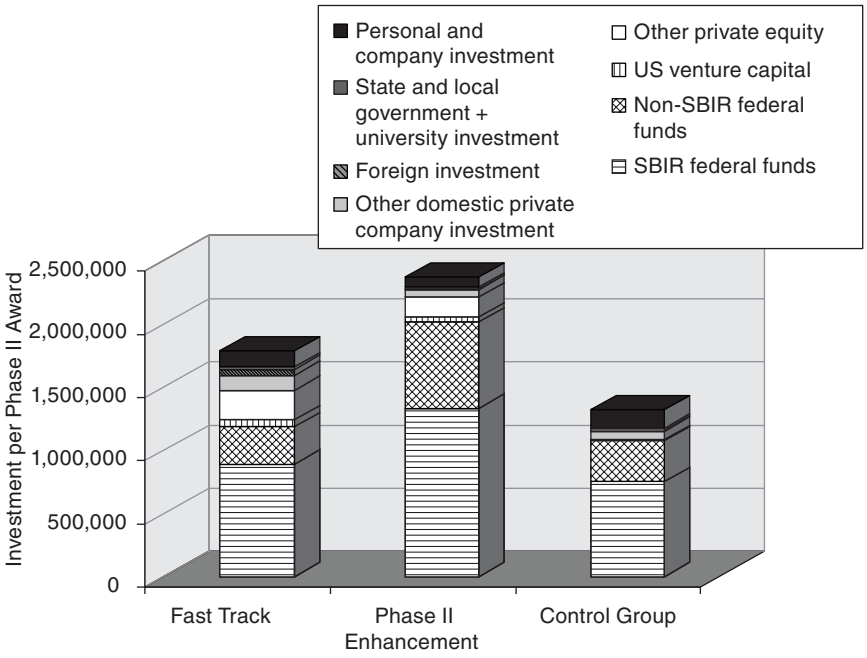

FIGURE 2-19 Average investment including SBIR.
SOURCE: NRC Project Survey 2006, Question 23. See Appendix C.

Fast Track Phase II and Phase II Enhancement Awards will be larger than in projects that are neither.[84]

To get a complete picture of the funding that goes into the research, development, and transition into commercialization, we need to consider the SBIR funding for the award as well.

Fast Track

Fast Track awards reported an average Phase II SBIR award that is $100,000 higher than the control group.[85]

[84]The 2005 survey for the NRC study found that 920 responding DoD projects awarded Phase II from 1992 to 2001 averaged $795,734 in additional non-SBIR developmental funding, a larger average than the control group, but below that of Fast Track in the current survey (NRC Project Survey 2006, Question 23, in Appendix C). The average responding project in the 2005 survey had three more years in this study to acquire additional funding. The 2005 survey results can be found in National Research Council, *An Assessment of the SBIR Program at the Department of Defense*, Charles W. Wessner, ed., Washington, DC: The National Academies Press, 2009, Appendix B.
[85]Phase II Enhancement Awards averaged $1,333,061 in SBIR funding. Fast Track awards averaged $890,374. Control group awards averaged $794,292. The apparent advantage of Fast Track over the control group is an illusion. Fourteen of the Fast Track awards received subsequent Phase II

Phase II Enhancement

As Phase II Enhancement can obtain up to a half million dollars in additional SBIR money by obtaining appropriate matching funds, Figure 2-16 adds the SBIR funding to the funding shown in Figure 2-15. The average SBIR funding for the responding awards was $500,000 higher for Phase II Enhancement awards than for Control Group.

Returning to the comparison of additional funding between the Phase II Enhancement and the control group on Figure 2-15, we can examine the totals without the input of Phase II Enhancement by third parties. As discussed above, Phase II Enhancement awards received, on average, $400,000 more in awards than the control group. Since Phase II Enhancement provides a dollar for dollar match of SBIR funding to third-party funding, it can be presumed that at least $400,000 of the additional average funding for Phase II Enhancement (displayed in Figure 2-15) was the funding that was executed during the additional year of Phase II. This $400,000 is less than 40 percent of the difference in average additional funding of Phase II Enhancement compared to the control group.[86]

2.2.6.2 Venture Capital Impacts

Venture capital investment is often suggested as an alternative to SBIR.[87] However, less than two percent of the awards reported any venture funding. Four Fast Track, one Control Group, and three Phase II Enhancement awards reported venture funding.[88] As can be seen from Figure 2-15, the impact of venture capital on available funding was marginal. The average venture capital investment on these few projects was less than $1,000,000. The number of projects reporting VC funding was too small to allow substantive comparisons between groups.

Enhancement, thus adding to their SBIR funding. When these 14 are removed from the Fast Track averages, the average SBIR for the remaining 50 Fast Track awards ($797,267) is comparable to that of the control group.

[86]A similar direct comparison for Fast Track is not simple. Fast Track awards receive no additional SBIR funding compared to control group. The required third-party funding may be a dollar for dollar match to the Phase II award, or a one dollar to four SBIR dollars match dependent on whether this is the firm's first SBIR Phase II. Since almost two-thirds of Fast Track respondents said this was their first Phase II, the average third-party match would be 1/3 x $800k +2/3 x $200k = $400k; however, almost one fourth of the Fast Track also received Phase II Enhancements, raising this average for third-party funding to about one half million dollars. Continuing this logic, one fifth of the Phase II Enhancement respondents were also Fast Track awards, hence the full average third-party funding for Phase II Enhancement awards was also almost a half million dollars.

[87]The limitation on majority VC owned firms was implemented only beginning in 2002. For a review of the impact of the SBA rule on the SBIR program at NIH, see, National Research Council, *Venture Capital Funding and the NIH SBIR Program*, Charles W. Wessner, ed., Washington, DC: The National Academies Press, 2009.

[88]One of the awards reporting venture capital was both a Fast Track and a Phase II Enhancement.

2.2.7 Knowledge Effects: Patents and Scientific Publications

The congressional objectives for the SBIR program include additions to the nation's scientific and technical knowledge. Patents, copyrights, and scientific publications are all evidence that this objective is being addressed by the SBIR program. The number of patents and copyrights applied for and issued is a measure of the intellectual property being generated. Since most scientific journals are refereed, the number of publications submitted and published measures to some degree the scientific merit of the SBIR. The numbers of patents, copyrights, trademarks, and scientific publications to date were measured by the survey.[89] (See Figure 2-20.)

Fast Track

A concern expressed by some opponents of Fast Track is that, in order to attract third-party investors, there can be no true research in a Fast Track SBIR. The project must be much further down the development path. They contend that to obtain third-party financing, innovation must be complete or nearly complete and the SBIR merely serves to validate. If this is the case, one might expect a lower level of patent and copyright activity for Fast Track.

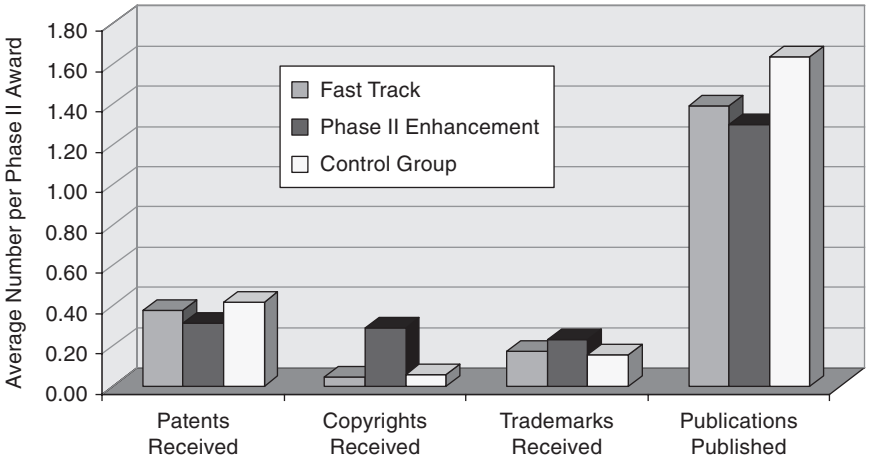

FIGURE 2-20 Disclosure activity: Average number of patents, copyrights, trademarks, and scientific publications received for the technology developed as a result of project.
SOURCE: NRC Project Survey 2006, Question 18. See Appendix C.

[89]NRC Project Survey 2006, Question 18. See Appendix C.

The data reported in the figure above indicate that Fast Track and Control Group projects tend to patent at much the same rate. Both Fast Track and Control Group projects reported 0.42 patents per Phase II award. Eighty six percent of FT projects reported zero patents, compared with 77 percent of Control Group projects.[90]

Phase II Enhancement

The average patents reported received per phase II award varies from 0.30 for Phase II Enhancement to 0.42 for the control group.[91] Once again, only a few firms reported receiving patents: 13 percent of PIIE firms and 23 percent of the Control Group.[92] It therefore appears that patenting is a somewhat less important tool for protecting intellectual property among PIIE firms.

It is also worth noting that, as in other area, skew is important: one firm accounted for a fifth of all Control group patents (9).

2.2.7.1 Scientific Publications

The largest disclosure of research results appears to be in scientific publications. Three hundred and sixty-seven of the 380 papers reported as submitted to scientific publications were published. The control group included one award that reported 50 publications and another that reported 12 publications. Five awards (three Phase II Enhancement and one each Fast Track and Control Group) reported ten publications apiece. Most awards (74 of 107) that reported publication, had three or fewer papers published in scientific journals. Overall, there was little difference in the reported intellectual property/disclosure results for the vast majority of awards in each group. Slight differences in averages were due to single high performers in each category.

2.2.8 Impact of the Use of Fast Track and Phase II Enhancement on Responding Awards

Respondents were asked several questions that were answered only by Fast Track awards or only by Phase II Enhancement Awards. The first question dealt with the source of matching funds in the Fast Track proposal or in the Phase II Enhancement proposal. (See Figure 2-21.)

Since respondents could identify more than one source, the percentage totals of responses for the sources in Figure 2-18 add up to more than 100 percent. The number of respondents indicating their own firm as the source of matching funds in the proposal is quite unusual. Nothing prevents a firm from investing in its own SBIR research; however, DoD criteria for Fast Track

[90]N=56 and n=107 respectively.
[91]One control group Phase II award received 11 patents, which accounts for its advantage in averages. Ibid.
[92]N=77 and n=107 respectively.

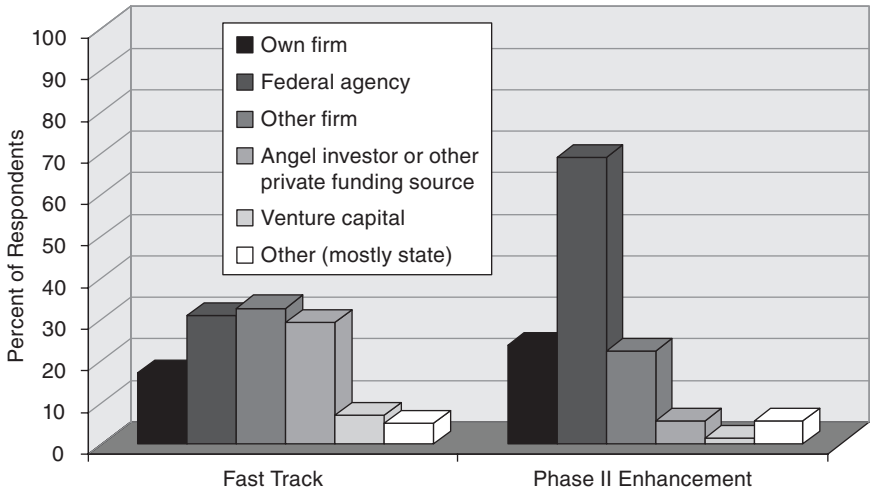

FIGURE 2-21 Proposal matching funds: Sources of matching or co-investment funding included in the proposal.
SOURCE: NRC Project Survey 2006, Question 25. See Appendix C.

specifically require that the matching funds in the proposal have to come from an outside third-party source.

Fast Track

The requirement to find third-party financing for Phase II and to obtain finalized agreements within 150 days of the award of Phase I has been a deterrent to participation in Fast Track. One-fourth of the Fast Track respondents reported that it took six months or more to obtain an agreement for third-party financing, indicating that they had to begin the search for financing prior to obtaining the Phase I award. The reported average time to obtain third-party financing for Fast Track was 3.5 months. The longest reported time was 12 months.

Phase II Enhancement

For Phase II Enhancement, the individual component programs have differing criteria for outside investors, some specifying only acquisition programs qualify and others allowing private sector. The tilt toward acquisition programs for Phase II Enhancement can be seen in the high percentage of federal agency shown as the source of matching funds for that program.

For Phase II Enhancement, the average time to find and obtain an agreement for third-party financing was 4.1 months.[93] Eleven percent of the respondents reported times of 12 or more months. Phase II Enhancement proposals are submitted on the schedule required by the individual components, but never prior to the completion of the first year of Phase II. Hence there is much more time available to locate and negotiate with the third-party source.[94]

The survey asked for comparison of the performance of Phase II Fast Track Awards and awards that also received Phase II Enhancement to performance of a standard Phase II award. As shown in Figure 2-22, the surveyed awards were judged to perform better, worse, or the same as a standard Phase II. Note that the relevant comparison in each case is between the control group and either Fast Track or PIIE. There is no relevant comparison between the latter groups. Note also that in the case of each variable, both Fast Track and PIIE were reported to compare favorably with the control group.

2.2.8.1 Speed to Market

Over 50 percent of Fast Track and Phase II Enhancement respondents contended that the initial products reached the market faster than products of the average standard Phase II award. For Phase II Enhancement, which includes an extra year of Phase II development, seven percent stated that the time for the initial product to reach the market was longer than would have occurred absent the Phase II Enhancement.[95]

2.2.8.2 Sales to Date

A substantial percentage of Fast Track (38 percent) and Phase II Enhancement (48 percent) projects claimed that sales to date were greater than would have occurred with a standard Phase II award. Similarly, both Fast Track (52 percent) and Phase II Enhancement (47 percent) projects claimed that investment to date was greater than would have occurred with a standard Phase II award. Seven percent (four awards) reported smaller investment to date than would have occurred absent the Phase II Enhancement.[96]

2.2.8.3 Potential Sales

Potential sales were expected to be greater for Fast Track (45 percent) and for Phase II Enhancement (69 percent) projects than these groups would have expected to occur with a standard Phase II award. Investment in Phase II Enhancement may ease the transition into a DoD procurement. Seventy-five percent of the awards that reported such investment also reported improved transition. Similarly, 72 percent of the Fast Track projects that reported

[93]NRC Project Survey 2006, Question 26. See Appendix C.
[94]Ibid.
[95]NRC Project Survey 2006, Question 27 and 29. See Appendix C.
[96]See NRC Project Survey 2006, Question 27 and 29. See Appendix C.

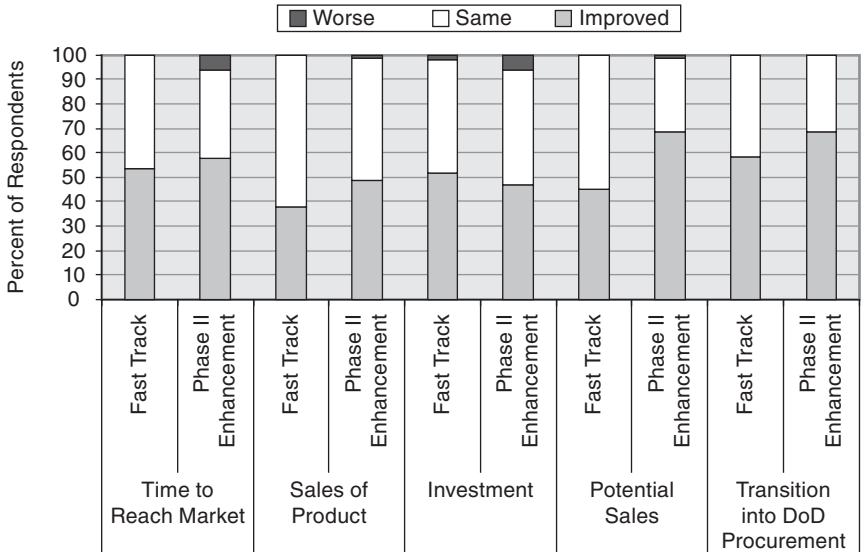

FIGURE 2-22 Comparisons to standard SBIR awards: Impact Fast Track or Phase II Enhancement had as compared to a standard Phase II proposal. SOURCE: NRC Project Survey 2006, Questions 27 and 29. See Appendix C.

investment by a federal agency as their source of matching funds also reported improved transition.[97]

2.2.8.4 Satisfaction with Fast Track and the Phase II Enhancement

Figure 2-23 shows the bottom line satisfaction by the firms with both the Fast Track program and the Phase II Enhancement program. Respondents were asked "In retrospect, knowing the outcome, are you satisfied with your decision to use" the program (Fast Track or Phase II Enhancement) "on this Phase II"?

High percentages of both groups expressed satisfaction with their decision to use those programs (90 percent of the Fast Track group and 95 percent Phase II Enhancement group). These questions about both Fast Track and Phase II Enhancement were only asked of participants in those programs. The next series of questions elicited opinions from firms who had not or would not in the future participate in one of these programs.

[97]Ibid.

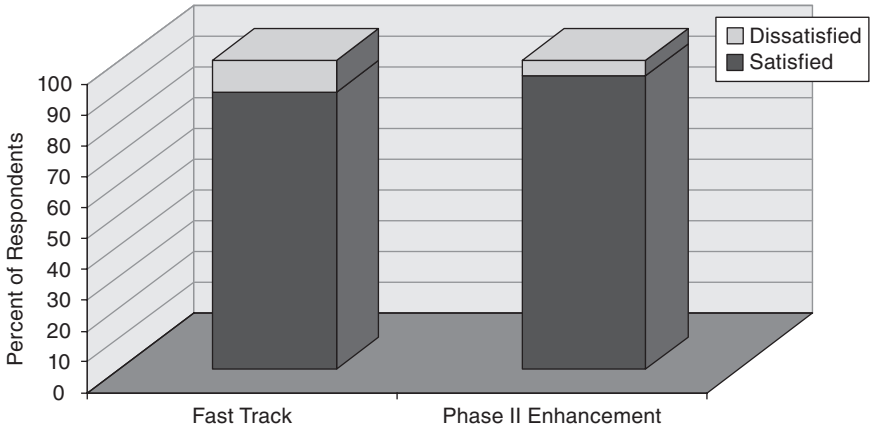

FIGURE 2-23 Customer satisfaction with programs: Decision to use Fast Track or Phase II Enhancement.
SOURCE: NRC Project Survey 2006, Questions 28 and 30. See Appendix C.

2.2.9 Reasons for Not Submitting Fast Track and Phase II Enhancement Proposals

The following information was determined from questions on the firm survey.[98]

Fast Track

Firms were asked if they had ever submitted a Fast Track proposal.[99] Thirty-eight percent of those responding had submitted a Fast Track proposal. Of those who had submitted a Fast Track proposal, 38 percent said that they were likely to do so in the future. However, firms did not express strong opinions in responding as to whether they would submit future Fast Track proposals. Nineteen percent of all respondents said yes; one-third said no; and the rest did not answer this question. Ten percent of the firms that had submitted for Fast Track in the past said that they would not do so in the future.

Firms that had not submitted, or were not likely to submit a Fast Track proposal, were asked to identify why. Their responses are shown in Figure 2-24.

[98]The project survey is not the basis for categorizing a firm as belonging to Fast Track, Phase II Enhancement, or control groups. This is because a given firm (1) could have been surveyed in more than one award category and/or (2) could have award(s) in another category but not sampled in that category.
[99]NRC Firm Survey 2006, Question 15. See Appendix B.

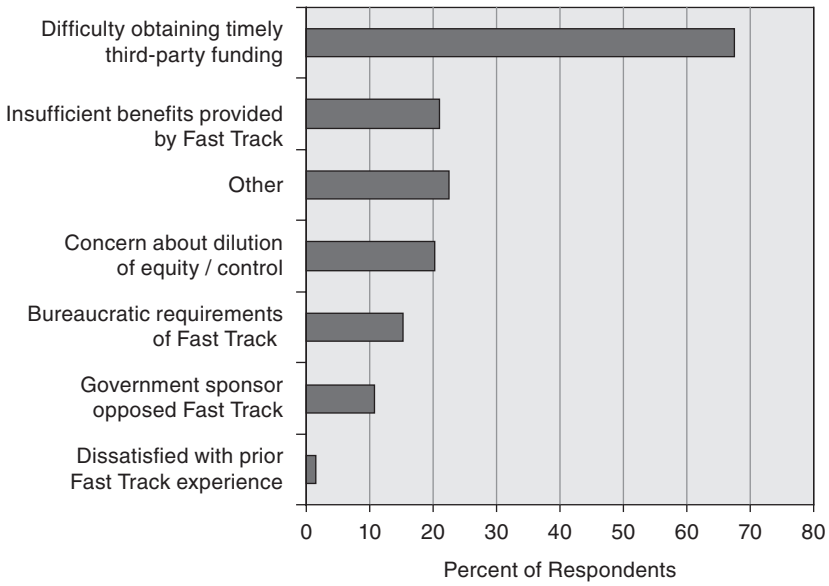

FIGURE 2-24 Reasons for not submitting Fast Track proposals
SOURCE: NRC Firm Survey 2006, Question 16. See Appendix B.

Difficulty in finding third-party funding in time to submit a Fast Track application[100] was by far the primary reason for not submitting or planning to submit. Firms that responded "other" offered a variety of reasons. The most frequent response (4 of 29 who responded other) was lack of knowledge or understanding of Fast Track. The second most frequent response (3 of 29) was that the firm was no longer eligible for SBIR. Only one other response, dealing with lack of commercial maturity of the technology, was given by more than one firm.

Phase II Enhancement

The firms were asked the same questions about participation in Phase II Enhancement.[101] Fifty-one percent of firms reported that they had submitted a Phase II Enhancement proposal. Of these, 61 percent reported that they were likely to do so in the future. Although many firms indicated that they were likely to submit future Phase II Enhancement proposals, again many expressed no opinion. Forty-six percent of all respondents said that they were likely to submit future Phase II Enhancement proposals; eight percent said that they were

[100]Although Fast Track Phase II proposals are not due for six or more months (component dependent) after the Phase I award, Fast Track applications are due 150 days after the Phase I award.
[101]NRC Firm Survey 2006, Question 17. See Appendix B.

unlikely; and the rest did not answer this question. Six percent of the firms that had submitted for Phase II Enhancement in the past reported that they would not do so in the future.

Firms that had never submitted for Phase II Enhancement or which said they would not do so in the future were asked to identify why. Their responses are shown in Figure 2-25.

Because some components require that third-party funding be provided by acquisition programs, the response dealing with such funding was split to differentiate between private sector and acquisition program funding. Many respondents (26 of 38) who identified difficulty in obtaining acquisition program funding also identified difficulty in obtaining private sector funding. For firms reporting "other," the most frequent response (over half of the 32 firms who responded "other") was lack of knowledge or understanding of Phase II Enhancement. This may indicate a need to better publicize the program. The second most frequent response (5 of 32) was that the firm was no longer eligible for SBIR. No "other" response was given by more than one firm.

2.2.10 Dilution of Ownership

Some SBIR contractors may be reluctant to seek third-party financing, particularly from venture capital companies, fearing that they will lose control of their firms. Others may welcome such cash infusions, preferring to have partial control over a potentially large firm to full control of a small one.[102] Some in this latter group may intend to sell their interests as the firm gets large and roll the profits into starting a new firm. Those leery of equity funding are often heavily involved in advancing technology and less interested in production. They are afraid that outside investors would change the fundamental nature of the firm. The business expertise that venture capital insists on putting in place (if not already there) creates an environment likely to produce commercial success, but such success may not be the principal goal of the owners.[103]

Third-party investors may also be larger firms who want to merge with or partially or completely own the SBIR firm after the award. Finalized agreements and ongoing negotiations are shown in Figure 2-26.

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[102]Other sources of funding include family, angel investors, and state programs, though the role of these diverse sources changes as the firms evolves from the seed and early stages of development through to the later states.

[103]For a qualitative study of entrepreneur perspectives on conceptualizing and starting successful ventures, see, F. G. Crane and J. Sohl, "Imperatives for Venture Success: Entrepreneurs Speak," *The International Journal of Entrepreneurship and Innovation*, May 2004, pp. 99-106. For an overview of the growth, characteristics, and challenges of the venture capital industry in the United States, see Paul Alan Gompers and Joshua Lerner*, The Venture Capital Cycle,* 2nd Edition, Cambridge, MA: MIT Press, 2004.

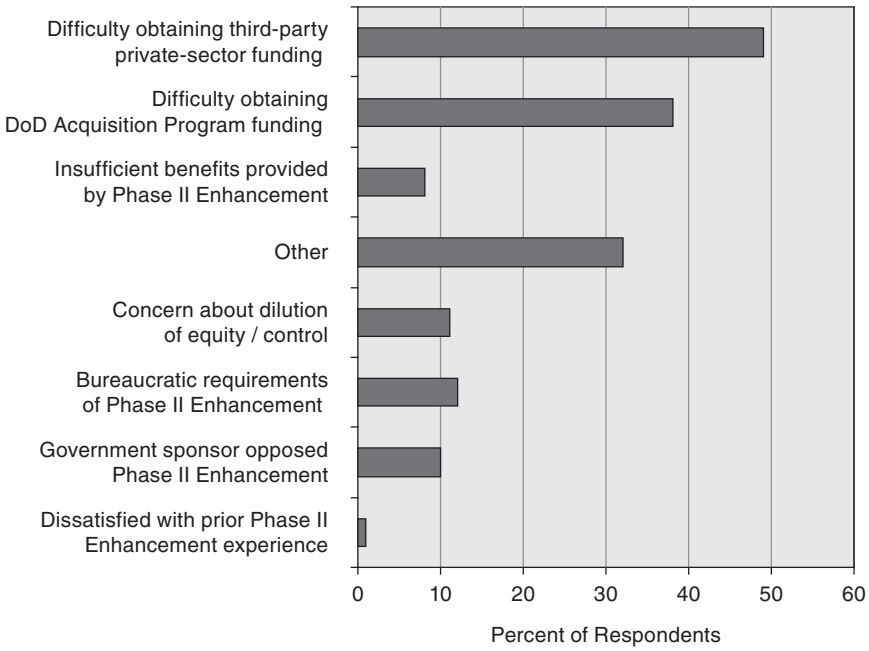

FIGURE 2-25 Reasons for not submitting Phase II Enhancement proposal.
SOURCE: NRC Firm Survey 2006, Question 18. See Appendix B.

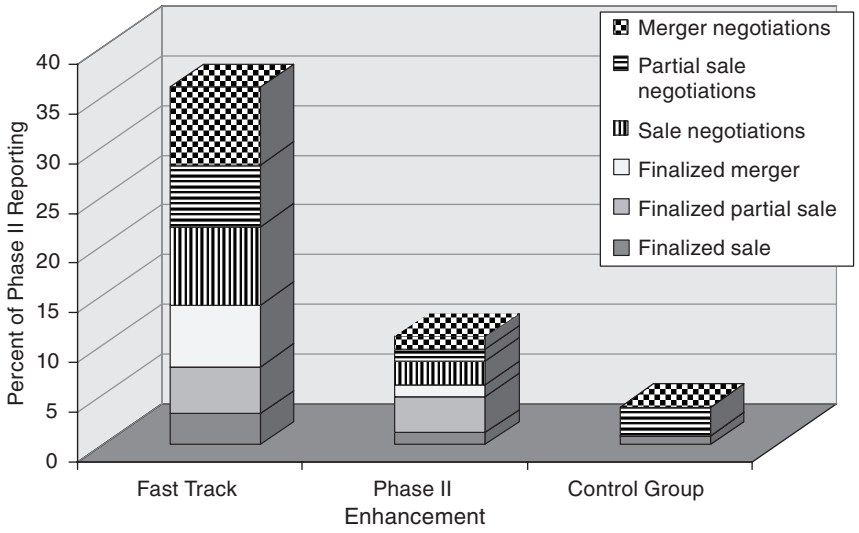

FIGURE 2-26 Dilution of firm ownership
SOURCE: NRC Project Survey 2006, Question 12. See Appendix C.

Fast Track

The figure indicates that overall FT firms were much more likely than control group firms to be engaged in equity-related activities. Given the need for matching funds this is of course not surprising.

Figure 2-23 portrays the "cost" to firm owners of Fast Track firms. To obtain third-party funding, they may be limiting their personal share of the potential gain from their innovation, by selling a share of their firm. But they may also be increasing the ultimate gain from the innovation by infusing cash and business expertise at the critical point in development. Fourteen percent of the Fast Track awards have resulted in finalized agreements for sale of ownership, partial sale of ownership, or merger. Negotiations are ongoing for another 22 percent. Whether this is a cost or an opportunity is very much a personal evaluation.

This compares with one percent of firms (one firm) reporting a finalized agreement, in this case for partial sale of the firm.

Phase II Enhancement

The impact of equity-related activities is lower for Phase II Enhancement firms, where only 6 percent report finalized activity in sale or merger. This is still considerably greater than for the control group.

3

Findings and Recommendations

FINDINGS

A. The advantage of the DoD SBIR Fast Track program is that it emphasizes the need to leverage third-party funding to achieve mission goals and commercialization.

- Fast Track seeks to improve commercialization of innovative technologies through preferential evaluation and efforts to close the funding gap that can occur between Phase I and Phase II of the SBIR program.
- The time-lag between the conclusion of Phase I and the receipt of Phase II funds can create cash-flow problems for small firms. Fast Track provides expedited review and essentially continuous funding from Phase I to Phase II as long as applying firms can demonstrate that they have obtained third-party financing for their technology.[1]

B. The 2001 evaluation of Fast Track by another National Research Council committee found the DoD SBIR Fast Track program to be effective.[2]

- The program was found to be effective in:
  - Leveraging public funding with private investments;

[1]Third-party funding, in this case, is most often acquisition program funding.
[2]See National Research Council, *The Small Business Innovation Research Program: An Assessment of the Department of Defense Fast Track Initiative,* Charles W. Wessner, ed., Washington, DC: National Academy Press, 2000. Given that virtually no published analytical literature existed on SBIR, this Fast Track study pioneered research in this area, developing extensive case studies and newly developed surveys.

- Focusing management attention on markets and on obtaining private capital, thereby improving commercial outcomes of SBIR projects; and
- Winnowing out projects that lacked commercial potential, either for procurement or private markets.

- In sum, the 2001 report found that DoD's Fast Track Initiative was achieving its objective of greater commercialization and recommended that the program be continued and expanded where appropriate.
- This update of the 2001 study finds that Fast Track continues to be successful in reducing the funding gap between Phases I and II; however, the percent of Fast Track awards reporting no gap has decreased and the average gap has increased in recent years.[3]

C. Firms that apply for Fast Track tend to be new to the program and younger than average SBIR firms.[4]

- Fast Track firms have had far fewer past Phase II awards than the overall population. Sixty-four percent have had no prior Phase II awards. Among the firms surveyed, the group that applied only for Fast Track had the smallest percentage over $5 million in annual income and the highest percentage under $5 million in annual income.[5]
- Fast Track is successful in involving firms with no prior SBIR experience. This is important, but the number of Fast Track awards remains small, lessening the significance of this effect.[6]

D. This study has found that, while effective, the DoD SBIR Fast Track program has some structural limitations. These include:

- **Phasing**. Fast Track requires firms to obtain funding commitments prior to completing Phase I. This means attempting to find such funding very early in Phase I or even before it starts—i.e., before the demonstration of feasibility is completed. Given the uncertainty about a project's viability, the terms investors require are likely to be less favorable at this stage.
- **Need for equity**. Many small innovative firms are reluctant to part with equity that is often demanded by private sector investors. In

[3]See Figures 2-24 and 2-15.
[4]See Figures 2-3, 2-4, and 2-6.
[5]See Figure 2.6.
[6]Only 2.5 percent of Phase II awards are Fast Track. The survey indicates 64 percent of Fast Track participants are first time Phase II awardees. However, for the other 97.5 percent of the DoD Phase II program, 37 percent are first time Phase II. Thus, only 4.4 percent of all first Time Phase II awards are on Fast Track proposals. See related Recommendation C.

addition, the pressure to obtain private sector investment can act as a disincentive for more innovative endeavors.[7]

E. Firms that have participated in either Fast Track or Phase II Enhancement found that experience to be a positive one.

- Ninety percent of the surveyed firms participating in Fast Track and 95 percent of those participating in Phase II Enhancement reported satisfaction with their decision.[8]
- Compared with the control group, the Fast Track and the Phase II Enhancement programs have achieved greater commercialization outcomes, and improved take up of technologies by DoD components.

F. The Phase II Enhancement offers additional support beyond that provided through Fast Track. The Phase II Enhancement:

- Does not require evaluation of the Phase II proposal outside of the DoD component's normal evaluation process, providing firms additional time to locate third party investors and place less of a burden on management.
- Employs criteria established by the component to meet the priorities of the component, making the Phase II Enhancement program responsive to the needs of the component.
- Provides firms extensive time to locate a third party investor since proposals are not due until late in Phase II and provides additional time (normally one additional year) and additional SBIR funding to the firm, providing added flexibility for firms.
- Provides the opportunity, based on a project's technical achievement, to leverage acquisition program funding to increase the level of funding available; i.e., an acquisition program has its R&D investment in Phase II Enhancement matched by SBIR funding, enabling it, thereby, to achieve more with its program funding.[9]

G. Participation in Fast Track has declined in recent years.

- For the first four years of the Fast Track program, 7 percent of the DoD Phase II SBIR awards were Fast Track. For the most recent four years,

[7]Venture capitalists are typically reluctant to invest in highly innovative and, thus, highly risky endeavors. For an empirical analysis, see Gavin C. Reid and Julia A. Smith, *Risk Appraisal and Venture Capital in High Technology New Ventures,* New York: Routledge, 2007, p. 27. Given the difficulty of obtaining such funding, requiring co-investment from venture capital can thus serve as a disincentive for firms with highly innovative ideas from participating in the SBIR program.
[8]See Figure 2-21: Decision to use Fast Track or Phase II Enhancement.
[9]See Chapter 1, section on "DoD Initiatives to Improve Commercialization: The Phase II Enhancement."

less than 2.5 percent of the DoD Phase II SBIR awards were Fast Track.
- From 2002 to 2005, DoD components awarded five times as many Phase II Enhancement awards as Fast Track Awards.[10]

RECOMMENDATIONS

A. To encourage greater commercialization, the DoD SBIR program should retain its focus on obtaining matching private and/or procurement funds. The need for incentives to match these funds as technical progress warrants and is enhancing program outcomes.

B. The DoD Phase II Enhancement program should be continued and expanded as appropriate.

- **Given that the Enhancement provides additional support beyond that available through the Fast Track program, DoD should expand the Phase II Expansion program, as appropriate.** These positive user-based outcomes suggest that DoD should, to the extent feasible and appropriate, expand the Phase II Expansion program within the services, organizations, and agencies of DoD, keeping in mind that the program has multiple objectives (not just commercialization) and that not all firms can or should be expected to acquire matching funding.
- **Given that long gaps in funding make it difficult for a small company to sustain its research projects, DoD should consider increasing the duration of gap funding for all Phase II selections.** The average gap between the end of Phase I and the start of Phase II leads many firms to stop work or to work at a reduced pace. Some of these firms may be selected subsequently for a Phase II Enhancement award.[11] An analysis of whether the funding gap between Phase I and Phase II has changed over the years would be useful to DoD's consideration of how much to increase the duration of gap funding.[12]

C. The Fast Track program should be continued, given its success in encouraging firms with little or no prior SBIR experience to innovate and commercialize their product.

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[10]The DoD SBIR public Web site indicates that 77 Fast Track awards were made during the years 2002 to 2005. During that period, the Web site indicates that 395 Phase II Enhancement awards were made.
[11]See Figures 2-14 and 2-15.
[12]See "Areas for Future Research," particularly with respect to the statistical analysis of the survey response data, in Chapter 1 of this report.

- Fast Track is suited to early-stage projects, often pursued by newer firms. These firms often face a funding gap and can benefit from incentives to seek investors. (See Finding B).
- In light of this study, some modifications to the Fast Track program might be considered. These could include increasing the number of Fast Track awards by identifying those projects and firms that could most benefit from the Fast Track alternative, and reducing delay as much as possible between Phase I and Phase II.
- Given the benefits offered by Fast Track, the program should be continued, even if a larger number of firms will continue to work with the Phase II Enhancement approach.

D. DoD should encourage continued experimentation by management in the SBIR program.

- As the positive example of the Phase II Enhancement illustrates, DoD should continue to experiment with potential refinements to its SBIR program.
- Both the Congress and the Department management should provide the flexibility and the resources to continue program experimentation, monitor progress, and evaluate outcomes.[13]

E. DoD should continue regular assessments of SBIR program results.

- As the study demonstrates, regular assessments provide a valuable means of improving and adapting the program to address evolving mission needs and technological advances.
- Cross-agency comparisons of the impact of the Phase II Enhancement programs could prove useful for the continued refinement of the SBIR program.

[13]See Recommendations D and E (Chapter 2) in National Research Council, *An Assessment of the SBIR Program at the Department of Defense*. Charles W. Wessner, ed., Washington, DC: The National Academies Press, 2008. Recommendation D states that "DoD should encourage and support pilot programs that evaluate new tools for improving the program's overall performance." Recommendation E states that "to carry out the measures recommended above to improve program utilization, management, and evaluation, the program should be provided with additional funds for management and evaluation."

Appendixes

Appendix A

Survey Methodology and Administration

This appendix provides a description of the survey, including how the survey was administered.

A. SAMPLE SELECTION

The selection of the survey sample involved determination of which Phase II awards and firms should be surveyed. The projects selected for this sample included DoD Fast Track award winners, Phase II Enhancement awards and other DoD awards (which were neither Fast Track nor Phase II Enhancement) selected as a control group.[1]

The prior studies of SBIR commercialization by GAO in 1991 showed that it often takes several years after completion of Phase II before significant sales are achieved.[2] The 1991 survey questionnaire was sent all the Phase II awardees from the first 4 years—1984 through 1987—in which the agencies made Phase II awards. The 2000 Fast Track study by the NRC did not have the luxury of allowing the Fast Track surveyed award four years to commercialize. Since there was no Fast Track prior to 1997, and the study had to be completed in 1999, Phase II awards given in 1997 were surveyed in 1999.[3]

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[1]In selecting the Phase II awards for a control group survey, random samples were drawn from each award year from 1997 to 2002 insuring that the overall average age was comparable to that of the Fast Track sample, and the number per service was comparable to the number per service from the combination of the Fast Track and Phase II Enhancement samples. Distribution of the control group was also comparable to the distribution of Fast Track and Phase II Enhancement by states. In aggregate, 392 control projects were selected. A larger sample of control awards was selected on the assumption that these awards might have a lower response rate."

[2]U.S. General Accounting Office, *Small Business Innovation Research Shows Success But Can Be Strengthened*, GAO/RCED-92-37, Washington, DC: U.S. Government Printing Office, March 1992.

[3]Although the averages sales per Fast Track Phase II award in the 1999 survey was more than double that of the average control group Phase II award, the Fast Track average sales was less than one third

For the current study effort, the GAO survey methodology (which is also being used in the ongoing larger NRC study of SBIR at five agencies) could be applied.[4] Thus, the sample for the 2006 survey included all Fast Track Phase II awarded from program inception to 2002.[5] All 250 Phase II Fast Tracks awarded through 2002 were surveyed.

Although Phase II Enhancement was announced in a 1999 Solicitation, DoD components began making Enhancement awards in 1999 as modifications to Phase II contracts that had been awarded in 1997. Hence, for both programs the initial Phase II awards were made in 1997. In 1997, three times as many proposals received Fast Track Phase II contracts as proposals that followed the standard Phase II award process but were subsequent recipients of a Phase II Enhancement. The growth in the number of Phase II Enhancements and the decline in the number of Fast Track awards was such that the number of proposals awarded Phase II in 2002, which subsequently received Phase II Enhancement awards exceeded the number receiving Fast Track awards in 2002 by a factor of three. Fast Track and Phase II Enhancement are not mutually exclusive. Twenty-four of the 250 Fast Track awarded by 2002 also received Phase II Enhancement awards. The sample of 219 Phase II Enhancement awards surveyed was selected to be comparable to the Fast Track awards.[6]

In selecting the Phase II awards for a control group survey, random samples were drawn from each award year from 1997 to 2002. This ensured that the overall average age was comparable to that of the Fast Track sample and that the number per service was comparable to the number per service from the combination of the Fast Track and Phase II Enhancement samples. Distribution of the control group was also comparable to the distribution of Fast Track and Phase II Enhancement by States. In aggregate, 392 control projects were selected. A larger sample of control awards was selected on the assumption that these awards might have a lower response rate.

B. ADMINISTRATION OF THE SURVEY

The questionnaire used in the 1999 National Research Council assessment of SBIR at the Department of Defense, *SBIR: An Assessment of the*

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of the sales reported by GAO per Phase II award, which had which had two to five more years to commercialize.

[4]For a review of the methodology, see National Research Council*, An Assessment of the Small Business Innovation Research Program—Project Methodology*, Washington, DC: The National Academies Press, 2004.

[5]Two Phase II awards from the 1996 Solicitations occurred in 1996; the remainders of the awards from those Solicitations were not made until 1997.

[6]A survey of 100 percent of the 384 Phase II through 2002, which received Enhancements awards, would have been disproportionately skewed to the Phase II award years 2001 and 2002, resulting in the average Phase II Enhancement award surveyed having more than a year less time to commercialize than the average Fast Track award. At the time of the survey, the average age for sampled awards was: Fast Track 7.2 years, Phase II Enhancement 6.9 years, and Control group 7.2 years.

Department of Defense Fast Track Initiative evolved from the earlier GAO survey. Both surveys asked questions about the firm and questions about the specific Phase II award.

In the 2008 NRC SBIR study, the NRC selected questions that were a further evolution of questions used in surveys for the 2000 NRC Fast Track report. . Eighty percent of the questions on the earlier NRC study were incorporated and 24 new questions added to attempt to understand both commercial and non-commercial aspects, including knowledge base impacts, of SBIR, and to gain insight into impacts of program management. However, the NRC recognized that many firms would be surveyed about multiple awards. Rather than ask questions about the firm on each Phase II survey, the 2005 questionnaire was divided into a firm survey and a separate Phase II award survey. This same format was applied for the 2006 study. Four additional questions dealing with Fast Track and Phase II Enhancement were added to both the firm and Phase II surveys.[7]

The section above on sample selection described how Phase II awards to be surveyed were selected. Once an award was selected, the firm responsible for that award was added to the firm sample. Some firms had more than one award selected. Surveys (one per firm and one per sampled award) were emailed to the 601 firms conducting the 807 projects (control group plus study sample) on April 19, 2006. Subsequent emails were sent to an additional 30 firms (each with a single Phase II award.)[8] The characteristics of the firms in the sample are described below.

This sample was used to mail out the survey and as a basis for selection of firms to be subsequently interviewed. Award information, including addresses, principal investigators (PI) and phone numbers, all of the characteristics used in matching, as well as other information in the database such as award amounts, dates, contract numbers and scheduled durations were provided to the investigators to assist in selection of firms for interviews. Information was also provided to enable survey of the government technical points of contact.

Advantages and Disadvantages of On-line Surveys

The surveys were administered on-line, using a web server. The formatting, encoding and administration of the survey was subcontracted to BRTRC, Inc. of Fairfax, VA.

There are many potential advantages to online surveys including cost, speed, and flexibility in questions. As response rates with on-line surveys become clear, they indicate the need for follow up with non-respondents. Hyperlinks provide amplifying information, and built in quality checks control

[7]See survey questions in Appendix B (Firm) and Appendix C (Phase II Award).

[8]Thus the total sample was 837 awards to 631 firms.

the internal consistency of the responses. Finally, online surveys allow dynamic branching of question sets, with some respondents answering selected sub-sets of questions but not others, depending on prior responses.

Web surveys for the NRC's 2008 SBIR reports—administered in 2005—also made clear that there are also disadvantages to attempting on line surveys in an era of viruses, worms, spam blockers and phishing. Survey recipients are increasingly suspicious of unsolicited email that requires interaction and that requests detailed information. Despite these disadvantages, which limit response rates, the existence of the encoded 2005 survey, responses to that survey, and already established web site procedures for survey administration, together made the use of a similar on line survey the most cost effective approach for the administering—in 2006—the DoD Phase II Enhancement survey.

Since many of the firms and some of the Phase II projects had responded to the survey administered in 2005, the research team wanted to avoid asking the firm for answers already provided. Surveys to such firms were linked to their prior answers. For example, historical information from the prior survey, such as what year was the firm founded, were not displayed again. When the response to a question previously answered could have changed, such as how many SBIR Phase II awards has your firm received from the federal government, the question was displayed with the prior answer filled in. The firm could then accept the earlier answer or change it.

The conduct of an on-line survey required knowledge of the email address of the correct official. An SBIR Point of Contact (POC) and email address was available for every firm that had submitted for a DoD SBIR since 1999. However, only limited email addresses were available for the remainder of the firms, and firms only update their information when they submit new proposals to DoD. Firms frequently move as they grow or shrink; new POC are added; and email systems are often changed. The decision to use an on-line survey meant that the first step of survey distribution was an outreach effort to establish contact with the firms.

Establishment of Contact

If point of contact (POC) and email information was not available, or if the information that was available failed to work in the 2005 study, a search was conducted to acquire new information. Contact was attempted by calling the agency provided phone number for the firm, then by using the Central Contractor Registration database, Business.com (powered by Google) and Switchboard.com. When an apparent match was found, the firm was called to verify that it was in fact the firm, which had completed the SBIR. Often firms had phone numbers that seemed correct, but they were never present and did not return calls.

At the conclusion of this effort, no email address could be determined for 24 firms.

To enhance cooperation with the survey further, an advance letter from the NRC study director, Dr. Charles W. Wessner, was sent to each of the selected firms three weeks prior to the survey. The letter described the purpose and importance of the study and requested cooperation in survey completion. As expected from the earlier studies, a number of advance letters (8 percent) were returned as undeliverable. On the return of these undelivered letters, the firm was looked up in Internet yellow pages, the Central Contractor Registration database, Business.com, and Switchboard.com, to try to find correct address information. If a new address and phone were found, the firm was contacted to verify that it was indeed the correct firm, and where possible to obtain a Point of Contact (POC) to address the survey to. Attempts were also made contact the PI listed in the DoD awards database. Once a POC was identified, the email address list for the survey was updated. For POC identified after distribution of the survey, a survey request was emailed to the POC.

On April 19, 2006, the survey was announced by email to the previously identified points of contact. 94 of the 607 email could not be delivered. These "bounced" email led to a new search effort, which ultimately updated 34 email addresses.

High Response Rates

By November 1, 2006, seven months into the survey, 240 responses had been received. Eighty-four firms, responsible for 120 sampled projects could not be contacted due to incorrect or missing email addresses. Six of the firms were known to have been acquired and two known to be out of business. Using the same methodology as the GAO had used in 1992, undeliverables, and out of business firms were eliminated prior to determining the response rate. Although 837 projects were surveyed, 120 were eliminated as described. This left 717 projects, of which 240 responded, representing a 33 percent response rate. Similarly, the 232 firm surveys completed represented a 42 percent response rate from firms. Considering the length of the survey and its voluntary nature, this rate was relatively high and reflects both the interest of the participants in the SBIR program. The sample groupings and their address and response data are shown in Tables App-A-1 and App-A-2.

C. FAST TRACK REVISITED, AND INITIAL EVALUATION OF PHASE II ENHANCEMENT

We now turn to a description of the characteristics of the survey sample groups and copies of the announcement letters. Slightly different announcement letters were sent to firms that responded to the 2005 study than to those which had not responded.

Phase II Award Sample

All, except two, of Phase II Awards sampled were awarded from 1997 to 2002. Fast Track began with the first solicitation of 1996; thus, due to the time needed to select, award and execute the Phase I and to select and award Phase II, most of the earliest Fast Track Phase II were awarded in 1997. Two of these initial Fast Track Phase II awards were conferred in 1996. Any Phase II awarded after 2002 was considered to lack sufficient time to have commercialized by the release of the survey in the spring of 2006.

Fast Track

All 250 Phase II Fast Tracks awarded through 2002 were surveyed.

Phase II Enhancement

In 1997, three times as many proposals received Fast Track Phase II contracts as proposals which followed the standard Phase II award process but were subsequent recipients of a Phase II Enhancement. The growth in the number of Phase II Enhancements and the decline in the number of Fast Track awards was such that the number of proposals awarded Phase II in 2002, which subsequently received Phase II Enhancement awards exceeded the number receiving Fast Track awards in 2002 by a factor of three. Sampling 100 percent of the Phase II Enhancements Phase Ii from 1997 to 2002 would have resulted in the average age of the Phase II Enhancement being over a year younger than the average Fast Track. This reduction in time to commercialize would have distorted the results. Consequently 100 percent of the early Phase II enhancements and random sample of the later years was selected. The sample consisted of 219 Phase II Enhancement awards (including 24 which were also Fast Track) awarded their Phase II from 1997 to 2002

Control Group

The Control Group sample was randomly selected to approximate the distribution of the other two samples. All 392 Phase II awards were conferred from 1997 to 2002.

Average Time Since Award

At the time of the survey, the average age for sampled awards was: Fast Track 7.2 years, Phase II Enhancement 6.9 years and Control group 7.2 years.

Firm Characteristics

The selection of firms was determined by the selection of Phase II awards. Every firm, which had a Phase II award in one or more of the sample award sample groups, was put in the firm sample. Although most firms had only a single award sampled, the 837 awards sampled resulted in only 631 firms.

Firms could not be categorized as a Fast Track firm or a Phase II Enhancement firm or a control group firm, since the firm could also have awards in one of the other categories.[9] Overall Characteristics of the 631 sampled firms are shown in Table App-A-3.

D. UNDERSTANDING SURVEY RESPONSE RATES

Response rates can serve as a valuable statistic to judge the quality of surveys.[10] A small survey response may limit the statistical power and credibility of surveyed data. However, low response rates do not necessarily imply bias, and there appears to be no commonly used standard for an "acceptable" level of survey response. Survey response rates, meanwhile, continue a decades-long decline and this development is of growing concern among survey experts.

Declining Response Rates

Survey response rates have long been declining in the United States.[11] The overall response rates for web surveys are now typically less than 30 percent.[12] Response rates for web or paper surveys sent by email reflect this declining trend. One analysis of response rates to 31 email surveys conducted between 1986 and 1999 reported a mean response rate of 36.83 percent, but the subset of surveys conducted in the 1998 to 1999 period reported a mean response rate of 31 percent.[13] According to a 2006 study, mean response rates for surveys of executives have declined, with an overall response rate of 32 percent.[14]

Survey fatigue may account for some of the decline in survey response rates. Given their relative speed, low cost, and ease of administration, the number of emailed web surveys has risen in the United States. This increase in surveying has, however, led to a rising refusal rate among survey recipients.[15]

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[9]Some sampled firms had awards sampled in more than one category. Many firms, sampled for awards in one category, had awards that were not sampled in other categories; e.g., a sampled Fast Track award and a not sampled Phase II Enhancement in the same time frame.

[10]P. P. Biemer and L. E. Lyberg, *Introduction to Survey Quality*, New York: John Wiley and Sons, 2003.

[11]Edith de Leeuw and Wim de Heer, "Trends in Household Survey Nonresponse: A Longitudinal and International Comparison," in Robert M. Groves, Don A. Dillman, John L. Eltinge, and Roderick J. A. Little, eds., *Survey Nonresponse*, New York: Wiley, 2002, pp. 41-54.

[12]Michael D. Kaplowitz, Timothy D. Hadlock, and Ralph Levine, "A Comparison of Web and Mail Survey Response Rates," *Public Opinion Quarterly*, 68(1):94-101, 2004.

[13]Kim Sheehan, "E-mail Survey Response Rates: A Review," *Journal of Computer Mediated Communication*, 6(2), 2001.

[14]Cynthia S. Cycyota and David A. Harrison, "What (Not) to Expect When Surveying Executives: A Meta-Analysis of Top Manager Response," *Organizational Research Methods*, 9:133-160, 2006.

[15]Kim Sheehan, "E-mail Survey Response Rates: A Review," op. cit.

The growth of malicious internet viruses has also led to the widespread use of filtering software to delete unsolicited emails, lowering survey response rates.[16]

Gauging the Quality of Response Rates

Low survey responses may compromise the sample size, the statistical power, the credibility of the data, and compromise the ability to generalize information from collected data.[17] However, low response rates do not necessarily suggest bias because the respondent's characteristics may still be representative of the population from which it was drawn.[18] Gauging the quality of response rates, thus, depends on evaluating how well the analysis characterizes the non-responders, and the extent to which the non-response is linked to the information sought in the survey.

No Formal Minimum Threshold

Reflecting this disjuncture, there appears to be no standard for a minimal acceptable response rate. A survey of leading academic journals by the American Association for Public Opinion Research found that there is no consensus on a cutoff threshold, with several journal editors noting that they often make judgments on the validity of survey size on a case-by-case basis.[19]

Improving Response Rates

Response rates can be improved by pre-notification letters from reputable organizations, by keeping surveys short, and by sending follow-up reminders. The salience of the issue being surveyed to the persons being surveyed is also a factor in improving response rates.[20]

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[16]Ibid.
[17]S. Rogelberg, C. Spitzmüeller, I. Little, and S. Reeve, „Understanding Response Behavior to an Online Special Survey Topics Organizational Satisfaction Survey," *Personnel Psychology*, 59:903-923, 2006.
[18]D. Dillman, *Mail and Internet Surveys: The Tailored Design Method*, 2nd Edition, Toronto, Ontario: John Wiley and Sons, Inc, 2000.
[19]Timothy Johnson and Linda Owens, "Survey Response Rate Reporting in the Professional Literature," Paper presented at the 58th Annual Meeting of the American Association for Public Opinion Research, Nashville, TN, May 2003.
[20]Kim Sheehan, "E-mail Survey Response Rates: A Review," op. cit.

SURVEY ANNOUNCEMENT LETTER

THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine

Director
Technology, Innovation, and Entrepreneurship

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Washington, DC 20001
Phone: 202 334 3801
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EMAIL: cwessner@nas.edu

16 March 2006

CEO or President
[Firm]
[Address]
[City], [State] [Zip]

Dear Sir or Madam,

I am writing to request your assistance with a study being carried out by the National Academy of Sciences at the request of the Congress to evaluate ways in which the Small Business Innovation Research (SBIR) program could be improved.

To carry out the study, the National Academies appointed a distinguished Steering Committee headed by the Honorable Dr. Jacques S. Gansler, former Under Secretary of Defense for Acquisition, Technology and Logistics (for additional information on the study, please see <*http://www7.nationalacademies.org/sbir*>).

As part of its analysis, the Committee commissioned a major survey of awardees that was conducted in 2005. Twelve hundred firms completed surveys in 2005 I am asking now for your assistance in evaluating two important DoD SBIR initiatives—Fast Track and Phase II Enhancement. A new survey will include all Phase II awarded from 1997 to 2002, which were either Fast Track or Phase II Enhancement, as well as a control group consisting equal number of standard Phase II awards.

The surveys will consist of a firm survey and an award survey for each Phase II in the sample. The surveys, which will take about 30-40 minutes to complete, will be conducted on-line using the same proven site and procedure used in the successful 2005 survey.

The DoD SBIR submission site has identified for your firm POC as **[POCName]** at **[POCemail]**. The purpose of this letter is to request your support of this important study. If your POC information has changed, we would ask that you have the appropriate person update their contact information at <*https://www.dodsbir.net/submission/SignIn.asp*> or email the correct POC name/email to jcahill@brtrc.com.

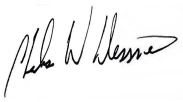
An appropriate POC would often be the CEO, CTO, business manager, or principal investigator. In any case, he/she should be knowledgeable of the products of your SBIR, of efforts to commercialize those products, and your firm's experiences and opinions concerning Fast Track and Phase II Enhancement. The survey is will be distributed to your POC by email in the near future.

Please note, survey responses will be confidential. The results are to be aggregated with those of other firms for survey analysis. Your response is, however, very important for the integrity and completeness of the study.

Let me thank you in advance. Your input will be a significant contribution to our understanding and recommendations to the Congress for improvements to the program.

If you have any questions, please do not hesitate to contact me. Thank you for your cooperation.

Sincerely yours,



Charles W. Wessner, Ph.D.
Director
Technology, Innovation,
and Entrepreneurship

SURVEY ANNOUNCEMENT LETTER TO RESPONDENTS TO 2005 SURVEY

THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine

Director
Technology, Innovation, and Entrepreneurship

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EMAIL: cwessner@nas.edu

16 March 2006

CEO or President
[Firm]
[Address]
[City], [State] [Zip]

Dear Sir or Madam,

I am writing again to request your further assistance with the study being carried out by the National Academy of Sciences at the request of the Congress to evaluate ways in which the Small Business Innovation Research (SBIR) program could be improved. This request should take only around ten minutes to fulfill.

To carry out the study, the National Academies appointed a distinguished Steering Committee headed by the Honorable Dr. Jacques S. Gansler, former Under Secretary of Defense for Acquisition, Technology and Logistics (for additional information on the study, please see <*http://www7.nationalacademies.org/sbir*>).

As part of its analysis, the Committee commissioned a major survey of awardees that was conducted in 2005. Thank you for the effort that your firm spent on completing those surveys I am asking now for your assistance in evaluating two important DoD SBIR initiatives—Fast Track and Phase II Enhancement. The new survey will include all Phase II awarded from 1997 to 2002, which were either Fast Track or Phase II Enhancement, as well as a control group consisting equal number of standard Phase II awards.

The surveys will consist of a firm survey and as well as an award survey for each Phase II in the sample. The surveys will again be conducted on line. Surveys for firms and awards, which completed a survey in 2005, will not repeat previously answered questions unless the answer may have changed with the passage of time. Any repeat of previous questions will have your 2005 answers filled in. Your firm may overwrite if the answer has changed. As noted, the new questions on each survey should take less than 10 minutes to complete. Surveys on awards not sampled in the 2005 survey will take about 40 minutes.

The POC and email address that DoD has identified for your firm is **[POCName]** at **[POCemail]**. The purpose of this letter is to request your support of this important study, and if your POC information has changed, have the appropriate person update their contact information at <*https://www.dodsbir.net/submission/SignIn.asp*> or email the correct POC name/email to jcahill@brtrc.com.

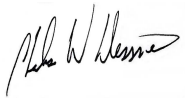
An appropriate POC would often be the CEO, CTO, business manager, or principal investigator. In any case, he/she should be knowledgeable of the products of your SBIR, of efforts to commercialize those products, and your firm's experiences and opinions concerning Fast Track and Phase II Enhancement. The survey is will be distributed to your POC by email in the near future.

Please note, survey responses will be confidential. The results are to be aggregated with those of other firms for survey analysis. Your response is, however, very important for the integrity and completeness of the study.

Let me thank you in advance. Your input will be a significant contribution to our understanding and recommendations to the Congress for improvements to the program.

If you have any questions, please do not hesitate to contact me. Thank you for your cooperation.

Sincerely yours,



Charles W. Wessner, Ph.D.
Director
Technology, Innovation,
and Entrepreneurship

TABLE App-A-1 Surveyed Phase II Awards

	Award Surveys				
Award Category	Email Contact (Number)	Could Not Contact (Number)	Completed Survey (Number)	Overall Response Rate (%)	Contacted Response Rate (%)
Fast Track	156	61	50	23	32
Phase II Enhancement	198	12	69	33	35
Both Fast Track and Phase II Enhancment	32	2	14	41	44
Control Group	331	45	107	28	32

TABLE App-A-2 Firm Contact Status

Email Status	Number of Firms	Percent of Firms
Correct Email	513	81
No Email	24	4
Bounced Email	60	10
Updated with Correct Email	34	5
Totals	631	100

TABLE App-A-3 Overall Characteristics of the 631 Sampled Firms

Year Founded	Percent of Firms	Number of Phase II	Percent of Firms	Current Number of Employees	Percent of Firms	Firm Location	Percent of Firms
Prior to 1983	19	>100	1	>200	5	CA	21
1983 to 1992	36	51 to 100	3	51 to 200	15	MA	10
1993 to 1996	24	26 to 50	9	21 to 50	17	VA	9
1997 to 1999	17	11 to 25	13	6 to 20	35	OH	6
After 1999	4	6 to 10	22	0 to 5	28	PA	5
		2 to 5	37			NY	5
		1	15			MD	5
						CO	4
						NJ	4
						TX	3
						FL	3
						All Others	25

Appendix B

Fast Track/Phase II Enhancement Firm Survey Summary of Responses

RESULTS AND RELATED NOTES APPEAR IN BOLD. (NOTES TO PROGRAMMER: QUESTIONS IN *ITALICS* SHOULD BE AUTOFILLED FROM FIRM DATABASE OR PRIOR SURVEY. QUESTIONS IN `TYPEWRITER FONT` SHOULD NOT BE DISPLAYED IF PREVIOUS FIRM SURVEY WAS COMPLETED. NOTE: NO QUESTION NUMBERS ARE DISPLAYED ON THE SURVEY.)

Introduction

This survey is a continuation of a major study commissioned by the U.S. Congress to review operations of SBIR grant programs at federal agencies. The assessment, by the National Research Council, seeks to determine the impact of DoD SBIR program initiatives, and to investigate ways in which the programs could be improved.

FIRM Survey

If your firm is registered in the DoD SBIR/STTR Submission website, the information filled in below is based on your latest update as of January 2006 on that site. Additional completed information, if any, is from the NAS SBIR survey that you completed last year. Since you may have entered this information many months ago, you may edit this information to make it correct. In conjunction with that information, the additional questions will help us understand how the Fast Track and Phase II Enhancement programs impact the SBIR program and how they can be improved.

Part A

1. *Company Name:* _____
2. *Street Address:* _____
3. *City:* _____ *State:* ____ *Zip:* _____
4. *Company Point of Contact:* _____
5. *Company Point of Contact Email:* _____
6. *Company Point of Contact Phone: (___) ____ - _____ Ext:* _____
7. The year your company was founded: _____

Part B

1. Was your company founded because of the SBIR Program?

   a. **80%** No.
   b. **7%** Yes.
   c. **13%** Yes, In part.

2. Information on company founders. (Please enter zeros or the correct number in each pair of blocks.)

   a. Number of founders. ☐☐ **39% reported one founder; 30% two: Average was 2.1.**
   b. Number of other companies started by one or more of the founders. **Average 1.1.**
   c. Number of founders who have a business background. **46% reported one or more.**
   d. Number of founders who have an academic background. **60% reported one or more.**

   5% Unknown.

3. What was the most recent employment of the company founders prior to founding this company? (Select all that apply.) **Answers exceed 100% due to multiple founders.**

   a. **76%** Other private company.
   b. **26%** College or University.
   c. **8%** Government.
   d. **4%** Other.

4. *How many SBIR and/or STTR awards has your firm received from the Federal Government?*

   a. *Phase I: _____ What year did you receive your first Phase I Award? _____*
   30% report 5 or less Phase I; 30% report greater than 20. 33% of firms received first Phase I before 1993. 28% received first Phase I after 1998.
   b. *Phase II: _____ What year did you receive your first Phase II Award? _____*
   52% report 5 or less Phase I; 28% report greater than 10. 31% of firms received first Phase I before 1993. 44% received first Phase I after 1998.

5. *What percentage of your company's growth would you attribute to the SBIR program after receiving its first SBIR award?*

   a. **21%** *Less than 25%.*
   b. **29%** *25% to 50%.*
   c. **28%** *51% to 75%.*
   d. **22%** *More than 75%.*

6. *Number of company employees (including all affiliates):*

   a. *At the time of your company's first Phase II Award: ___* **49% report less than six; 10% report greater than 50.**
   b. *Currently: _____***17% report less than six; 26% report greater than 50.**

7. What Percentage of your Total R&D Effort (Man-hours of Scientists and Engineers) was devoted to SBIR activities during the most recent fiscal year?___% **39% of firms report greater than 50%.**

8. *What was your company's total revenue for the last fiscal year?*

   a. **2.8%** *<$100,000.*
   b. **11%** *$100,000 to $499,999.*
   c. **14.7%** *$500,000 to $999,999.*
   d. **36.7%** *$1,000,000 to $4,999,999.*
   e. **26.6%** *$5,000,000 to $19,999,999.*
   f. **6.9%** *$20,000,000 to $99,999,999.*
   g. **1.4%** *$100,000,000 +.*
   h. **0%** *Proprietary.*

9. *What percentage of your company's revenues during its last fiscal year is Federal SBIR and/or STTR funding (Phase I and/or Phase II)?* _____
13% report zero. 31% report more than 50%.

10. Which, if any, of the following has your company experienced as a result of the SBIR Program? (Select all that apply.)

____ Made an initial public stock offering in calendar year ☐☐☐☐
Three IPO reported. (1996, 2000, 2005.)

a. _____ Planned an initial public stock offering for 2006/2007.
One IPO planned.

b. _____ Established one or more spin-off companies.
How many spin-off companies? ☐☐
39 firms created 69 spin-off companies.

c. **83%** None of the above.

11. *How many patents have resulted, at least in part, from your company's SBIR and/or STTR awards?* _____ **39% of firms reported no patents; 3% reported more than 25. Average number of patents was 4.3.**

The next three questions address how market analysis and sales of the commercial results of SBIR are accomplished at your company.

12. This company normally first determines the potential commercial market for an SBIR product, process or service:

a. **64%** Prior to submitting the Phase I proposal.
b. **21%** Prior to submitting the Phase II proposal.
c. **14%** During Phase II.
d. **1%** After Phase II.

13. Market research/analysis at this company is accomplished by: (Select all that apply.)

a. **38%** The Director of Marketing or similar corporate position.
b. **11%** One or more employees as their primary job.

c. **44%** One or more employees as an additional duty.
d. **20%** Consultants.
e. **48%** The Principal Investigator.
f. **62%** The company President or CEO.
g. **8%** None of the above.

14. Sales of the product(s), process(es) or service(s) that result from commercialising an SBIR award at this company are accomplished by: (Select all that apply.)

a. **40%** An in house sales force.
b. **56%** Corporate officers.
c. **36%** Other employees.
d. **28%** Independent distributors or other company (ies) with which we have marketing alliances.
e. **26%** Other company (ies), which incorporate our product into their own.
f. **8%** Spin off company (ies).
g. **28%** Licensing to another company.
h. **8%** None of the above.

The remaining questions specifically address the DoD Fast Track and Phase II Enhancement programs.

15. With respect to DoD Fast Track Proposals: (Select all that apply.)

a. **53%** This firm has never submitted a DoD Fast Track SBIR proposal.
b. **38%** This firm has submitted DoD Fast Track SBIR proposal (s).
c. **20%** This firm is unlikely to submit a DoD Fast Track SBIR proposal in the future.
d. **33%** This firm is likely to submit future DoD Fast Track SBIR proposal (s).

16. Why have you not previously submitted a Fast Track proposal and/or why are you unlikely to submit future Fast Track proposals? (Select all that apply.) **Seen only by firms, which checked 16a. and/or 16c.**

a. **67%** Experienced or perceived difficulty in obtaining third party funding in time to meet the requirements for Fast Track.
b. **21%** Concern about dilution of firm equity and/or loss of control of firm.
c. **16%** Bureaucratic requirements of Fast Track application process.

d. **2%** Dissatisfaction with results of an earlier experience with Fast Track.
e. **11%** Indication received from government sponsor that the sponsor did not recommend Fast Track.
f. **22%** Perception that Fast Track does not provide sufficient benefits.
g. **22%** Other. (Explain briefly and/or use to briefly expand on any of the above answers._____)

17. With respect to DoD Phase II Enhancement/Plus, (Select all that apply.)

a. **40%** This firm has never submitted a DoD Phase II Enhancement/Plus SBIR proposal.
b. **51%** This firm has submitted DoD Phase II Enhancement/Plus SBIR proposal (s).
c. **8%** This firm is unlikely to submit a DoD Phase II Enhancement/Plus SBIR proposal in the future.
d. **46%** This firm is likely to submit future DoD Phase II Enhancement/Plus SBIR proposal (s).

18. Why have you not previously submitted a Phase II Enhancement/Plus proposal and/or why are you unlikely to submit future Phase II Enhancement/Plus proposals? (Select all that apply.) **Seen only by firms, which checked 18a. and/or 18c.**

a. **39%** Experienced or perceived difficulty in obtaining DoD Acquisition Program funding.
b. **49%** Experienced or perceived difficulty in obtaining third party private sector funding.
c. **11%** Concern about dilution of firm equity and/or loss of control of firm with private sector funding.
d. **12%** Bureaucratic requirements of Phase II Enhancement/Plus application process.
e. **1%** Dissatisfaction with results of an earlier experience with Phase II Enhancement/Plus.
f. **10%** Indication received from government sponsor that the sponsor did not recommend Phase II Enhancement/Plus.
g. **8%** Perception that Phase II Enhancement/Plus does not provide sufficient benefits.
h. **33%** Other. (Explain briefly and/or use to briefly expand on any of the above answers._____)

Appendix C

Phase II Survey for Fast Track Study
Summary of Responses

Phase II Survey 2006

RESULTS AND RELATED NOTES APPEAR IN BOLD. UNLESS OTHERWISE SPECIFIED, ANSWERS ARE ARRAYED AS THE PERCENTAGE OF THAT SAMPLE GROUP (FT/PIIE/CONTROL) RESPONDING THAT ANSWER.

Introduction: This survey is a continuation of a major study commissioned by the U.S. Congress to review operations of SBIR programs at federal agencies. This assessment, by the National Research Council, seeks to determine the impact of Department of Defense SBIR program initiatives, and to investigate ways in which the programs could be improved.

Your participation in this survey will assist us greatly in recommending changes to SBIR administration within DoD The survey should take about 15 to 40 minutes of your time. If you have further questions either about the survey or about the assessment more broadly, please contact Dr. Charles Wessner, Study Director, National Research Council (cwessner@nas.edu).

PROPOSAL TITLE:
AGENCY:
TOPIC NUMBER:
PHASE II CONTRACT NUMBER:

Part I: Current Status of the Project

1. What is the current status of the project funded by the referenced SBIR award? Select the one best answer.

   a. **9/8/4** Project has not yet completed Phase II. Skip to Question 13.
   b. **17/6/13** Efforts at this company have been discontinued. No sales or additional funding resulted from this project. Go to Question 2.
   c. **6/10/14** Efforts at this company have been discontinued. The project did result in sales, licensing of technology, or additional funding. Go to Question 2.
   d. **34/28/38** Project is continuing post Phase II technology development. Skip to Question 3.
   e. **9/16/13** Commercialization is underway. Skip to Question 3
   f. **23/33/18** Products/Processes/ Services are in use by target population/customer/consumers. Skip to Question 3

2. Did the reasons for discontinuing this project include any of the following? (PLEASE SELECT YES OR NO FOR EACH REASON AND NOTE THE ONE PRIMARY REASON.) **This question answered only by those who answered b or c to first question.**

	Yes	No	Primary Reason
a. Technical failure or difficulties.	**20/8/17**	**80/92/83**	**13/0/14**
b. Market demand too small.	**73/54/66**	**27/46/34**	**0/15/31**
c. Level of technical risk too high.	**20/23/14**	**80/77/86**	**0/0/3**
d. Not enough funding.	**60/54/59**	**40/46/41**	**20/23/3**
e. Company shifted priorities.	**47/46/17**	**53/54/83**	**27/0/3**
f. Principal investigator left.	**13/31/10**	**87/69/90**	**7/23/3**
g. Project goal was achieved (e.g., prototype delivered for DoD use).	**47/62/69**	**53/38/31**	**13/15/21**
h. Licensed to another company.	**0/8/3**	**100/92/97**	**0/0/3**
i. Product, process, or service not competitive.	**20/31/17**	**80/69/83**	**0/8/0**
j. Inadequate sales force capability.	**20/15/24**	**80/85/76**	**0/0/10**
k. Other (please specify): _____	**27/23/17**	**73/77/83**	**20/15/7**

The next question to be answered depends on the answer to Question 1. If c, go to Question 3. If b, skip to Question 13.

Part II: Commercialization Activities and Planning

The next four questions concern actual sales to date resulting from the technology developed during this project. Sales includes all sales of a product, process, or service, to federal or private sector customers resulting from the technology developed during this Phase II project. A sale also includes licensing, the sale of technology or rights etc.

3. Has your company and/or licensee had any actual sales of products, processes, services or other sales incorporating the technology developed during this project? (Select all that apply.)

   a. **24/30/28** No sales to date, but sales are expected. Skip to Question 8.
   b. **21/14/23** No sales to date nor are sales expected. Skip to Question 13.
   c. **47/53/32** Sales of product(s).
   d. **12/11/8** Sales of process(es).
   e. **28/44/15** Sales of services(s).
   f. **10/15/5** Other sales (e.g., rights to technology, licensing, etc.).

4. For your company and/or your licensee(s), when did the first sale occur, and what is the approximate amount of total sales resulting from the technology developed during this project? If multiple SBIR awards contributed to the ultimate commercial outcome, report only the share of total sales appropriate to this SBIR project. (Enter the requested information for your company in the first column and, if applicable and if known, for your licensee(s) in the second column. Enter approximate dollars. If none, enter 0 [zero]).

   a. Year when first sale occurred. Your Company Licensee(s)
   FT 38% before 2001
   PIIE 32% before 2001
   Control 30% before 2001

   b. Total Sales Dollars of Product (s) Process(es) or Service(s) to date.
   b1.) $_____ b2.) $_____

	Average Company Sales From Product Process Service	Average Licensee Sales From Product Process Service
FT	**$661,672**	**$12,500**
PHII +	**$1,162,962**	**$170,554**
Control	**$777,593**	**$12,523**

c. Other Total Sales Dollars (e.g., Rights to technology, Sale of spin-off company, etc.) to date.

c1.) $_____ c2.) $_____

	Average Other Company Sales	Average Other Licensee Sales
FT	**$53,593**	**$312,586**
PHII +	**$149,710**	**$3,450**
Control	**$77,570**	**$9,346**

To date, approximately what percent of total sales from the technology developed during this project came from the following customers? (If none enter 0 (zero). Round percentages. Answers should add to about 100%.)

a. **21/31/20** Domestic private sector.
b. **36/46/27** Department of Defense (DoD).
c. **33/19/10** Prime contractors for DoD.
d. **1/0/1** NASA.
e. **0/0/1** Other federal agencies (Pull down).
f. **0/0/4** State or local governments.
g. **8/4/32** Export Markets.
h. **0/0/0** Other (Specify). _____

The following questions identify the product, process, or service resulting from the project supported by the referenced SBIR award, including its use in a fielded federal system or a federal acquisition program.

5. Is a Federal System or Acquisition Program using the technology from this Phase II? If yes, please provide the name of the Federal system or acquisition program that is using the technology.
   a. **86/76/89** No
   b. **14/24/11** Yes ____ **Thirty-five programs or systems were identified.**

6. **Omitted.**

7. Did a commercial product result from this Phase II project?

   30/35/26 Yes. If yes please complete a, b, and c as appropriate.
   70/65/74 No.

   a. Trade or Commercial name. **Sixty-nine Trade or Commercial names were identified**.
   b. Generic name. **Fifty-two Generic names were identified.**
   c. Model number (if applicable). **Nine model numbers were identified.**

8. If you have had no sales to date resulting from the technology developed during this project, what year do you expect the first sales for your company or its licensee? **Cmt to programmer: Only firms that had no sales but answered that they expect sales get this question.**

   The year of expected first sale is ☐☐☐☐ **The percentages of each sample group that entered a future year in which they expect to have a first sale is 22/24/27.**

9. For your company and/or your licensee, what is the approximate amount of total sales expected between now and the end of 2007 resulting from the technology developed during this project? (If none, enter 0 (zero).)

   a. Total sales dollars of product(s), process(es) or services(s) expected between now and the end of 2007. **Answers are total expected for that sample group divided by total responses from that group.**

      FT $498,969
      PIIE $1,645,329
      Control $622,664

   b. Other Total Sales Dollars (e.g., rights to technology, sale of spin-off company, etc.) expected between now and the end of 2007. **Answers are total expected for that sample group divided by total responses from that group.**

      FT $29,844
      PIIE $58,129
      Control $286,545

   c. Basis of expected sales estimate. Select all that apply.

      a. **2/5/1** Market research
      b. **28/43/39** Ongoing negotiations
      c. **67/57/67** Projection from current sales
      d. **24/28/22** Consultant estimate
      e. **17/28/20** Past experience
      f. **0/0/0** Educated guess
      g. **20/26/18** Existing contracts

10. How did you (or do you expect to) commercialize your SBIR award? Select all that apply.

a.	**1/4/ 1**	No commercial product, process, or service was/is planned.
b.	**28/43/35**	As software.
c.	**67/57/67**	As hardware (final product, component, or intermediate hardware product).
d.	**24/28/22**	As process technology.
e.	**17/28/20**	As new or improved service capability.
f.	**0/0/0**	As a drug.
g.	**0/0/0**	As a biologic.
h.	**20/26/18**	As a research tool.
i.	**3/4/3**	As educational materials.
j.	**0/0/0**	Other, please explain. _____

11. **Omitted.**

Part III: Other Outcomes

12. As a result of the technology developed during this project, which of the following describes your company's activities with other companies and investors? (Select all that apply.).

	Activities	U.S. Companies/Investors		Foreign Companies/Investors	
		Finalized Agreements	Ongoing Negotiations	Finalized Agreements	Ongoing Negotiations
a	Licensing Agreement(s)	**19/17/12**	**24/18/22**	**8/3/2**	**5/3/6**
b	Sale of company	**3/3/0**	**11/5/1**	**3/0/0**	**0/0/0**
c	Partial sale of company	**5/3/1**	**8/0/4**	**3/0/0**	**0/0/1**
d	Sale of technology rights	**5/7/2**	**16/11/14**	**3/3/0**	**5/0/1**
e	Company merger	**8/3/0**	**8/3/1**	**3/0/0**	**3/0/0**
f	Joint venture agreement	**11/0/0**	**12/14/13**	**0/3/1**	**0/3/1**
g	Marketing/ distribution agreement(s)	**13/13/7**	**21/5/8**	**7/7/8**	**5/0/2**
h	Manufacturing agreement(s)	**3/3/2**	**13/0/12**	**0/3/2**	**3/0/6**
i	R&D agreement(s)	**3/10/16**	**24/5/19**	**3/3/6**	**8/0/5**
j	Customer alliance(s)	**16/21/14**	**19/10/22**	**0/0/6**	**5/0/5**
k	Other Specify____	**8/8/4**	**3/8/2**	**3/0/0**	**0/0/0**

13. In your opinion, in the absence of this SBIR award, would your company have undertaken this project? (Select one.)

    a. **6/1/4** Definitely yes. Go to Question 14.
    b. **11/10/12** Probably yes. Go to Question 14.
    c. **17/14/15** Uncertain. Skip to Question 16.
    d. **33/39/34** Probably not. Skip to Question 16.
    e. **33/36/36** Definitely not. Skip to Question 16.

14. If you had undertaken this project in the absence of SBIR, this project would have been:

    a. **18/11/0** Broader in scope.
    b. **18/33/41** Similar in scope.
    c. **64/56/59** Narrower in scope.

15. In the absence of SBIR funding: (Please provide your best estimate of the impact.)

    a. The start of this project would have been delayed about **13/5/6**_months. **(FT/PIIE/Control) answers are average number of months reported.**

    b. The expected duration/time to completion would have been:
        1. **80/67/58** Longer.
        2. **0/0/15** The same.
        3. **0/0/0** Shorter.
        20/33/26 No response.

    c. In achieving similar goals and milestones, the project would be:
        1. **0/0/0** Ahead.
        2. **0/0/16** The same place.
        3. **78/83/58** Behind.
        20/33/26 No response.

16. Employee information. (Enter number of employees. You may enter fractions of full time effort [e.g., 1.2 employees]. Please include both part time and full time employees, and consultants, in your calculation.) **Responses are the average number of employees reported by FT/PIIE/Control.**

Number of employees (if known) when Phase II proposal was submitted.	**27/47/35**
Current number of employees.	**55/103/58**
Number of current employees who were hired as a result of the technology developed during this Phase II project.	**2.7/2.6/2.0**
Number of current employees who were retained after Phase II as a result of the technology developed during this Phase II project.	**2.5/2.2/2.2**

17. The Principal Investigator for this Phase II Award was a: (Check all that apply.)

    a. **2/5/7** Woman.
    b. **9/4/11** Minority.
    c. **89/93/83** Neither a woman nor a minority.

18. Please give the number of patents, copyrights, trademarks and/or scientific publications for the technology developed as a result of this project. (Enter numbers. If none, enter 0 [zero].). **Responses are the totals report by each group FT/PIIE/Control**

Number Applied For/Submitted		Number Received/Published
47/57/58	Patents	**24/23/45**
3/21/10	Copyrights	**3/21/6**
12/21/23	Trademarks	**11/18/ˆ7**
92/107/181	Scientific Publications	**89/103/175**

Part IV: Other SBIR Funding

19. How many SBIR awards (from any federal agency) did your company receive prior to the Phase I that led to this Phase II? **Reponses are the average number of awards reported by FT/PIIE/Control.**

    a. Number of previous Phase I awards. **3.8/31.4/13.3**
    b. Number of previous Phase II awards. **1.7/2.7/5.6**

20. How many SBIR awards has your company received that are related to the project/technology supported by this Phase II award ? **Reponses are the average number of awards reported by FT/PIIE/Control.**

    a. Number of related Phase I awards. **2.2/2.5/2.5**
    b. Number of related Phase II awards. **1.2/1.4/1.5**

Part V: Funding and Other Assistance

21. Prior to this SBIR Phase II award, did your company receive funds for research or development of the technology in this project from any of the following sources?

    a. **23/18/26** Prior SBIR (Excluding the Phase I that proceeded this Phase II).
    b. **14/17/17** Prior non-SBIR federal R&D.
    c. **5/7/1** Venture capital.
    d. **16/12/7** Other private company.
    e. **22/10/5** Private investor.
    f. **36/34/32** Internal company investment (including borrowed money).
    g. **6/5/0** State or local government.
    h. **0/1/1** College or university.
    i. **0/4/5** Other (Specify). _____

Commercialization of the results of an SBIR project normally requires additional developmental funding. Questions 22 and 23 address additional funding. Additional developmental funds include non-SBIR funds from federal or private sector sources, or from your own company, used for further development and/or commercialization of the technology developed during this Phase II project.

22. Have you received or invested any additional developmental funding in this project subsequent to Phase II?

    a. **73/82/60** Yes. Continue.
    b. **27/18/40** No. Skip to Question 24.

23. To date, what has been the total additional developmental funding for the technology developed during this project? If none, enter 0 (zero). **Responses are average reported funding for FT/PIIE/Control.**

	Source	Developmental Funding
a.	Non-SBIR federal funds.	**$296,217 / $682,171 / $324,795**
b.	Private Investment.	
	(1) U.S. venture capital.	**$52,344 / $39,867 / $4,673**
	(2) Foreign investment.	**$48,242 / $3,012 / $10,280**
	(3) Other Private equity.	**$232,746 / $155,506 / $5,417**
	(4) Other domestic private company.	**$118,949 / $58,988 / $64,785**
c.	Other sources.	
	(1) State or local governments.	**$18,164 / $15,663 / $3,178**
	(2) College or Universities.	**$391 / $1,488 / $12,617**
d.	Not previously reported.	
	(1) Your own company (Including money you have borrowed).	**$112,166 / $72,316 / $129,178**
	(2) Personal funds.	**$15,188 / $6,193 / $14,009**

24. Did this award identify matching funds or other types of cost sharing (as an eligibility or competitive criterion) in the Phase II? Check all that apply. **Responses are percent of all respondents.**

    a. **24** Yes. This was a DoD Fast Track.
    b. **5** Although not a DoD Fast Track nor Phase II Enhancement/Plus, matching funds/co-investment/cost sharing were identified in the original Phase II.
    c. **30** Yes. This was a Phase II Enhancement/Plus.
    d. **41** No matching funds / co-investment/cost sharing were identified in the Phase II. If d, skip to Question 31.

25. List all sources of matching or co-investment funding included in the proposal. Check all that apply.

    a. **17/24/50** Our firm provided funding (includes borrowed funds).
    b. **31/69/0** A federal agency provided non-SBIR funds.
    c. **33/23/58** Another firm provided funding.
    d. **29/6/8** An angel investor or other private investment source provided funding.
    e. **7/1/0** Venture capital provided funding.
    f. **5/5/0** Other (Identify).

26. How long in months did it take to obtain and finalize agreement(s) for third party funding/in kind support? Answer all that apply. **Responses are average number of months identified by FT and PIIE**

    3.5 ☐☐ Months, if Fast Track.

    4.3 ☐☐ Months, if Phase II Enhancement/Plus.

The next two questions answered only by Fast Track awards (Q 24a.)

27. What impact did the use of Fast Track for this effort, rather than the standard Phase II proposal, have on the following: (Please answer all.)

    a. The initial product reached the market **53%** faster, **0** slower, **47%** at about the same time as it would have had standard (non Fast Track) Phase II procedures been used.
    b. Sales of the product to date are **38%** greater, **0** smaller, **62%** about the same as they would be had standard (non Fast Track) Phase II procedures been used.
    c. Investment to date is **52%** greater, **1%** smaller, **47%** about the same as it would be had standard (non Fast Track) Phase II procedures been used.
    d. Potential sales resulting from this SBIR are **45%** greater, **0** smaller, **55%** about the same as they would be had standard (non Fast Track) Phase II procedures been used.
    e. Fast Track **59%** improved or **41%** did not improve transition into a DoD procurement.

28. In retrospect knowing the outcome, are you satisfied with your decision to use Fast Track on this Phase II?
    a. **90%** Yes. Fast Track was better than a standard Phase II proposal because (Explain briefly)_____.
    b. **10%** No. We should have used the standard Phase II proposal rather than Fast Track because (Explain briefly) _____.

The next two questions answered only by Phase II Enhancement/Plus awards (Q 24c.)

29. What impact did the use of Phase II Enhancement/Plus for this effort, compared to a standard Phase II have on time to market, sales to date, investment to date, and sales potential? Please answer all.

    a. The initial product reached the market **58%** faster, **6%** slower, **36%** at about the same time as it would have in the absence of Phase II Enhancement/Plus.
    b. Sales of the product to date are **50%** greater, **2%** smaller, **48%** about the same as they would be in the absence of Phase II Enhancement/Plus.
    c. Investment to date is **47%** greater, **6%** smaller, **47%** about the same as it would be in the absence of Phase II Enhancement/Plus.
    d. Potential sales resulting from this SBIR are **69%**greater, **1%** smaller, **30%** about the same as they would be in the absence of Phase II Enhancement/Plus.
    e. Phase II Enhancement/Plus **69%** improved or **31%** did not improve transition into a DoD procurement.

30. In retrospect, knowing the outcome, are you satisfied with your decision to use Phase II Enhancement/Plus on this Phase II?

    a. **95%** Yes. Phase II Enhancement/Plus was an improvement over the standard Phase II process because (Explain briefly) _____.
    b. **5%** No. We should not have bothered with Phase II Enhancement/Plus because (Explain briefly) _____.

31. Did you experience a funding gap between the end of Phase I and the start of Phase II?

    a. _____ Yes. The gap was ☐☐ months. Continue.

	Had Gap (percent)	Average Gap of Projects Reporting Gap (months)	Average Gap—All Projects (months)
FT	**34**	**4.3**	**1.5**
PIIE	**65**	**4.9**	**3.2**
Control	**69**	**8.8**	**6.1**

    b. _____ No. Skip to Question 34.

32. Project history. Please fill in for all dates that have occurred. **Almost half of the respondents left the dates blank. The percent responding by sample group were FT 33%, PIIE 64%, and Control 68%. Eighteen percent of the respondents claimed to have submitted their Phase II proposals the same day as they completed Phase I. 33% submitted prior to completion of Phase I. Proposals reported to be submitted prior to the end of Phase I ranged from an average of 68 days early for the Control group to 94 days early for Fast Track. Half of the proposals were reported to have been submitted after Phase I was complete. This self imposed funding gap ranged from 197 days for PIIE proposals to 232 days for the Control group.**

    Date Phase I ended (Month/ year: e.g., 08/94) | | | / | | |

    Date Phase II proposal submitted (Month /year) | | | / | | |

33. If you experienced funding gap between Phase I and Phase II for this award, select all answers that apply:

    a. **19/42/40** Stopped work on this project during funding gap.
    b. **13/20/25** Continued work at reduced pace during funding gap.
    c. **3/2/1** Continued work at pace equal to or greater than Phase I pace during funding gap.
    d. **5/4/7** Received bridge funding between Phase I and II.
    e. **0/1/2** Company ceased all operations during funding gap.
    66/35/31 No reported funding gap

    Responses for each group are slightly over 100% since more than one answer could apply.

34. **Omitted.**

35. In executing this award, was there any involvement by universities (faculty, graduate students, facilities, and/or university developed technologies)?

    36/20/29 Yes.
    64/80/71 No.

36. What relationships existed between your firm's efforts on this Phase II project and any university(ies) or college(s). (Select all that apply.)

    a. **3/0/0** The Principal Investigator (PI) for this Phase II project was at the time of the project a faculty member.

b. **5/1/0** The Principal Investigator (PI) for this Phase II project was at the time of the project an adjunct faculty member.
c. **22/13/17** Faculty member(s) or adjunct faculty member (s) worked on this Phase II project in a role other than PI, e.g., consultant.
d. **16/10/13** Graduate students worked on this Phase II project.
e. **16/10/14** University/college facilities and/or equipment were used on this Phase II project.
f. **2/1/2** The technology for this project was licensed from a university or college.
g. **6/4/5** The technology for this project was originally developed at a university or college by one of the participants in this Phase II project.
h. **14/10/17** A university or college was a subcontractor on this Phase II project.

In remarks enter the name of the university or college that is referred to in any blocks that are checked above. If more than one institution is referred to, briefly indicate the name and role of each.
Remarks: **Respondents named the University of Central Florida three times. Six universities—Colorado, Maryland, Minnesota, Purdue, UCLA and Wayne State—were named twice, and twenty others were named by a single respondent.**

Appendix D

Update of SBIR Fast Track Case Studies

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SELECTION OF A SUBSET OF EARLIER FAST TRACK CASES FOR UPDATE

In an earlier NRC study of the SBIR Fast-Track initiative, members of an NRC research team conducted a series of case studies of SBIR projects which included both Fast-Track and non-Fast Track participants. Of the total of 55 project case studies conducted for the earlier study, 17 were Fast Track cases, and 38 were non-Fast Track cases. While the cases centered on projects, they also treated the companies that received the SBIR awards and conducted the research. There were slightly fewer companies than projects because several case-study projects were conducted by the same company, but in the case of the Fast Track projects, there was a one-to-one correspondence between projects and companies: 17 projects carried out by 17 companies.

A preliminary search of the 17 previous Fast Track companies was done using Dun & Bradstreet company reports to determine which of the companies could still be found. Of the 17 companies, 10 were found to have reports on file. While it is possible that some of the remaining seven companies also may be still in existence, no Dun & Bradstreet reports were found for them, and further searches for contact information came up empty. Moreover, not all of the 10 companies for which Dun & Bradstreet reports were on file could be found—although 9 of the 10 were found.

AN OVERVIEW OF THE 55 EARLIER CASE STUDIES

The previous case studies, from which the 10 Fast Track companies were drawn, were conducted by five different researchers, focused on projects and associated award recipients in different regions of the country, and on a variety of research questions. A brief summary follows of the earlier five sets of

cases which included the Fast Track award recipients, with illustrative research questions and findings from each set:[1]

(1) Researcher John Scott's set of 14 cases included six Fast Track and eight non-Fast Track projects in 13 companies.[2]

Illustrative Research Questions and Findings:

Question: In the absence of the SBIR funding, would the research projects have been undertaken in the same way or at the same pace?

Finding: It was concluded that the projects would not have been undertaken in the same way or at the same pace in absence of the SBIR program, due to the expectation that they would have been under funded.

Question: Were there differences between Fast Track and non-Fast Track projects in their estimated lower-bound social rates-of-return?

Finding: As a group, the Fast Track projects were estimated to have higher prospective lower-bound social rates of return.

(2) Researcher Albert Link's set of 12 cases included six Fast Track and six non-Fast Track projects in 12 companies.[3]

Illustrative Research Questions and Findings:

Question: Do Fast Track projects progress more rapidly than standard SBIR awards?

Finding: Fast Track projects proceeded to Phase II research faster than non-Fast Track projects.

Question: Do the Fast Track projects commercialize more rapidly than the non-Fast Track projects?

Finding: Fast Track projects developed a commercialization strategy sooner than non-Fast Track projects, but those Fast Track projects did not anticipate having commercial products sooner than non-Fast Track projects.

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[1]In addition to the 55 case studies, the earlier study of Fast Track included a survey of 379 Phase II awards.

[2]Study focus and key findings of John Scott's case study set were reported in "An Assessment of the Small Business Innovation Research Program in New England: Fast Track Compared with Non-Fast Track Projects," in National Research Council, *The Small Business Innovation Research Program: An Assessment of the Department of Defense Fast Track Initiative*, Charles W. Wessner, ed., Washington, DC: National Academy Press, 2000, pp. 104-105.

[3]Study focus and key findings of Albert Link's case study set were reported in "An Assessment of the Small Business Innovation Research Fast Track Program in Southeastern States," in National Research Council, *The Small Business Innovation Research Program: An Assessment of the Department of Defense Fast Track Initiative*, op. cit., pp. 194-210.

(3) Researcher Maryann Feldman's set of five cases included one Fast Track and four non-Fast Track projects.[4]

Illustrative Research Questions and Findings:

Question: What has been the role of DoD's SBIR in financing bioscience research?

Finding: DoD's SBIR was found to have played a substantial role in financing bioscience research, with the study documenting more than $240 million in SBIR awards for bioscience-related research by small firms.

Question: How does funding of small start-up biotech companies by DoE and NIH compare?

Finding: DoD and NIH funding of the projects examined was found to be complementary; these agencies funded different applications, and it was common for a firm that received DoD funding to subsequently apply to NIH.

(4) Researchers David Audretsch's, Juergen Weigand's, and Claudia Weigand's set of 12 cases included zero Fast Track and 12 non-Fast Track[5]

Illustrative Research Questions and Findings:

Question: To what extent have recipients of SBIR awards altered their career choices as a result of SBIR, particularly by commercializing their knowledge by starting a new firm?

Finding: Study results suggested that the SBIR influenced the career paths of scientists and engineers by facilitating the start-up of new firms; it was found that a significant number of the scientists and engineers would not have become involved in the commercialization process in the absence of SBIR.

Question: Has the behavior of recipients of SBIR awards "spilled over" by inducing other colleagues to commercialize their knowledge in the form of starting a new firm?

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[4]Study focus and key findings of Maryann Feldman's case study set were reported in "Role of the Department of Defense in Building Biotech Expertise," in National Research Council, *The Small Business Innovation Research Program: An Assessment of the Department of Defense Fast Track Initiative*, op. cit., pp. 251-274.

[5]Study focus and key findings of the case study set of David Audretsch, Juergen Weigand, and Claudia Weigand were reported in "Does the Small Business Innovation Research Program Foster Entrepreneurial Behavior? Evidence from Indiana," in National Research Council, *The Small Business Innovation Research Program: An Assessment of the Department of Defense Fast Track Initiative*, op. cit., pp. 160-193.

Finding: The study concluded that as a result of the demonstration effect by SBIR-funded commercialization, a number of other scientists altered their careers to include commercialization efforts.

(5) Researcher Reid Cramer's set of 12 cases included four Fast Track and eight non-Fast Track[6]

Illustrative Research Questions and Evidence-Based Answers:

Question: What organizational characteristics differentiate the SBIR companies?

Finding: Three categories of firms were found among the case-study firms, resulting in the following classification by firm type: (1) contractor firms, (2) technologies firms, and (3) scientific firms.

Question: Are there benefits from the SBIR beyond commercial sales?

Finding: Benefits of the case-study companies were not only expressed in terms of commercial sales, but also in terms of expanding basic research, responding to government needs, and developing applications for technology.

UPDATING THE 10 FAST TRACK CASES

The current study has focused on updating the earlier Fast Track cases that could be found, but without the single-project focus of the earlier study and without pursuing the research questions of that earlier study. Rather, the focus of this update is on the company: on major changes in the company over the nearly 10 years since the earlier case was performed; on shifts in the company's technology focus and application areas over the period; on the extent of commercialization by the company and specifically on commercialization of its SBIR-funded technology; on the number of SBIR awards received by the company; and on company views about SBIR and Fast Track awards, and, where relevant, Phase II Enhancement awards.

The updated case studies are based on telephone interviews with owners, presidents, or designated points of contacts within the companies; supplementary information from the companies provided by email correspondence; information gleaned from company Web sites; news releases; Dun & Bradstreet company reports; SBA SBIR and Fast Track on-line awards databases; and the earlier case studies.

The interview discussions focused on the following topics:

[6]Study focus and key findings of Reid Cramer's case study set were reported in "Patterns of Firm Participation in the Small Business Innovation Research Program in Southwestern and Mountain States," in Naitonal Research Council, *The Small Business Innovation Research Program: An Assessment of the Department of Defense Fast Track Initiative*, op. cit., pp. 160-159.

- Verification of current company location and contact information, founding date, and ownership structure.
- Verification of the number and type of SBIR awards the company has received, including Fast Track and Phase II Enhancements, the agency making the award, the year and amount, and the project title, as reported by on-line SBA databases.
- Major company developments over the nearly 10 years since the previous case studies were done.
- SBIR effects, if any, on the firm.
- Commercialization status, including whether the company's SBIR awards have led to commercial products, including use of SBIR project results by DoD.
- Views about the SBIR program in general.
- Level of satisfaction with Fast Track.
- Identification of any problems or shortcomings with Fast Track
- Identification of any positive aspects of Fast Track.
- Suggested changes to Fast Track.
- Views about whether they would consider proposing again to SBIR; proposing again for a Fast Track award; or proposing for a Phase II Enhancement award; factors influencing their decisions.

Table App-D-1 lists the 10 company cases selected for update—nine of which were found still in existence. Of the nine found, seven agreed to cooperate with the study. Entries are provided for all 10 of the companies, but information derived from interview is available only for the seven which cooperated.

The table provides overview information for the 10 companies, including the following: location; forms of ownership and major changes since 1998; founding dates; technology focus then and now; number of employees then and now; and the number of SBIR awards received over a specified period. In addition to the information summarized in Table App-D-1, the individual cases provide the following kinds of information: descriptions of major changes experienced by the companies since the original Fast Track case study was performed about 10 years ago; application areas for technologies then and now; descriptions of company commercialization; and company views of the SBIR program, of Fast Track, and, where applicable, of Phase II Enhancement awards. An analysis of aggregate findings for each kind of information collected follows.

Location

As would be expected given the regional distribution of the original case studies, the Fast Track cases for update are geographically dispersed. Three are located in the northeast; two in the west; and five in the south,

although one of the latter was acquired by a company headquartered in California.

Ownership and Size

At the time the case studies for these 10 companies were originally done, all were small, privately owned companies. Two were woman owned, and one of the woman-owned companies was also minority owned. Half had 10 or fewer employees, and all but one had no more than 26 employees. A single company had more than 100 employees.

At the time of the update, one of the companies (Picolight) had been acquired by a very large, publicly held company, and another (CG^2) had been acquired by a privately owned company larger than CG^2, though still a small company. One company (Opts) appears no longer to exist. The remaining companies showed no change in ownership. Two (Hyperion Catalysis and Matis) had become larger; three (Synkinetics, AvPro, and Summitec) had become smaller; and two (Yardney and PTS) remained little changed in size.

Founding

All but one of the 10 companies was started between 1982 and 1995. At the time of the original case studies, three of the companies (Picolight, Opts, and CG^2) were less than five years old. Of these three, two had been acquired by larger companies prior to this case study update, and one had gone under. The oldest company, Yardney, started in 1944, began to use SBIR awards in the early 1990s to advance its battery technology for defense and aerospace applications.

One of the companies, Picolight, was a second startup by a former AT&T Bell Laboratories researcher. One of the companies, Synkinetics, was a spin-off company of MIT's Lincoln Laboratory in the early 1980. Another, Matis, was started in 1990 to respond to U.S. defense scientific computing needs, and has maintained close academic ties. Yet another of the companies, Summitec, started in 1987 to conduct defense R&D, had shifted away from R&D.

Technology Focus and Application Areas

Of the nine companies found, all had stayed in the same general technology field from the time of the earlier case studies to the present. At the same time there were significant shifts in focus, technical advances, and new applications.

Yardney, for example, used its SBIR awards to develop high performance Li-ion batteries for defense and aerospace applications, a change from its former battery line. CG^2 broadened its virtual reality capabilities and

broadened the applications beyond missile simulation testing to virtual training in urban assault and homeland defense, flight training, ground vehicle training, and additional weapons system simulation. Picolight advanced from developing its VCSEL platform technology to developing VCSEL-based transceivers and other devices for communication systems. Synkinetics advanced from fuel efficiency transmission technology to a patent-protected transmission system. AvPro made advances in moving its advanced process control technology for fabricating composite aerospace structures onto the shop floor. Hyperion Catalysis advanced from conducting carbon research to improving its manufacturing process technology for making carbon nanotubes and applying its carbon nanotube technology to making plastic parts for automobiles, electronics including flat-panel displays, and advanced batteries.

In contrast to most of the companies which generally advanced their technologies, Summitec stayed in the general field of information technology, but moved out of research. It shifted from pursuing software for transmission of video images over narrow bandwidth for military applications, to providing technical services in information technology to government agencies.

Commercialization

The seven companies for which interviews were conducted were asked about their commercialization. Of the seven cooperating, six reported that they had commercialized technologies which they had developed. Six offered products for sale and several also provided services. The seventh (Summitec), having shifted its business away from R&D, offered a commercial service.

Speaking specifically about commercializing their SBIR-funded technologies, two of the seven companies (Summitec and Hyperion Catalysis) stated explicitly that they had not commercialized their SBIR-funded technologies. Four (Yardney, Picolight, AvPro, and CG^2) emphasized that they had commercialized their SBIR-funded technologies. One (Matis) spoke of commercializing its technology but did not directly connect commercialization to SBIR-funded projects.

Four (Yardney, AvPro, CG^2, and Matis) of the seven companies were supplying products and services primarily for military applications. At least two (Picolight and Hyperion Catalysis) of the seven companies had developed strong applications in civilian markets. One (Summitec) was providing information technology services to the Department of Energy.

Number of SBIR Awards Received

Six of the 10 companies received no more than five SBIR awards, and three received three or fewer. One received seven awards. Then there were three of the 10 companies that received considerably more awards: Yardney (56), Picolight (17), and CG^2 (22). An observation is that the companies that

received the most SBIR awards over the period examined included three of four that reported commercializing their SBIR-funded technologies, as well as the two companies (Picolight and CG^2) that were acquired by larger companies. The small number of respondents means that these observations can not be generalized.

Views on the SBIR Program

Of the seven companies who provided comments on the SBIR program, three were extremely enthusiastic about the SBIR program in general. Of the three who were enthusiastic, Picolight's founder called the SBIR program, "Excellent." Adding, "It works." He went on to describe how he was able to build the foundation of his company's device technology and his company on SBIR awards. Yardney's President explained how the SBIR program had been particularly important to his company in helping it boost its R&D and sustain a research group, establish a new technology needed by aerospace and defense clients, and provide a path for implementation. The designated spokesperson for CG^2said, "SBIR in general is fantastic," and elaborated that the SBIR gives small companies the chance to take on high-risk research and to undertake more advanced topics of DoD interest. These three were the companies that had the most experience with the SBIR program and the most recent awards.

Three companies (Summitec, Hyperion Catalysis, and Matis)—none of whom had received SBIR awards since the original case studies were done—thought that the program had been satisfactory and could recall no specific problems. Matis' President also noted that the SBIR awards had promoted company growth and helped the company to generate revenues.

Views on Fast Track and Phase II Enhancement Awards

Given that all of the companies had received Fast Track awards but only two (CG^2 and Yardney) had received Phase II Enhancement awards, it is not surprising that company comments focused on Fast Track rather than Phase II Enhancement awards. Yet, because a decade had passed since their last Fast Track award, institutional memory of these companies did not appear to be strong in most cases. According to Matis, Fast Track was "satisfactory," but it did not recall the Fast Track award it received in 1997 as being "very significant." According to CG^2, the company sees both Fast Track and Phase II Enhancement awards as "having value," but noted that "the discussion of Fast Track has not come up recently in proposal planning." According to Hyperion Catalysis, Fast Track "worked well," but no specifics were given.

Several companies did have relatively vivid recall of their earlier Fast Track awards. AvPro's President, for example, said the third-party financing requirement of Fast Track was instrumental in enabling his company to obtain an SBIR Phase II award. Without Fast Track's third-party financing

requirement, he doubted that his company would have been able to obtain the Phase II award because of what he considered a "negative response of academic reviewers to technical challenges associated with manufacturing and process innovations." As another example of recall—but of a contrasting effect—Picolight's President praised Fast Track as being particularly helpful in helping him secure financing from third-party investors and leverage the SBIR award into a much larger investment amount. Thus, in the case of AvPro, Fast Track's major significance was in obtaining SBIR funding, whereas for Picolight, Fast Track's major significance was in obtaining the third-party financing.

Several of the company respondents spoke of their perceptions of the comparative roles of Fast Track and Phase II Enhancement Awards, rather than of their specific experience. According to CG^2's spokesperson, the company sees these awards as having quite different functions, stating, "Fast Track is better for simpler projects where the research gap is of prime concern, and Phase II Enhancement is better for longer, larger, more complex projects that require more funding to get the R&D to Phase III." Yardney said that it had more interest in the "faster funding feature" of Fast Track, than in the larger funding amount offered by Phase II Enhancement. Several of the companies said they were unfamiliar with the Phase II Enhancement award, but expressed interest in learning more.

An interesting observation regarding Fast Track was that while none of the seven responding companies were negative about Fast Track, none had received additional Fast Track awards since the award it received in the late 1990s—the award that was the subject of the earlier case studies. It appeared that none of the companies had applied for additional Fast Track awards, but this was only implied and has not been verified. Yet all of the responding companies who were still in R&D expressed potential future interest in both Fast Track and Phase II Enhancement Awards.

Suggestions for Improvements in SBIR

Four of the responding companies offered comments that either directly or indirectly suggested changes to strengthen the SBIR program.

AvPro's President urged that there be greater receptivity toward proposals that address technical challenges to implementing practical process and manufacturing technologies. According to him, overly academic reviews of proposals tend to give low scores to proposals that aim at addressing process and manufacturing technologies, because these reviewers tend not to appreciate the technical difficulties of integrating technologies in a shop-floor environment. (AvPro had found the Fast Track program to be a way around this problem.)

Hyperion Catalysis described SBIR awards as "very difficult to obtain" and as "requiring substantial company time to work through the process"—a comment which does not necessarily imply a problem with SBIR, but is worth considering since it may suggests undue application difficulties. Hyperion

Catalysis also expressed disappointment that its efforts to take its Fast Track technology into use by DoD had failed.

Yardney's President spoke about the erosion of the research-funding power of a Phase I SBIR award and the urgent need for an increase to ensure that this award continues to serve its intended purpose.

Picolight's President had a comment on why SBIR does not work better for many companies, with implied advice for companies on how they might change the way they approach SBIR, as well as potential advice on how better to formulate SBIR topics and reviews. He postulated that many companies tend to be less successful in building strong technology bases and companies from SBIR because they chase in scattered directions available SBIR topics rather than closely align their proposals with well-thought-through company goals. From the perspective of SBIR, this comment might imply that avoiding over-specification (i.e., unnecessarily constrained) specification of topics would give companies more leeway to align proposals with company goals. It may also imply that greater attention be given by administrators of proposal solicitations or reviewers of proposals to the alignment of proposed projects with company goals.

The individual cases study updates follow.

Advanced Processing Technology (AvPro), Inc. Case Study[7]

COMPANY INFORMATION

Addresses: AvPro, Inc.
2795 Broce Dr.
Suite A
Norman, OK 73072
and
P.O. Box 1696
Norman, OK 73070

Telephone: 405-360-4848
Fax: 405-360-4899
Email: alongbrake@avproinc.com
Web site: <*http://www.avproinc.com*>

Year Started: 1990

Ownership: Privately owned corporation

President: Thomas Rose

Number of Employees:
Earlier Case Study (Approx. 1999): 10
Current Case Study (2007/2008): 7

Company Changes Since Earlier Case Study:

AvPro has continued as a small company working in the area of processing controls for manufacturing composite aerospace structures. On the surface, there are few apparent changes, but there have been important changes below the surface in terms of shifts toward more advanced approaches for controlling composites processing to meet the challenges of increasing complexity of composite structures.

The major change since the earlier case has been the implementation of systems using the outcome of the Fast Track SBIR at major companies such as Vought, Boeing, and General Atomics. Implementation of these systems has

[7]The following informational sources informed this case study: a telephone discussion with Thomas Rose, company founder/owner/president, February 21, 2008; the Web site of AvPro, Inc.; Dun & Bradstreet company report; SBA on-line Tech-net; and on-line Fast Track file.

resulted in lower manufacturing costs and greater ability to record and manage the processing of composites. These successes are building blocks to developing a fundamental shift in approach to composite material processing.

By retaining a small but constant staff, it has been possible for AvPro to address the diverse technologies involved and survive for the time it takes for the technology to mature. While AvPro remains small, it has access to many resources through collaboration with both military and commercial research and development centers. According to the Company's President, Tom Rose, this approach permits AvPro to have a major impact without a major overhead.

TECHNOLOGY, APPLICATIONS, AND COMMERCIALIZATION

Technology Focus:

Earlier Case Study (Approx. 1999): Processing science and control systems for composites

Current Case Study (2007/2008): Advanced process control and equipment management

Application Areas:

Earlier Case Study (Approx. 1999): Composite aerospace structures

Current Case Study (2007/2008): Composite aerospace structures

Commercialization of Technology:

AvPro has provided process control systems that are directly derived from the commercialized versions of its SBIR developments. It has provided process control systems to the U.S. Air Force, U.S. Army, GKN Aerospace, Vought, Lockheed, Boeing, Nordam and many smaller fabricators of composite structures.

The Company's focus is process control applied to the production of composites for aircraft structures. According to Dr. Rose, the company strives to take advances in process control to the shop floor—not an easy task and one for which the challenges tend to be underappreciated. He explained that composite production companies have little downtime to accommodate the incorporation of changes in process, as well as a low tolerance for interruptions that may occur as the workforce adjusts to changes.

Perhaps more significant, Dr. Rose sees a "catch 22" wherein engineering activities cannot design in the requirement for a new technology that has not been demonstrated in the shop. The shop, in turn cannot justify capital equipment costs and training without the requirement for the technology upgrade from engineering. Dr. Rose pointed out that while it may appear that such a transition is simply a logistics challenge, there are in fact many technical challenges that require talent of a caliber similar to those required for an SBIR project.

Reflective of these challenges, AvPro initially focused on embedding advanced capability into control systems it sold to fabricators, and has now

turned its focus on engineering activities to begin to utilize the embedded capabilities to verify critical changes in material during bonding, sealing, and fabricating composite structures.

SBIR, FAST TRACK, AND PHASE II ENHANCEMENTS

SBIR Grants, 1994-2007: 4
(See Table App-D-2 for details.)

Fast Track Awards: 1

Phase II Enhancement Awards: 0

Views on SBIR and Fast Track:

Recalling AvPro's earlier experience with Fast Track, Dr. Rose, said, "Fast Track makes a lot of sense." He cast his comments on Fast Track in the context of a difficulty he said companies like his often face in getting SBIR approval on proposals for manufacturing and process innovations that have their technical challenges in issues of integration and overcoming barriers to implementing sophisticated, often fragile systems in a hardened and workable form in a real shop-floor environment. Often, he said, academic reviewers do not appreciate this type of proposal—favoring proposals that address more fundamental research issues.

Thus, according to Dr. Rose, the main advantage of Fast Track to his company was not so much bridging the financing gap, but rather helping it to get the Phase II award at all, which he doubted would have happened without Fast Track. Dr. Rose thought that the attention given by Fast Track to a company's ability to attract third-party investment significantly improved AvPro's ability to gain approval of its proposed process research project.

He saw no problems with Fast Track, but rather viewed it as a step towards a type of change that he would encourage the SBIR program to emphasize even more: that is, a greater acceptance of proposals that address technical challenges to implementation of practical manufacturing and process technologies.

In support of his argument that public funding of process technologies, including SBIR funding, is justified, Dr. Rose pointed out that just as academic research adds to the publicly available knowledge base, so do process and manufacturing technologies where industry acceptance of the resulting materials requires extensive testing and certification by third parties of the production processes. He explained that most of the data needed to implement a change in process must ultimately reside in the public domain because the data are used by regulatory agencies as well as for litigation activities in case of an adverse event. A private company that takes on the task of implementing and documenting process change in industries such as the aeronautics industry can increase its exposure to lawsuits while incurring substantial costs that its competitors do not

incur because they can readily access the resulting data in the public domain. If this type of work is done under public funding the industry and the nation stand to benefit without creating an unfavorable business proposition for the innovating company or early adopters, he explained. Once the data is in the public domain and a regulatory compliance framework is established, the playing field is leveled and the risk of implementing the innovation is greatly reduced.

Views on Phase II Enhancement Awards:

Dr. Rose noted that AvPro has had no experience with Phase II Enhancement awards, but expressed interest in them—particularly given that they also use third-party financing as a selection criterion.

CG^2, Inc. Case Study[8]

COMPANY INFORMATION

Address: CG^2, Inc.
(Now Quantum3D Huntsville Development Center)
1525 Perimeter Parkway
Suite 160
Huntsville, AL 35806

Quantum3D Corporate Headquarters
6330 San Ignacio Ave
San Jose, CA 95119
Tel: 408-360-8700
Fax: 408-361.9965

Web site: *<http://www.cg2.com>*

Year Started: 1995

Acquired in 2002 by:
Quantum3D
6330 San Ignacio Avenue
San Jose, CA 95119
Phone: 408-361-9999

Web site: *<http://www.quantum3d.com>*

Ownership: CG^2 is a wholly owned subsidiary of Quantum3D, a privately owned corporation.

Number of Employees:
Earlier Case Study (Approx. 1999): 15 (CG^2 only)
Current Case Study (2007/2008): 12 (CG^2 only);
83 (CG2/Quantum3D consolidated)

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[8]The following informational sources informed this case study: a telephone interview with Sandra Vaquerizo, designated point of contact, CG^2, Inc., Orlando R&D Office, February 14, 2008, followed by email correspondence on February 15 and 22, 2008; the Web sites of CG^2 and Quantum3D; a press release about the merger; Dun & Bradstreet company report; SBA on-line Tech-net; and on-line Fast Track file.

Revenue:

Earlier Case Study (Approx. 1999): not available (CG^2 only); $19.6 million (Quantum3D consolidated)

Current Case Study (2007/2008): $1.8 million ($CG^2$ only); $21.8 million (CG2/Quantum3D consolidated)

Company Changes Since Earlier Case Study:

The most significant change concerning CG^2, Inc. has been its merger in 2002 with Quantum3D, a leading developer and manufacturer of commercial off-the-shelf, open-architecture, real-time computing solutions for visual and sensor simulation and training markets. This merger provided CG^2 with a close commercial partner that reportedly positioned CG^2 better to commercialize the results of its R&D.

TECHNOLOGY, APPLICATIONS, AND COMMERCIALIZATION

Technology Focus:

Earlier Case Study (Approx. 1999): Virtual reality scene generation

Current Case Study (2007/2008): Software products and services for 3D graphics visualization, real-time image generation, simulation

Application Areas:

Earlier Case Study (Approx. 1999): Virtual testing of missiles to lower testing costs

Current Case Study (2007/2008): Virtual training in urban assault and homeland defense, flight training, ground vehicle training, and weapons system simulation and assessment

Commercialization of Technology:

CG^2 successfully completed the 1997 Fast Track proposal, and subsequently generated revenue based on the technology. Following the merger with Quantum3D, CG^2 maintained its focus on research for government clients, and additional product lines were launched in the military, aerospace, and commercial visual simulation and training markets through Quantum3D.[9]

SBIR, FAST TRACK, AND PHASE II ENHANCEMENTS

SBIR Awards, 1997-2007: 22

(See Table App-D-3 for details.)

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[9] CG^2 Commercialization Report, accessed at <*http://www.dodsbir.net/submission/CompanyCommercialization/Report.asp?mode=>*.

Fast Track Awards: 1

Phase II Enhancement Awards: 1 (Note: the company reported that it had received a Phase II Enhancement award, but did not identify when the award was received.)

Views on SBIR:

CG^2's Sandra Vaquerizo, the company's designated spokes person for the interview, said, **"**SBIR in general is fantastic. It gives small companies the chance to take on high-risk research. It allows companies to undertake more advanced topics of DoD interest."

Views on Fast Track and Phase II Enhancement Awards:

According to Ms. Vaquerizo, the company has had one Fast Track award and one Phase II Enhancement award. Discussion of Fast Track has reportedly not come up recently in proposal planning.

While the company sees both Fast Track and Phase II Enhancement awards of value, the company sees them as having quite different functions. For small firms trying to avoid the funding gap, it sees Fast Track as most desirable. Ms. Vaquerizo noted, "Although DoD provides a Phase II option to avoid the funding gap, funding from this source is often running months behind, meaning that other sources of bridge funding, such as Fast Track, are quite relevant." Continuing, she said, "Fast Track is better for simpler projects where the research gap is of prime concern, and Phase II Enhancement is better for longer, larger, more complex projects that require more funding to get the R&D to Phase III."

Hyperion Catalysis International Case Study[10]

COMPANY INFORMATION

Address: Hyperion Catalysis International, Inc.
38 Smith Place
Cambridge, MA 02138

Tel: 617-354-9678
Fax: 617-354-9691
Email: info@hyperioncatalysis.com
Web site: *<http://www.hyperioncatalysis.com>*

Year Started: 1982

Ownership: Privately owned corporation

Vice President of Engineering:
James Leacock

Number of Employees:
Earlier Case Study (Approx. 1999): 20
Current Case Study (2007/2008): 60[11]

Company Changes Since Earlier Case Study:

The Company, founded in 1982 to develop novel forms and morphologies of carbon, tripled in size since the earlier case study was done. It has since become a world leader in carbon nanotube development and commercialization.[12] Annual sales in 2007 were reported at $4.7 million.[13] The company continues to conduct research, but has focused its R&D on improving manufacturing process technology for carbon nanotubes and on developing new application areas. As it has grown in size over the past 10 years and developed more product sales, the company has funded its R&D from internal funding

[10]The following informational sources informed this case study: a telephone interview with Dr. James Leacock, vice president of engineering, Hyperion Catalysis International, February 28, 2008; the company's Web site; the company's Dun & Bradstreet report; SBA on-line Tech-net; and on-line Fast Track file.
[11]Company's 2007 Dun & Bradstreet report.
[12]*<http://www.hyperioncatalysis.com>*.
[13]Company's 2007 Dun & Bradstreet report.

sources. It has shifted away from defense applications to applications in civilian markets.

TECHNOLOGY, APPLICATIONS, AND COMMERCIALIZATION

Technology Focus:

Earlier Case Study (Approx. 1999): Novel forms and morphologies of carbon

Current Case Study (2007/2008): Carbon nanotube technology, carbon and graphite products

Application Areas:

Earlier Case Study (Approx. 1999): Ultracapacitors based on nano-fiber electrodes for hybrid electric vehicles and military systems

Current Case Study (2007/2008): Plastic parts for automotive, electronics, and emerging application areas including flat-panel displays, advanced batteries and fuel cells, and plastic reinforcement.

Commercialization of Technology:

According to Dr. Leacock, the earlier Fast Track award did not lead to successful commercialization or take-up by defense agencies. However, out of its larger carbon nanotube R&D efforts, the company has developed and commercialized a flagship technology: a conductive, vapor grown, multi-walled carbon nanotube, called FIBRIL™ nanotube. FIBIL nanotubes are reportedly being used commercially to make high performance conductive plastics for applications requiring demanding performance. Indicative of the company's continuing pursuit of commercialization and growth, it had at the time of the case update job postings for three business development managers—for the automotive industry, semiconductor industry, and catalyst support.

SBIR, FAST TRACK, AND PHASE II ENHANCEMENTS

SBIR Grants, 1996-2007: 3
(See Table App-D-4 for details.)

Fast Track Awards: 1

Phase II Enhancement Awards: 0

Views on SBIR:

Given that the company has received no SBIR awards since 1997, Dr. Leacock, the company's Vice President for Engineering, was reaching back in memory to recall Hyperion Catalysis' experience with the SBIR program. As he

recalled, the company's experience with the program was satisfactory and there were no problems. At the same time, he said, the awards were very difficult to obtain and required substantial company time to work through the process. Subsequently, the company has pursued no further participation in the program, but was not ruling it out for the future.

Views on Fast Track:

According to Dr. Leacock, the Fast Track award worked well. However, the company was disappointment that it was not successful with follow-on efforts to apply the technology in the intended defense applications.

Matis, Inc.
Case Study[14]

COMPANY INFORMATION

Address: Matis, Inc.
1255 Biltmore Dr. NE
Atlanta, GA 30329

Telephone: 404-248-9821
Fax: 404-248-0154
E-mail: matis@matis.net
Web site: <*http://www.matis.net*>

Year Started: 1990

Ownership: Privately owned, woman-owned corporation

President: Elena Matis-Oliker

Number of Employees:
Earlier Case Study (Approx. 1999): 5
Current Case Study (2007/2008): 12

Company Changes Since Earlier Case Study:

The company was started by its officers in 1990, in response to U.S. defense-related scientific computing needs. It appears since to have broadened its client base from DoD to include private industry. While it continues to be small, it has more than doubled its number of employees over the past 10 years—from 5 to 12. The company continues to work closely with the academic community, and collaborates with mathematicians, physicists, computer scientists, and software engineers from the United States, Germany, Israel, and Russia. The company's slogan is "mathematical models and algorithms turned into software."

[14]The following informational sources informed this case study: a telephone discussion with Elena Matis-Oliker, company founder/owner/president, followed by an email response to questions asked, February 13, 2008; the company Web site; Dun & Bradstreet company report; SBA on-line Tech-net; and on-line Fast Track file.

TECHNOLOGY, APPLICATIONS, AND COMMERCIALIZATION

Technology Focus:

Earlier Case Study (Approx. 1999): Software tools, simulation
Current Case Study (2007/2008): Software tools, mathematical models, computer aided design, scientific computing, optimization methods, 3D visualization

Application Areas:

Earlier Case Study (Approx. 1999): Simulation of environment of antenna systems on aircraft and ships
Current Case Study (2007/2008): Simulation of environment of antenna systems on aircraft, ground vehicles, and ships; rapid prototyping, medical imaging

Commercialization of Technology:

The company offers several products. DOVA (Diffraction Over Virtual Airframe) uses high-frequency and differential geometric techniques to compute radiation patterns of platform-mounted antennas. GeomFix is described as a toolbox for fixing geometry of surface models. It can be used to convert an existing CAD model into a model suitable for engineering analysis and computations, to construct new models, and to fix deficiencies in models. Matis also offers services. One service is to transform real life geometries of clients into models suitable for rapid prototyping, medical imaging, electromagnetic computations, computational fluid dynamics, and engineering analysis and computations. Another service for clients is to compute antenna radiation patterns

SBIR, FAST TRACK, AND PHASE II ENHANCEMENTS

SBIR Grants, 1996-2007: 2
(See Table App-D-5 for details.)

Fast Track Awards: 1

Phase II Enhancement Awards: 0

Views on SBIR:

According to the company's president**,** receiving the SBIR awards promoted growth and helped it to generate revenues. This reference is to the 1996 Phase I and 1997 Phase II Fast Track award—the only SBIR awards received by the company during the period examined.

Views on Fast Track and Phase II Enhancement Awards:

While the company found its experience with Fast Track "satisfactory," it did not find the Fast Track aspect of the award it received in 1997 to be very significant. It has had no experience with Phase II Enhancement awards. According to the company's president, to obtain funds for new and innovative research and development, it would consider proposing again to the SBIR program—including proposals both for Fast Track and for a Phase II Enhancement award.

OPTS, INC.
CASE STUDY[15]

Note: The company was not located.

COMPANY INFORMATION

Last Address Found:

Optical Processing Technology & Systems (Opts) Inc.
2302 Triana Blvd SW
Suite B
Huntsville, AL 35805

Telephone: 256-883-2911 (Disconnected)

Year Started: 1994

Ownership: Privately owned corporation, majority owned by founder

Number of Employees:

Earlier Case Study (Approx. 1999): 5
Last D&B Report in 2003: 9
Current Case Study (2007/2008): unavailable, assumed to be 0

Company Changes Since Earlier Case Study:

The company could not be located. The company's Dun & Bradstreet report was last revised in 2003. That report noted that in 2001 a chapter eleven bankruptcy filed in U.S. bankruptcy court, Decatur, AL, was dismissed. Corporate and business registrations were reported as of May 2007, but on-line searching and calls to telephone numbers listed in the past for the company failed to locate the company.

TECHNOLOGY, APPLICATIONS, AND COMMERCIALIZATION

Technology Focus:

Earlier Case Study (Approx. 1999): Hardware to enhance images for missile targeting
Last D&B Report 2003: Computer systems design

[15]The following informational sources informed this case study: Dun & Bradstreet company report; SBA on-line Tech-net; and on-line Fast Track file.

Application Areas:

Earlier Case Study (Approx. 1999): U.S. defense-related missile targeting

Last D&B Report 2003: Computer integrated systems for commercial and industrial applications

Commercialization of Technology: No information was obtained

SBIR, FAST TRACK, AND PHASE II ENHANCEMENTS

SBIR Grants, 1996-2007: 4

(See Table App-D-6 for details.)

Fast Track Awards: 1

Phase II Enhancement Awards: 0

Views on SBIR: No information was obtained.

Views on Fast Track and Phase II Enhancement Awards: No information was obtained.

Picolight Incorporated Case Study[16]

COMPANY INFORMATION

Company Status: In 2007, Picolight was acquired by JDS Uniphase Corporation.

Address: Former Picolight Incorporated
1480 Arthur Avenue
Louisville, CO 80027

is now the Colorado location (at the above address) of

JDS Uniphase Corporation
430 N. McCarthy Boulevard
Milpitas, CA 95035

Tel: 303-530-3189 (Colorado location)
Fax: 303-527-7419 (Colorado location)

Web sites: *<http://www.picolight.com>*
(Picolight's Web site was still accessible as of 2-29-08)
<http://www.jdsu.com>

Year Started: 1995 (Picolight)

Ownership: Privately owned, venture-funded corporation prior to its acquisition in 2007 by JDS Uniphase Corporation (JDSU), a publicly held, large corporation (NASDAQ: JDSU)

Founder and CTO of Picolight Prior to its Acquisition: Jack Jewell

Number of Employees:
Earlier Case Study (Approx. 1999): 26 (Picolight, Inc., only)
Current Case Study (2007/2008): 95 (current number at the former Picolight location of JDSU)

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[16]The following informational sources informed this case study: a telephone interview conducted February 29, 2008, with Dr. Jack Jewell, chief technical officer (CTO) of Picolight, Incorporated, prior to the company's acquisition by JDSU; the still-accessible Web site of Picolight; JDSU's Web site; a press release announcing the acquisition of Picolight by JDS Uniphase; Dun & Bradstreet company report; SBA on-line Tech-net; and on-line Fast Track file.

Company Changes Since Earlier Case Study:

At the time of the earlier case study, it was noted that Picolight was one of several of the SBIR case-study firms that had already identified clients and firm clusters its products would serve. In addition, Picolight was called out in the earlier case as a having generated additional investment far exceeding the SBIR contract amount and the required third-party Fast track match. The company obtained funding from leading venture capital companies. Subsequently, Picolight achieved four-fold growth by developing and commercializing its technology prior to its acquisition by JDSU in May of 2007. JDSU is a large company with approx. $400 million in quarterly revenue,[17] and a leader in broadband and optical innovation.

TECHNOLOGY, APPLICATIONS, AND COMMERCIALIZATION

Technology Focus:

Earlier Case Study (Approx. 1999): Vertical cavity surface-emitting laser (VCSEL) technology

Current Case Study (2007/2008): VCSEL-based optical pluggable transceivers and component technologies

Application Areas:

Earlier Case Study (Approx. 1999): Switches and routers for communications applications

Current Case Study (2007/2008): High-speed optical interconnects for switches and routers for communication systems requiring high data rates, low power consumption, and high reliability, including enterprise networks, data centers, campuses, and metro networks

Commercialization of Technology:

Picolight's founder and Chief Technical Officer, Jack Jewell, is a recognized pioneer in the development and commercialization of the company's vertical cavity surface-emitting laser (VCSEL) technology. VCSELs are semiconductor lasers that emit light vertically through the surface of a wafer rather than through its edges.

Prior to its acquisition by JDSU, Picolight had successfully commercialized its VCSEL-based technology platform, and was offering a family of VCSEL-based optical transceivers and components to link network elements. Although the company did not sell its devices directly to DoD, Mr. Jewell thinks DoD likely is using its devices, secured through other clients of Picolight.

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[17]JDSU Press Release, "JDSU Completes Acquisition of Picolight," May 29, 2007; *BARRON'S, Tech Trader Daily*, "JDSU Beats the Street," February 5, 2008; and JDSU's Web site, <*http://www.jdsu.com*>.

According to a company marketing brochure, at the time of its acquisition, Picolight had a rapidly expanding customer base, and, as of mid-2005, had shipped in excess of four million VCSEL-based devices to its customers—primarily communications companies in the United States and abroad, the latter reached through an international network of partners.[18] Picolight's acquisition by JDSU—with its optical communications business segment—brings a vertically integrated manufacturing model that may foster the further commercial development of VCSEL products.

SBIR, FAST TRACK, AND PHASE II ENHANCEMENTS

SBIR Grants, 1996-2007: 17
(See Table App-D-7 for details.)

Fast Track Awards: 2

Phase II Enhancement Awards: 0

Views on SBIR:

In the words of Dr. Jewell, Picolight founder, the SBIR program is "excellent" and "it works." He described how he built the foundation of his company's device technologies—and his company—from SBIR awards. Table App-D-7 shows the intensity of SBIR funding between 1996 and 2000, when he was building the company's technical base.

To get the most out of the SBIR program, Dr. Jewell emphasized that a company should align its SBIR proposals with its business goals and stay focused, as he had done. He noted, in contrast, that some companies make a mistake of chasing in scattered directions depending on whatever SBIR topics are posted. By seeking only funding that was compatible with his company's goals, Dr. Jewell was successful—after six Phase II SBIRs—in building a technology base and a company with products for sale.

Views on Fast Track:

According to Dr. Jewell, Fast Track was very helpful to him in securing his second angel round of investment. It was Fast Track's leveraging of third-party funding that he found most attractive about the program—rather than its help in bridging between Phase I and Phase II funding. He explained that Fast Track gave him a persuasive case to make with potential investors that enabled him to leverage the SBIR award into a much larger investment.

[18]Picolight marketing brochure, available as of February 21, 2008, at <*http://www.picolight.com/UserFiles/PDF/corp_brochure.pdf*>.

Power Technology Services (PTS), Inc, Case Study[19]

Note: The Company did not provide an interview

COMPANY INFORMATION

Addresses: Power Technology Services (PTS), Inc.
7800 Netherlands Dr.
Raleigh, NC 27502

Tel: 919-362-1501

Email: ptsco@mindframe.net

Web site: none found

Year Started: 1984 [Source: previous case study]; 1992 [Source: 2007 Dun & Bradstreet]

Ownership: Privately owned corporation

President: John Driscoll

Number of Employees:
Earlier Case Study (Approx. 1999): 5
Current Case Study (2007/2008): 6

Company Changes Since Earlier Case Study:
The company appears to have changed little since the last case study was done. It continues as a very small firm, operating as a group of engineers and consultants, with a focus on research, development, and manufacture of specialty semiconductors.

TECHNOLOGY, APPLICATIONS, AND COMMERCIALIZATION

Technology Focus:
Earlier Case Study (Approx. 1999): Research of double-sided flip chips

[19]The following informational sources informed this case study: Dun & Bradstreet company report; SBA on-line Tech-net; and on-line Fast Track file. The company did not respond to requests for a telephone interview.

Current Case Study (2007/2008): Research, development, and manufacturing of semiconductors

Application Areas:

Earlier Case Study (Approx. 1999): Hybrid electric power systems for military electric tanks

Current Case Study (2007/2008): No information obtained

Commercialization of Technology: No information obtained

SBIR, FAST TRACK, AND PHASE II ENHANCEMENTS

SBIR Grants, 1996-2007: 7

(See Table App-D-8 for details.)

Fast Track Awards: 1

Phase II Enhancement Awards: 0

Views on SBIR: No information obtained

Views on Fast Track and Phase II Enhancement Awards: No information obtained

Summitec Corp
Case Study[20]

COMPANY INFORMATION

Address: Summitec Corp
12129 Broadwood Drive
Knoxville, TN 37934-4688

Tel: 865-671-7552

Fax: 865-671-2550

E-mail: ayin@summitec.com

Web site: *<http://www.summitec.com>*
(under construction as of February 2008)

President: Dr. C. F. Andrew Yin

Summitec ownership:
Privately owned, woman-owned, minority-owned corporation

Certifications: 8(a) (expired)

Year Started: 1987

Number of Employees:
Earlier Case Study (Approx. 1999): 19
Current Case Study (2007/2008): 2 FT; 28 PT

Company Changes Since Earlier Case Study:

According to the company president, Dr. Andrew Yin, the company changed directions and stopped working in research areas for which SBIR grants were available. The timing of the topic of the previous case study—transmission of video images over narrow bandwidth—seemed, in the opinion

[20]The following informational sources informed this case study: a telephone interview with C. F. Andrew Yin, February 13, 2008; Dun & Bradstreet company report; SBA on-line Tech-net; and on-line Fast Track file; SBA profile at *<http://dsbs.sba.gov/dsbs/search/dsp_profile.cfm?User_Id=PN104302>*.

Dr. Yin, too far in advance of the market at the time the project was completed. Rather than continue pursuit of that technology, the company dropped its research focus and began providing technical support services to government agencies.

TECHNOLOGY, APPLICATIONS, AND COMMERCIALIZATION

Technology Focus:

Earlier Case Study (Approx. 1999): Compression-like software for transmission of video images over narrow bandwidth

Current Case Study (2007/2008): Technical services in information technology

Application Areas:

Earlier Case Study (Approx. 1999): Video communication for surveillance of bombing targets

Current Case Study (2007/2008): Technical services for government agencies

Commercialization of Technology:

Summitec did not commercialize its SBIR-sponsored technology for transmitting video images. Instead, the company shifted its business focus to providing technical services to government agencies—currently the U.S. Department of Energy.

SBIR, FAST TRACK, AND PHASE II ENHANCEMENTS

SBIR Grants, 1996-2007: 2

(See Table App-D-9 for details.)

Fast Track Awards: 1

Phase II Enhancement Awards: 0

Views on SBIR:

According to the company president, Dr. Yin, the SBIR program "works okay." Rather than problems with the SBIR, it was changing conditions with the company and a change in business focus that caused the company not to submit further proposals to SBIR following the Fast Track award in 1997.

Views on Fast Track and Phase II Enhancement Awards:

The company has had one Fast Track award and no Phase II Enhancement awards. According to Dr. Yin, the company was satisfied with its Fast Track experience, but due to changes in the business since that time does

not expect to propose for additional SBIR-, Fast Track-, or Phase II Enhancement awards.

Synkinetics, Inc., Case Study[21]

Note: The company did not provide an interview.

COMPANY INFORMATION

Address: Synkinetics, Inc.
5 Whittier Street
Framingham, MA 01701

Tel: 508-879-2400

Fax: 508-879-2433

Email: info@synk.com

Web site: *<http://www.synk.com>*

Year Started: 1982 according to previous case study; given on Web site as early 1990s; left blank in D&B

Ownership: Privately owned corporation

CEO: Kent George

Number of Employees:
Earlier Case Study (Approx. 1999): 8
Current Case Study (2007/2008): 2 (2007 Dun & Bradstreet report)

Company Changes Since Earlier Case Study:
The company was a spin-off company of MIT's Lincoln Laboratory in the early 1980s, founded to develop and commercialize ideas developed at the Laboratory. No additional information was obtained.

[21]The following informational sources informed this case study: the company Web site; Dun & Bradstreet company report; SBA on-line Tech-net; and on-line Fast Track file. The company did not respond to requests for a telephone interview.

TECHNOLOGY, APPLICATIONS, AND COMMERCIALIZATION

Technology Focus:

Earlier Case Study (Approx. 1999): Precision drive mechanism
Current Case Study (2007/2008): SYNKdrive® technology

Application Areas:

Earlier Case Study (Approx. 1999): Fuel efficiency of vehicles
Current Case Study (2007/2008): Fuel efficiency of marine and vehicle equipment; for use in hybrid transmissions, aerospace drive trains, and agriculture equipment

Commercialization of Technology:

According to its Web site, the company has a number of strategic partners and affiliates in the development of its SYNKdrive® technology.

SBIR, FAST TRACK, AND PHASE II ENHANCEMENTS

SBIR Grants, 1994-2007: 5
(See Table App-D-10 for details.)

Fast Track Awards: 1

Phase II Enhancement Awards: 0

Views on SBIR: No information was obtained

Views on Fast Track and Phase II Enhancement Awards: No information was obtained

Yardney Technical Products, Inc., Case Study[22]

COMPANY INFORMATION

Address: Yardney Technical Products (YTP), Inc.
82 Mechanic St. Ste 2
Pawcatuck, CT 06379

Tel: 860-599-1100

Email: Lois@yardney.com (Secretary of Company President, Mr. Yevoli)

Web site: *<http://www.yardney.com>*

Year Started: 1944 as Yardney Electric Corporation

Ownership: Privately owned corporation with a parent holding company

President/COO: Vincent Yevoli, Jr.

Number of Employees:
Earlier Case Study (Approx. 1999): 155
Current Case Study (2007/2008): 150[23]

Company Changes:

The Company already had a long history at the time of the earlier case study. It was founded in 1944 under a different name (Yardney Electric Corporation) and in a different location (New York City). It was acquired by the Whittaker Corporation in 1969, and moved to its present location (Pawcatuck, CT) in 1970. Then in 1990, the company was acquired by the company's present CEO, Richard Scibelli, from within Whittaker and the corporate name was changed to its current name. In 1995 a holding company, Ener-Tek International, was formed and became the parent company of Yardney. Throughout its history, the company has consistently focused on battery technology, but has shifted emphasis on the type of battery, moving from

[22]The following informational sources informed this case study: a telephone interview with Vince Yevoli, Yardney president and chief operating officer; the company Web site; Dun & Bradstreet company report; SBA on-line Tech-net; and on-line Fast Track file.
[23]2007 Dun and Bradstreet report.

lithium thionyl-chloride and nickel battery product lines to lithium-ion battery technology, while maintaining its silver-zinc battery technology.

TECHNOLOGY, APPLICATIONS, AND COMMERCIALIZATION

Technology Focus:

Earlier Case Study (Approx. 1999): Rechargeable batteries for defense applications

Current Case Study (2007/2008): High energy density batteries for defense applications

Application Areas:

Earlier Case Study (Approx. 1999): Defense missions requiring high performance batteries

Current Case Study (2007/2008): Air, land, sea, and space applications needing high performance battery systems, including aircraft, directed energy weapons, DoD radios, medical electronics, medical implants, missiles, professional cameras, robotics, spacecraft, unmanned combat vehicles, and other support applications

Commercialization of Technology:

The Company's SBIR awards have enhanced its battery research—particularly its Li-ion battery research in recent years—and the enhancements have gone directly into improving the performance of batteries supplied for use in aerospace and defense applications. The company maintains a small production line to meet its customers' specialized needs. It works in cooperation with the Department of Defense, NASA, and major defense contractors—including Boeing, Lockheed Martin, and others—to provide batteries used in such programs as Minuteman III ICBM, Delta II/IV, and Atlas V, the Mars Explorer Rover missions, the USAF B-2 Bomber and Global Hawk aircraft, and the U.S. Navy Advanced Seal Delivery System.[24] Annual sales are reported at $20 million in the company's 2007 Dun & Bradstreet report.

SBIR, FAST TRACK, AND PHASE II ENHANCEMENTS

SBIR Grants, 1991-2007: 56

(See Table App-D-11.)

SBIR Phase I: 39

SBIR Phase II: 15

[24] <*http://www.yardney.com*>.

Fast Track Awards: 1

Phase II Enhancement Awards: 1

Views on SBIR:
Yardney's President and COO, Vince Yevoli, said that the SBIR program has been particularly important in boosting the R&D program of this long established, on-going company. According to him, the SBIR program enabled Yardney to build its Li-ion battery capabilities from scratch, and to get the resulting high-performance battery systems into government applications with little delay. In summary, he listed three ways in which the SBIR program had been invaluable to Yardney: (1) It had provided the basis for establishing the company's Li-ion battery technology; (2) it had enabled the company to maintain a research group on a sustained basis; and (3) it had provided a path for implementing research results directly into production and application.

When asked how the SBIR program might be improved, Mr. Yevoli responded that the research-funding power of a Phase I award has badly eroded with time and an increase is needed to ensure that this award continues to serve its intended purpose.

Views on Fast Track and Phase II Enhancement:

Although the company's Fast Track award has been sufficiently long ago that there was little specific memory of the experience, Mr. Yevoli was willing to discuss both Fast Track and the Phase II Enhancement awards. He noted that the reason the company had not proposed for either of these awards in recent years was that its business model had not included seeking third-party financing for its technology implementations. Rather, it had followed the practice of self-financing the move of enhanced performance capabilities directly into its current product line and directly supplying its products to aerospace and defense customers. However, Mr. Yevoli could see a potential future interest of the company in Fast Track and third-party financing. He emphasized that the faster funding feature of Fast Track which keeps researchers employed between Phases I and II is of greater interest to his company than the larger funding amounts offered by Phase II Enhancement.

TABLE App-D-1 Ten Fast Track Companies Identified for Update: Their Location, Ownership, Founding Date, Technology, Number of Employees, and Number of SBIR Awards Received

Fast Track Companies Selected for Update	Location	Ownership and Change in Ownership Since 1998	Founding Date	Technology		Number of Employees		Number of SBIRs (Period Received)
				1998	2008	1998	2008	
Advanced Processing Technology (AvPro), Inc.	Norman, OK	Privately owned small corp; no change	1990	Processing science and control systems for composites	Advanced process control and equipment management	10	7	4 (1994-1997)
CG^2, Inc.	Huntsville, Al	Privately owned small corp; acquired by Quantum3D, San Jose, CA, also a priv. owned small corp.	1995	Virtual reality scene generation	Software products and services for 3D graphics visualization	15	12 of 100 total	22 (1997-2007)
Hyperion Catalysis Intnat'l.	Cambridge, MA	Privately owned small corp; no change	1982	Novel forms and morphologies of carbon	Carbon nanotube technology, carbon and graphite products	20	60	3 (1996-1997)

continued

TABLE App-D-1 Continued

Fast Track Companies Selected for Update	Location	Ownership and Change in Ownership Since 1998	Founding Date	Technology		Number of Employees		Number of SBIRs (Period Received)
				1998	2008	1998	2008	
Matis, Inc.	Atlanta, GA	Privately owned small, woman-owned corp; no change	1990	Software tools, simulation	Software tools, mathematical models, computer aided design, scientific computing, etc.	5	12	2 (1996-1997)
Opts, Inc.	Huntsville, AL	Privately owned small corp; appears to have gone out of business	1994	Hardware to enhance images for missile targeting	Computer systems design (2003)	5	9 (2003); 0 (2008)?	4 (1996-1997)
Picolight, Inc.	Louisville, CO	Privately owned, venture-funded small corp; acquired by JDS Uniphase Corp.,	1995	Vertical cavity surface-emitting laser (VCSEL) technology	VCSEL-based optical pluggable transceivers and component technologies	26	95 of 1,000s total	17 (1996-2000)

		Milpitas, CA, a publicly held large corp						
Power Technology Services (PTS), Inc.	Raleigh, NC	Privately owned small corp; no change	1984/ 1992*	Double-sided flip chips	R&D and manufacture of semiconductors	5	6	7 (1996-2005)
Summitec Corp.	Knoxville, TN	Privately, woman- & minority-owned small corp; no change in ownership	1987	Compression-like software for transmission of video images over narrow bandwidth	Technical services in information technology; a change in focus away from R&D	19	2 FT & 28 PT	2 (1996-1997)
Synkinetics, Inc.	Framingham, MA	Privately owned small corp; no change	1982/ early 1990s**	Precision drive mechanism	SYNKdrive®	8	2	5 (1994-2000)

continued

TABLE App-D-1 Continued

Fast Track Companies Selected for Update	Location	Ownership and Change in Ownership Since 1998	Founding Date	Technology		Number of Employees		Number of SBIRs (Period Received)
				1998	2008	1998	2008	
Yardney Technical Products, Inc.	Pawcatuck, CT	Privately owned corporation with a parent holding company; no change	1944	Rechargeable batteries for defense applications	Batteries (particularly Li-ion) for defense applications	155	150	56 (1991-2007

NOTE: *1984 was given as the founding date by the previous case study; 1992 was given by the company's 2007 Dun & Bradstreet report; **1982 was given as the founding date by the previous case study; early 1990s is given at the company's Web site.

TABLE App-D-2 AvPro's SBIR Awards, 1994-2007

Award Year	Agency	Total SBIR (Number)	Phase I (Number)	Phase II (Number)	Phase II-Fast Track (Number)	Phase II-Enhancement (Number)	Title
1994 1995	DoD AF	2	1	1	0	0	Fiber Optic Raman Sensors for the Remote Determination of Composite Chemical Characteristics
1996 1997	DoD AF	2	1	1	1	0	Low Cost Curing and Repair Process for Composites
Totals		4	2	2	1	0	

TABLE App-D-3 CG[2]'s SBIR Awards, 1997-2007

Award Year	Agency	Total SBIR (Number)	Phase I (Number)	Phase II (Number)	Phase II-Fast Track (Number)	Phase II-Enhancement (Number)	Title
1997	DoD Army	2	1	1	1		Virtual Reality Scene Generation by Means of Open Standards
2002	DoD Navy	4	2	2	0		▪ Material Encoded Textures with Computer Generated Forces ▪ Personal Computer Graphics Support for Texel Level Sensor Simulation
2003	DoD ▪ AF ▪ Army ▪ Army ▪ MDA	4	4	0	0		▪ PC Based Dynamic Real-Time Infrared Image Generation Capacity ▪ PC Based Real-Time Infrared/Millimeter Wave Scene Generator ▪ Scene Management for Complex

						Environments ▪ Advanced Scene Generation Techniques
						▪ Military 3-D Visualization Utilizing Gaming Technology ▪ New Modeling and Simulation Technology for Night Vision Goggle Mission Rehearsal ▪ Infrared/Millimeter Wave Scene Generator ▪ Advanced Scene Generation Techniques
2004	DoD	4	2	2	0	
	▪ Army					
	▪ Navy					
	▪ Army					

continued

TABLE App-D-3 Continued

Award Year	Agency	Total SBIR (Number)	Phase I (Number)	Phase II (Number)	Phase II-Fast Track (Number)	Phase II-Enhancement (Number)	Title
2005	DoD	4	3	1	0		▪ PC Scene Generation Bridge Architectures for Streaming Balanced Computation ▪ Light Detection and Ranging (LIDAR) Surface Feature Extraction Tool ▪ New Weather Depiction Technology for Night Vision Goggle (NVG) Training ▪ Military 3D Visualization Utilizing Gaming Technology
	▪ MDA						
	▪ Navy						
	▪ Navy						
	▪ Army						
2006	DoD	2	1	1	0		New Weather Depiction Technology for Night Vision Goggle (NVG) Training

2007	DoD ▪ Navy	2	0	2	0		▪ Surface Feature Extraction Tools Using LIDAR Data ▪ Enabling Cross-Domain Exploitation of a Common Geospatial Database
Totals		23*	13	9	1	1 (year not identified)	

NOTE: *According to the company, it has received a Phase II Enhancement award. However, the year was not identified, and it is not included in the year-by-year data.

TABLE App-D-4 Hyperion Catalysis's SBIR Awards, 1996-2007

Award Year	Agency	Total SBIR (Number)	Phase I (Number)	Phase II (Number)	Phase II-Fast Track (Number)	Phase II-Enhancement (Number)	Title
1996	DoD	2	1	1	1	0	Ultracapacitors Based on Nano-fiber Electrodes
1997	MDA						
1997	DoD DARPA	1	1	0	0	0	Affordable Nanotube Based "Molecular Composites"
Totals		3	2	1	1	0	

TABLE App-D 5 Matis' SBIR Awards, 1997-2007

Award Year	Agency	Total SBIR (Number)	Phase I (Number)	Phase II (Number)	Phase II-Fast Track (Number)	Phase II-Enhancement (Number)	Title
1996	DoD AF	1	1	0	0	0	A Novel Computational System for Real-Time Analysis and Prediction
1997	DoD AF	1	0	1	1	0	of An Virtual Reality Scene Generation by Means of Open Standards
Totals		2	1	1	1	0	

TABLE App-D-6 Opts' SBIR Awards, 1996-2007

Award Year	Agency	Total SBIR (Number)	Phase I (Number)	Phase II (Number)	Phase II-Fast Track (Number)	Phase II-Enhancement (Number)	Title
1996	NASA	2	1	1	0	0	Adaptive Compression Network
1997							
1997	DoD Army	2	1	1	1	0	Imaging Automatic Gain Control for Target Acquisition, Automatic Target Recognition and Tracking
Totals		4	2	2	1	0	

TABLE App-D-7 Picolight's SBIR Awards, 1996-2007

Award Year	Agency	Total SBIR (Number)	Phase I (Number)	Phase II (Number)	Phase II-Fast Track (Number)	Phase II-Enhancement (Number)	Title
1996 1997	DoD MDA	2	1	1	0	0	Wide-Angle Resonant Cavities for Superior Light Emitters
1996 1997	DoD MDA	2	1	1	0	0	Controlled Oxide Vertical-Cavity Surface-Emitting Lasers with Latreal Oxidation Barriers
1996 1997	DoD MDA	2	1	1	1	0	Long-Wavelength Oxide Vertical-Cavity Surface Emitting Lasers
1997	DoD DARPA	1	1	0	0	0	Multiple-Long-Wavelength Vertical-Cavity Surface-Emitting Laser Arrays
1997	DoD MDA	1	1	0	0	0	Advanced Epitaxial Growth of Extended-Performance Semiconductor Lasers

continued

TABLE App-D-7 Continued

Award Year	Agency	Total SBIR (Number)	Phase I (Number)	Phase II (Number)	Phase II-Fast Track (Number)	Phase II-Enhancement (Number)	Title
1997 1999	DoD MDA	2	1	1	0	0	Fiber-to-the-Desk Laser Transmitters and Receivers
1997 1998	DoD Navy	2	1	1	1	0	Stable Single Mode Oxide Vertical Cavity Surface Emitting Lasers
1997	HHS	1	1	0	0	0	On-Airway-Ideal Spectroscopic Sensor for Carbon Dioxide
1998	DoD MDA	1	1	0	0	0	Passively Aligned Single-Mode VCSEL Transceivers
1999	DoD MDA	1	1	0	0	0	High-Performance 1550nm Vertical-Cavity Surface-Emitting Lasers
1999 2000	DoD Navy	2	1	1	0	0	Viable 2.5-10 GHz 1300nm VCSEL Arrays
Totals		17	11	6	2	0	

TABLE App-D-8 PTS's SBIR Awards, 1996-2007

Award Year	Agency	Total SBIR (Number)	Phase I (Number)	Phase II (Number)	Phase II-Fast Track (Number)	Phase II-Enhancement (Number)	Title
1996	DoD	2	1	1	1	0	A New Dual-Gated DMCT for Hybrid Electric Power Systems
1997	DARPA						
2002	DoD	2	1	1	0	0	Novel High Current Switch for Spacecraft Power Bus Control
2003	AF						
2002	DoD	2	1	1	0	0	Thermionic Converters Based on Nanostructured Carbon Materials
2004	OSD						
2005	DoD	1	1	0	0	0	Cold Cathode for Traveling Wave Tubes
	AF						
Totals		7	4	3	1	0	

TABLE App-D-9 Summitec's SBIR Awards, 1996-2007

Award Year	Agency	Total SBIR (Number)	Phase I (Number)	Phase II (Number)	Phase II-Fast Track (Number)	Phase II-Enhancement (Number)	Title
1996	DoD	2	1	1	1	0	Very Low Bit-Rate Error-Resilient Video Communication
1997	Navy						
Totals		2	1	1	1	0	

TABLE App-D-10 Synkinetics' SBIR Awards, 1994-2007

Award Year	Agency	Total SBIR (Number)	Phase I (Number)	Phase II (Number)	Phase II-Fast Track (Number)	Phase II-Enhancement (Number)	Title
1994 1996	DoD DARPA	2	1	1	0	0	Precision Speed Reducer for Robotics and Manufacturing
1996 1997	DoD MDA	2	1	1	1	0	High Precision Gimbal Systems
2000	DoD Navy	1	1	0	0	0	
Totals		5	3	2	1	0	

TABLE App-D-11 Yardney's SBIR Awards, 1991-2007

Award Year	Agency	Total SBIR (Number)	Phase I (Number)	Phase II (Number)	Phase II-Fast Track (Number)	Phase II-Enhancement (Number)	Title
1991	DoD	2	1	1	0	0	Development of Silver-Zinc Cells of Improved Life and Energy Density
1993	Navy						
1993	DoD	1	1	0	0	0	Lithium-ion Rechargeable Battery System with Sulfur-Dioxide-Based Electrolyte
1997	NASA						
1993	NASA	1	1	0	0	0	High-Energy-Density, Rechargeable, Nickel-Zinc Cells with Improved Cycle Life
1994							
1994	DoD	1	1	0	0	0	Improvement of High Power Silver-Zinc Rechargeable Batteries for Underwater Vehicles
	Navy						
1994	DoD	2	1	1	0	0	High Rate Bipolar Lithium/Thionyl Cloride Power Source for Missile Guidance
1996	Navy						

1995	DoD	2	1	1	0	0	Low Cost, High Rate, High Energy Density Lithium-Ion Batteries
1996	AF						
1996	DoD DARPA	1	1	0	0	0	Development of a Synergetic Battery Pack (SBP)
1996	DoD	2	1	1	0	0	Advanced Development Program for a Lightweight, Rechargeable "AA" Zinc-Air Battery
1997	OSD						
1996	DoD	2	1	1	1	0	Low Cost, Lightweight, Rechargeable Lithium-ion Batteries
1997	OSD						
1997	DoD Army	1	1	0	0	0	Exploratory Development of Novel Manganese Oxide Cathode Materials for High Performance Lithium-ion Batteries
1997	NASA	1	1	0	0	0	A High Cycle Life, High Energy Density Battery Using A Metal Oxide Anode Material

continued

TABLE App-D-11 Continued

Award Year	Agency	Total SBIR (Number)	Phase I (Number)	Phase II (Number)	Phase II-Fast Track (Number)	Phase II-Enhancement (Number)	Title
1997 1998	NASA	2	1	1	0	0	A High Performance Lithium Battery Using An Alloy Anode
1998	DoE	1	1	0	0	0	A Mixed Metal Oxide Anode Material for High Energy Density Li-ion Batteries
1999 2000	DoD AF	2	1	1	0	0	Thin Film, Flexible Space Battery
1999	NASA	1	1	0	0	0	A Mixed Oxide Negative Electrode Material for Li-ion Batteries
2000 2001	DoD Army	2	1	1	0	0	Tin Based Negative Electrode Materials
2000	NASA	2	1	1	0	0	Title not found
2001	DoE	1	1	0	0	0	Intermediate Temperature Solid Oxide Fuel Cell Development

2002	DoE	1	1	0	0	The Development of a Polyvlent Battery System
2002	DoE	1	1	0	0	The Development of a Low-Cost Separator with Improved Performance
2002	DoD	2	1	1	0	Development of a Novel, Thin Film Lithium-ion Battery Technology
2003	MDA					
2002	DoD	2	1	1	0	Development of Onboard Power Sources for Interceptor Missiles
2003	MDA					
2003	DoD	3	1	1	1	An Ultra-lightweight Lithium Air Battery for Unmanned Air Vehicles
	AF					
2003	DoD	1	1	0	0	Advanced High Energy Batteries
	Army					
2003	DoD	2	1	1	0	Innovative Manufacturing Processes
2004	MDA					

continued

TABLE App-D-11 Continued

Award Year	Agency	Total SBIR (Number)	Phase I (Number)	Phase II (Number)	Phase II-Fast Track (Number)	Phase II-Enhancement (Number)	Title
2003	DoD Navy	1	1	0	0	0	Aluminum-Air Fuel Cell/Battery Research
2004	DoD Army	2	1	1	0	0	Lithium-Air Technology
2004	DoD MDA	1	1	0	0	0	Ballistic Missile System Innovative Power Storage Devices
2004	DoD Navy	1	1	0	0	0	Assessing Useful Remaining Life of Li-ion Batteries after Deep Discharges
2005	DoE	1	1	0	0	0	Low Temperature Performance of Li-ion Batteries
2005	DoD Navy	1	1	0	0	0	Pressure Tolerant Power Source for Off-Board Sensor
2006	DoE Navy	1	1	0	0	0	State-of-Charge Technology for Zn-air Battery Systems

2006	DoD Army	1	1	0	0	0	New and Improved Nonaqueous Electrolyte Components—Salts & Solvents
2006	DoD OSD	1	1	0	0	0	Innovative Lightweight Metal-Air Cell Cases for Non-Rechargeable Batteries
2007	DoD MDA	1	1	0	0	0	A Phase I SBIR Proposal to Lower the Cost and Improve the Manufacturing of Li-ion Batteries
2007	DoD Army	2	1	1	0	0	Lithium-Air/Lithium-Ion Hybrid Battery for Military Use
2007	DoD OSD	1	1	0	0	0	Phase I Nano-Engineered Anode Materials for rapid recharge High Energy density Lithium-ion Batteries

continued

TABLE App-D-11 Continued

Award Year	Agency	Total SBIR (Number)	Phase I (Number)	Phase II (Number)	Phase II-Fast Track (Number)	Phase II-Enhancement (Number)	Title
2007	DoE AF	1	1	0	0	0	Radically Designed High Energy Metal-Air Cell for Unmanned Aerial Vehicles
2007	NASA	1	1	0	0	0	Nano-Engineered Materials for Rapid Rechargeable space Rated Advance Li-Ion Batteries
2007	DoD DARPA	1	1	0	0	0	Energy Storage System for Very High Altitude Very Long Endurance Solar Aircraft
Totals		56	39	15	1	1	

Appendix E

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