United States General Accounting Office

GAO

Report to the Committee on Science, House of Representatives

June 1999

FEDERAL RESEARCH

Evaluation of Small Business Innovation Research Can Be Strengthened

GAO/RCED-99-114

GAO

United States
General Accounting Office
Washington, D.C. 20548

Resources, Community, and
Economic Development Division

B-281081

June 4, 1999

The Honorable James F. Sensenbrenner
Chairman
The Honorable George E. Brown, Jr.
Ranking Minority Member
Committee on Science
House of Representatives

This report responds to your request for information on the Small Business Innovation Research program. It discusses the distribution of awards, with special emphasis on the 25 companies that have won the most awards. It also discusses commercial potential as a factor taken into consideration by federal agencies when evaluating companies' proposals. The report includes a matter for congressional consideration that may help to clarify the relative emphasis that agencies, in evaluating proposals, should give to a company's commercialization record as part of the goal of commercialization and to the program's other goals. It also contains a recommendation to the Administrator of the Small Business Administration that may help to strengthen the evaluation of the program's commercial outcomes in response to the Government Performance and Results Act.

We are sending copies of this report to the Honorable Aida Alvarez, Administrator, Small Business Administration, and to the heads of the other federal agencies participating in the Small Business Innovation Research program. If you have any questions, I can be reached at (202) 512-3841. Major contributors to this report are listed in appendix XIII.

Susan D. Kladiva
Associate Director, Energy, Resources,
and Science Issues

Executive Summary

Purpose

As a nation competing in a global economy, the United States depends heavily on innovation through research and development. The Small Business Innovation Development Act of 1982, which authorized the Small Business Innovation Research (SBIR) program, emphasizes the benefits of technological innovation and the ability of small businesses to transform the results of research into new products. In its 16 years, the program has provided over 45,000 awards worth $8.4 billion in 1998 dollars to thousands of small high-technology companies. As the program has matured in the 1990s, congressional concern has focused on the companies' ability to commercialize the results of their research and on the concentration of awards in certain states and companies—commonly known as "frequent winners." SBIR awards, like total federal research and development expenditures, are heavily concentrated in certain states. Concern about frequent winners has arisen, in part, because studies conducted by GAO and the Department of Defense indicate that frequent winners achieve lower levels of commercialization than companies winning fewer awards.

To facilitate the discussion of these issues, the Subcommittee on Technology, House Committee on Science, asked GAO to review (1) the distribution of awards by company and geographic area, with special emphasis on the share of awards received by the 25 most frequent winners; (2) the extent to which federal agencies are considering commercial potential and the program's other goals in making their awards; and (3) previous evaluations of the SBIR program to identify opportunities to improve measurements of the program's outcomes.

Background

The act establishing the SBIR program identified four goals for the program: technological innovation, commercialization, the use of small businesses to meet agencies' research and development needs, and participation by minorities and disadvantaged persons. Funding for the program in fiscal year 1997 (the last year for which funding data are available) amounted to $1.1 billion.

Federal agencies that have external research and development budgets of more than $100 million are currently required to use at least 2.5 percent of this budget for the program. Ten federal agencies participate in the program. The Department of Defense accounts for about 45 percent of the awards, while the National Aeronautics and Space Administration, the Department of Health and Human Services, the Department of Energy, and the National Science Foundation together account for close to 48 percent.

Each agency makes awards and manages its own program while the Small Business Administration (SBA) plays a key administrative role that includes the issuance of policy directives and the maintenance of a central database on awards.

In reauthorizing the program in 1992, the Congress stated its intention to expand and improve the program, emphasize the program's goal of increasing the private sector's commercialization of technology developed through federal research and development, increase small businesses' participation in federal research and development, and improve the federal government's dissemination of information on the program. One new provision requires agencies, when evaluating proposals at an intermediate stage (phase II), to consider each proposal's commercial potential, which includes a company's commercialization record, commitments accompanying the proposal for developmental funding from sources other than the SBIR program, and other factors. The commercialization record, which indicates how successful the company has been in developing commercial applications of SBIR or other research, generally includes the company's sales, additional developmental funding, and other results of its SBIR awards. Another provision requires agencies to collect information on frequent winners. This greater emphasis on the results of the program mirrors the intention of the Government Performance and Results Act of 1993, which requires federal agencies to report on the outcomes of federal programs. The program is scheduled to terminate on October 1, 2000.

Results in Brief

From fiscal year 1983 through fiscal year 1997, the 25 most frequent winners received over $900 million, or about 11 percent of the program's awards. These companies represent fewer than 1 percent of all the companies that have received awards. The program has a high number of first-time participants. One-third of the companies receiving awards from fiscal year 1993 through fiscal year 1997 were first-time winners, indicating that the program is attracting hundreds of new companies annually. SBIR awards are concentrated in certain states. From fiscal year 1993 through fiscal year 1996, companies in one-third of the states received 85 percent of the program's awards, largely because companies in these states submitted the most proposals. Companies from California and Massachusetts won the highest number of awards. To broaden the geographic distribution of awards, agencies have made efforts to encourage the submission of proposals from companies in states with fewer awards. For example, the National Science Foundation has used a

program to support research in states that have received relatively little federal research funding to increase participation in the SBIR program.

In response to the 1992 reauthorization, agencies are considering commercial potential as an explicit criterion when evaluating proposals. At the same time, the emphasis on commercial potential has raised questions for the agencies. The reauthorization does not clarify how a company's commercialization record, as part of the goal of commercialization, and the program's other goals should be used in evaluations of proposals. This lack of clarity has led to differences across agencies in how they evaluate proposals. For example, using an approach shared by none of the other agencies, the Department of Defense planned to give significantly lower scores to companies perceived as poor commercializers. Early tests of Defense's plan indicated that some of the most frequent winners that have been relatively unsuccessful in commercializing their research results would not have been penalized if only a few of their awards had resulted in sales. At the same time, companies with far fewer awards and no previous sales might have been subject to penalties. Although the Department of Defense has revised its plan to avoid this problem, the lack of clarity in the legislation remains a concern. This report raises as a matter for congressional consideration how much emphasis the commercialization record as part of the goal of commercialization should receive relative to the program's other goals in evaluations of proposals.

Federal agencies and others have used various methods to evaluate the program's commercial outcomes. These methods have used "snapshots" of sales, data on additional developmental funding for the projects, "success stories," and other indications of commercial success. However, they become quickly outdated and do not provide an ongoing, consistent, and programwide record. The use of a single method with uniform criteria for success focusing on commercial outcomes and other indicators of success would help to satisfy the requirements of the Results Act.[1] The Small Business Administration is currently developing a new database called Tech-Net, which is scheduled for implementation in 1999. Tech-Net affords an opportunity to maintain current, consistent information about commercial and other outcomes and respond to the Results Act. This report recommends that it be used for this purpose.

[1]In December 1997, the Congress specified that information relating to the SBIR program must be included by each federal agency in updates or revisions to its strategic plan. 15 U.S.C. 638(t).

Principal Findings

Awards Go to Both Frequent Winners and New Applicants, and Agencies Are Trying to Broaden the Geographic Distribution of Awards

Both frequent and first-time winners receive significant funds under the program. From fiscal year 1983 through fiscal year 1997, the 25 most frequent winners accounted for a total of 4,629 awards and received over $900 million of the $8.4 billion awarded, with $108 million going to one company alone. These awards contributed substantially to the companies' annual revenue for fiscal year 1998, averaging about 43 percent of these companies' total annual revenue, with variations from a low of 6 percent to a high of 80 percent. First-time winners also received a significant portion of the awards. From fiscal year 1993 through fiscal year 1997, one-third of the companies receiving an award—over 750 companies each year, on average—were first-time winners.

The concentration of awards in certain states tends to reflect the concentration of federal research resources in general. A 1998 SBA study reported that the number of small high-technology firms in a state, its research resources, and the availability of venture capital are important factors in explaining the distribution of SBIR awards.[2] Agencies' efforts to broaden the geographic distribution of awards have included outreach conferences in states with fewer awards and a program at the National Science Foundation to support research in 18 states that have received relatively little federal research funding. Since 1994, this program has awarded 82 SBIR grants valued at over $7 million to numerous small businesses in these states.

The Emphasis on Commercialization May Have Unintended Consequences and Raises Questions About the Program's Other Goals

One of the purposes of the 1992 reauthorization was to emphasize the goal of commercialization. As required by the act, agencies are weighing the commercial potential of all proposals and are collecting data on commercialization by frequent winners. The emphasis on commercialization has created problems for some agencies in evaluating proposals. Measuring the commercial success of companies is difficult for several reasons. First, the role of the commercialization record in judging a company's current commercial potential remains unclear. In general, program managers reported that the commercialization record has played a limited role so far because it is only one of several factors considered as a part of commercial potential; however, the Department of Defense planned to make the record increasingly important in its evaluations of

[2]An Analysis of the Distribution of SBIR Awards by States, 1983-1996, SBA, Office of Advocacy (Jan. 1998).

proposals. Second, despite the greater emphasis on the goal of commercialization, according to some of the program managers, the other goals remain important. In their view, limited commercialization by itself may not signal failure if a company has achieved other goals.

Because the 1992 act and a 1993 SBA policy directive on implementing the act do not indicate how the commercialization record should be used, differences among the agencies have emerged. The Department of Defense, for example, developed an approach shared by none of the other agencies. It collected information on commercialization by companies, which it planned to use in evaluating proposals from companies that had won multiple SBIR awards. However, early tests of the plan showed that companies with relatively few awards and no sales might receive comparatively low scores, whereas the most frequent winners with only modest sales might not be penalized at all. The Department has revised its plan to avoid this problem by taking into account the concept of statistical significance as it relates to companies with widely varying numbers of awards.

A Method Exists to Improve the Measurement of Program Results

In the 1990s, studies by GAO, individual agencies, and others have focused on the commercial outcomes of awards, but the program itself has lacked the ability to measure its accomplishments as the Results Act directs. Two of the major methods used so far to survey the outcomes of SBIR research include GAO's approach[3] and case studies of companies that have been successful in commercializing the results of their research. In response to a congressional mandate, GAO surveyed companies that had won awards from fiscal year 1984 through fiscal year 1987 and received information on the outcomes of 1,457 projects. One of the key questions GAO asked was, "Has the technology associated with this project led to additional developmental funding and/or sales, and is further work on this technology under way?" This question has been used in subsequent surveys by other agencies, including the Department of Defense in 1996 and SBA in 1998. In addition, several agencies have presented success stories stemming from their SBIR awards. Although the methods have differed, many of the key criteria for success focus on common concerns about the level of sales, developmental funding, and job creation.

An opportunity exists to improve the measurement of outcomes and respond to the Results Act. This opportunity involves the use of uniform,

[3]Federal Research: Small Business Innovation Research Shows Success but Can Be Strengthened, (GAO/RCED-92-37, Mar. 30, 1992).

outcome-related criteria and the expansion of SBA's new Tech-Net database to provide information about these outcomes. SBA's previous central database was developed long before the passage of the Results Act and focused on inputs, such as company names and funding, while including virtually no information on results. Tech-Net, however, is an Internet database that will enable agencies to update information on their SBIR awards and companies to update information on their activities. Thus, a key feature of the system will be its ability to show changes in the program over time. Standard criteria for measuring commercial success and other outcomes, such as savings to agencies resulting from SBIR projects, could be identified and included in the new database. This approach, if implemented, will make available—for the first time—a central database that can be used to produce effective, consistent, ongoing evaluations of the program's commercial and other outcomes.

Matter for Congressional Consideration

When the Congress considers the reauthorization of this program, it may wish to clarify the relative emphasis that agencies, in evaluating companies' proposals, should give to a company's commercialization record as part of the goal of commercialization and to the program's other goals. This clarification would help ensure uniformity in the program and a clear set of standards for determining whether, and to what extent, commercialization and the program's other goals should be considered in evaluations of proposals.

Recommendation to the Administrator, Small Business Administration

To respond to the Government Performance and Results Act, GAO recommends that the Administrator develop standard criteria for measuring the commercial and other outcomes of the SBIR program and incorporate these criteria into the new Tech-Net database. The criteria should include uniform measures of sales, developmental funding, and other indicators of success.

Agency Comments and GAO's Evaluation

GAO provided a draft of this report to and obtained comments from the Small Business Administration and the 10 program agencies. GAO has discussed the specific issues raised by the agencies at relevant places in the report and incorporated the additional information and technical corrections from the agencies where appropriate.

The Small Business Administration generally agreed with the report. The Department of Defense, the Department of Education, the Department of

Agriculture, the Department of Transportation, the Department of Commerce, the National Science Foundation, and the Environmental Protection Agency generally agreed with the report while offering additional observations or suggesting specific technical corrections. The Department of Defense agreed with GAO's concern about the unintended consequences of its plan to use a company's commercialization record in evaluating proposals. It has revised its plan to avoid these unintended consequences. GAO has updated the report to reflect this revision of the Department's plan.

Several agencies expressed concerns regarding specific issues and suggested technical corrections. The Department of Energy disagreed with GAO's description of the Department's use of information on companies' commercialization records in evaluating SBIR proposals. GAO has deleted the specific points identified by the Department. Only one agency, the National Institutes of Health, commented on the matter for congressional consideration. The Institutes expressed concern about the matter's focus on uniformity, noting that it misses the fact that different relative emphases may be appropriate to agencies' different missions. The Institutes also questioned what they considered to be the draft report's close association between success and commercialization. In general, GAO does not believe that an effort to clarify the relative emphasis that should be given to commercialization and to the program's other goals will lead to insensitivity to agencies' different missions. Moreover, the report did not equate success and commercialization.

The Small Business Administration concurred with the recommendation but said that, for it to be effective, federal agencies must agree to provide the information, and the Congress must require the agencies to provide the information through the Tech-Net database. GAO notes that the agencies are already required to report information on awards to the Small Business Administration and believes that they could include the additional information on outcomes in responding to this reporting requirement. The Environmental Protection Agency, the National Aeronautics and Space Administration, and the National Institutes of Health expressed concern about issues related to the entry, maintenance, safeguards, reliability, and commercial emphasis of this information. In general, while GAO recognized that the implementation of this recommendation would raise these types of issues, it continues to believe that the recommendation's implementation will provide a useful opportunity to capture the results of the program and that these issues can be addressed effectively by coordination among the agencies. In response to concerns expressed by

the National Institutes of Health that commercial potential cannot be based solely on potential dollars in sales, GAO added a reference to other indicators of success in its recommendation, reflecting its recognition of the need for flexibility. GAO further discusses the agencies' comments on the matter for congressional consideration and the recommendation at the end of chapters 3 and 4, respectively. The agencies' comments appear in appendixes II through XII, together with GAO's responses.

Contents

Abbreviations

DOD	Department of Defense
EPSCoR	Experimental Program to Stimulate Competitive Research
R&D	research and development
SBA	Small Business Administration
SBIR	Small Business Innovation Research Program

Introduction

As a nation competing in a global economy, the United States depends heavily on innovation through research and development (R&D). The Small Business Innovation Development Act of 1982, which authorized the Small Business Innovation Research (SBIR) program, emphasizes the benefits of technological innovation and the ability of small businesses to transform the results of R&D into new products. The act designated four major goals for the program:

- stimulating technological innovation,
- using small businesses to meet federal R&D needs,
- fostering and encouraging participation by minorities and disadvantaged persons in technological innovation, and
- increasing the private sector's commercialization of innovations derived from federal R&D.

The Small Business Research and Development Enhancement Act of 1992 stated the congressional intention to

- expand and improve the program,
- emphasize the program's goal of increasing the private sector's commercialization of technology developed through federal R&D,
- increase small businesses' participation in federal R&D, and
- improve the federal government's dissemination of information about the program.

The Administration of the Program

In addition to establishing goals, the original legislation determined federal agencies' participation in and funding for the program. By 1986, agencies spending more than $100 million annually for external R&D were required to set aside not less than 1.25 percent of their total external R&D funds for the program. The 1992 reauthorization directed agencies to increase the set-aside to not less than 1.5 percent in fiscal years 1993 and 1994, not less than 2 percent in fiscal years 1995 and 1996, and not less than 2.5 percent in fiscal year 1997 and thereafter. This requirement has increased the annual funding to about $1 billion. At present, 10 agencies participate in the program. The five agencies with larger SBIR programs, accounting for over 90 percent of all awards, include the Department of Defense (DOD); the Department of Energy; the Department of Health and Human Services and its National Institutes of Health, in particular; the National Aeronautics and Space Administration; and the National Science Foundation. The five agencies with smaller SBIR programs include the Department of Commerce, the Department of Education, the Department

of Transportation, the Department of Agriculture, and the Environmental Protection Agency.

Agencies are required to issue a solicitation for proposals that sets the process in motion. The solicitation, a formal document issued by each agency, lists and describes the topics to be addressed by each company's proposals and invites companies to submit proposals for consideration. Each agency with a program is responsible for targeting research areas and administering its own funding agreements.

The Small Business Administration (SBA) is responsible for issuing policy directives for the general conduct of the SBIR programs within the federal government. The directives were to provide for simplified, standardized, and timely solicitations and a simplified, standardized funding process. In addition, they were to minimize the regulatory burden for small businesses participating in the program. Issued in January 1993, the current policy directive incorporated changes made by the 1992 legislation. Federal agencies were also required to report key data to SBA, which in turn has published annual reports on the program.

SBA's policy directive states that, to be eligible for an award, a small business must be

- independently owned and operated,
- other than the dominant firm in the field in which it is proposing to carry out an SBIR project,
- organized and operated for profit,
- an employer of 500 or fewer employees (including employees of subsidiaries and affiliates),
- the primary source of employment for the project's principal investigator at the time of the award and during the period when the research is conducted, and
- at least 51-percent owned by U.S. citizens or lawfully admitted permanent resident aliens.

The original law established a three-phase structure for the program. The first phase, not to exceed 6 months, was designed to determine the scientific and technical merit and the feasibility of a proposed idea. The second phase, not to exceed 2 years, was designed to further develop the idea. The SBA policy directive established $50,000 and $500,000 as the general limits for phase I and II awards, respectively. The 1992 reauthorization directed SBA to raise these figures to $100,000 and

$750,000, respectively, with an adjustment every 5 years to reflect economic and programmatic considerations. When selecting phase I proposals for awards, an agency is now required under the reauthorization and SBA's directive to consider the scientific and technical merit and feasibility of ideas that appear to have commercial potential. The funding for phase II shall be based on the results of phase I and the scientific and technical merit and feasibility of the proposal, including, among other things, a consideration of its commercial potential. The third phase is somewhat more flexible and difficult to define. In general, it is expected to result in commercialization or further research and development. Unlike phases I and II, phase III has no general limits in time or dollar amounts. In addition, a phase III project must obtain funds from non-SBIR sources in the federal government or in the private sector.

"Frequent Winners" and the Geographic Distribution of Awards Have Become Important Issues

In the SBIR program, the same companies have often received multiple awards, creating concerns about the concentration of awards. According to one expert, the program was established, in part, to enable small businesses to compete with large companies for a portion of the federal R&D funding, but the program has generated its own internal "corporate giants" against which even smaller businesses must now compete. While these "frequent winners" have received a significant share of the program's resources, they have generally demonstrated less commercial activity in phase III than companies with fewer awards.

We discussed this concern about frequent winners in our 1992 report on phase III commercialization.[1] At that time, as we pointed out, the five most frequent winners had received a total of almost $100 million from fiscal year 1983 through fiscal year 1990. Collectively, these five small businesses had received over 700 phase I and II awards from the program. For the purpose of further analysis in our report, we defined a frequent winner as a company that had won five or more phase II awards. We compared these companies with infrequent winners and found that frequent winners were achieving lower levels of phase III sales and less additional developmental funding from non-SBIR sources. The frequent winners were achieving about $117,000 less in sales and about $86,000 less in additional developmental funding per phase II award. In 1998, we also reported that frequent

[1]Federal Research: Small Business Innovation Research Shows Success but Can Be Strengthened (GAO/RCED-92-37, Mar. 30, 1992).

winners achieved lower levels of sales and less additional developmental funding.[2]

As part of its legislation to reauthorize the program in 1992, agencies were required to begin collecting data on the commercialization activity of companies that were submitting phase I proposals and had won 15 or more phase II awards in a 5-year period. Analyses of these data have shown that companies with numerous awards continue to commercialize at somewhat lower levels than other companies. For example, in a 1996 survey following up on our 1992 survey, a DOD contractor found that DOD recipients with nine or more phase II awards achieved less than half of the sales per project when compared with the recipients of phase II awards in general.

The geographic distribution of awards has become a more prominent issue since both the funding for the program and the number of awards per year have increased under the 1992 reauthorization. For example, a recent SBA study reported that one-third of the states received 85 percent of all SBIR awards and funds from fiscal year 1983 through fiscal year 1996 but also found that the distribution of SBIR awards tends to mirror the distribution of R&D funds in general.

The Government Performance and Results Act Has Increased the Emphasis on Evaluating the Results of Federal R&D

In setting forth its findings and reasons for enacting the Results Act, the Congress stated that congressional policy-making, spending decisions, and oversight are seriously handicapped by insufficient attention to programs' performance and results. One purpose of the act was to improve federal programs' effectiveness and public accountability by promoting a new focus on results. Echoing this concern about focusing on programs' results, Representative George Brown stated in September 1997 that information was not available to answer the most basic question about the effectiveness of the SBIR program. In a specific reference to the Results Act, he also recommended that agencies develop performance measures for their SBIR programs, collect information on the performance of grantees, and analyze the data in light of the program's goals. In December 1997, the Congress specified that information on the SBIR program must be included in the updates or revisions of agencies' strategic plans that are required under the Results Act.

[2]Federal Research: Observations on the Small Business Innovation Research Program (GAO/RCED-98-132, Apr. 17, 1998).

This emphasis on results raises a question about the availability and reliability of key data to answer questions about the extent to which awardees have achieved commercialization and the program's other goals. In measuring results, GAO, individual agencies, and others have developed a variety of evaluation approaches and criteria for the program's success. In each instance, the efforts have required the construction of new databases that permit a "snapshot" of the program and have become outdated in a relatively short time. Because of the growing attention being given to results, we tried to identify a more convenient and effective way of obtaining data and evaluating the program.

Objectives, Scope, and Methodology

As agreed with the Committee, we focused our review on three objectives. First, we provided a statistical overview of the distribution of awards by company and geographic area; we also identified outreach efforts by federal agencies and other organizations to broaden this distribution of awards. Second, we determined whether federal agencies are considering proposals' commercial potential in making their awards and what, if any, actions they have taken in response to concerns about the level of commercialization by frequent winners. Third, we reviewed previous evaluations of the SBIR program to identify opportunities to improve measurements of the program's outcomes.

To respond to the first objective, we obtained data on awards from the start of the program in 1983 through 1997, the most recent year for which data were available. Our main source of data was SBA, which maintains the most complete database on the program. Because of our concerns about the reliability of the information, we worked closely with SBA officials to review and correct the data. The main source of errors was the lack of a unique identifier for individual companies; slight changes in a company's name, caused by entering it in a slightly different way, resulted in data showing separate companies. We reviewed the records for all companies to eliminate these variations and arrive at a more accurate list of participants.

Once the data were corrected, we prepared a reliable database that showed the number of awards to each company since the start of the program. We used these data to develop a statistical profile for three groups of companies—the 25 companies with the most phase II awards, the infrequent winners with one to four phase II awards, and the companies with an intermediate number of awards. We chose the top 25 companies at the request of the Committee and used the number of phase

II awards as the criterion for identifying them because the dollar value of these awards substantially outweighs the dollar value of phase I awards. However, we included information on the number of phase I awards to provide a complete picture of the number of awards and the total funding received by the most frequent winners.

In analyzing the geographic distribution of awards, we obtained data from SBA and a consultant who has studied this issue for several years. We used these data to determine the distribution of awards among individual states. We interviewed program officials and the consultant to gain insight into agencies' outreach efforts.

To respond to the second objective, we briefly reviewed the program's major goals in relation to the growing focus on commercialization. We reviewed the 1992 reauthorization act and SBA's directives. Among other things, the legislation required agencies to consider the commercial potential of each proposal when making phase II awards and, when reviewing proposals for phase I awards submitted by companies that had received 15 or more phase II awards in the last 5 years, to collect data demonstrating how much previous phase III funding the companies had received. We analyzed agencies' efforts as they related to proposals from all companies; we then analyzed their efforts as they related to proposals from companies with larger numbers of awards. We interviewed officials at all of the SBIR agencies to learn about their implementation of the legislation. We gave particular attention to DOD's efforts because DOD makes about half of all awards under the program and planned to implement a significant new policy in May 1999.

In our discussions of the first two objectives, the definition of "frequent winners" may vary with the context. We use the term in three different ways in our report. First, it may refer to the top 25 frequent winners, that is, the group of companies that have won the most phase II awards since the start of the program. This is the group that the Committee asked us to analyze. Second, it may refer to the group of companies as specified in the legislation that reauthorized the program in 1992. This group consists of companies that have won 15 or more phase II awards during the last 5 years of the program. Third, it may refer to companies that have won 5 or more phase II awards since the start of the program. We defined these companies as frequent winners in our 1992 report, and DOD is using the same criterion in its plans for evaluating the commercial potential of frequent winners. To avoid confusion, we have noted the context for our use of this term wherever necessary.

To respond to the third objective, we reviewed the main evaluations of the program's results (primarily commercialization) performed by federal agencies and others. We examined their methods and criteria for success to identify common themes and criteria that could be applied to future evaluations. We interviewed SBA officials about their existing SBIR database and development of a new database, called Tech-Net, scheduled to replace the existing database in 1999. We explored the opportunity to enhance the new database by including "data fields" on the commercial and other outcomes of the program. We attended an SBA-sponsored meeting of database managers in December 1998 to discuss this and other ideas relating to Tech-Net. We presented our proposal at this meeting and followed up with a second presentation on the same issue at a meeting of program managers in January 1999.

Our work was performed in accordance with generally accepted government auditing standards from July 1998 through March 1999. Our work was focused on federal agencies in the Washington, D. C., area. We requested and received comments on our draft of this report from SBA and the 10 program agencies.

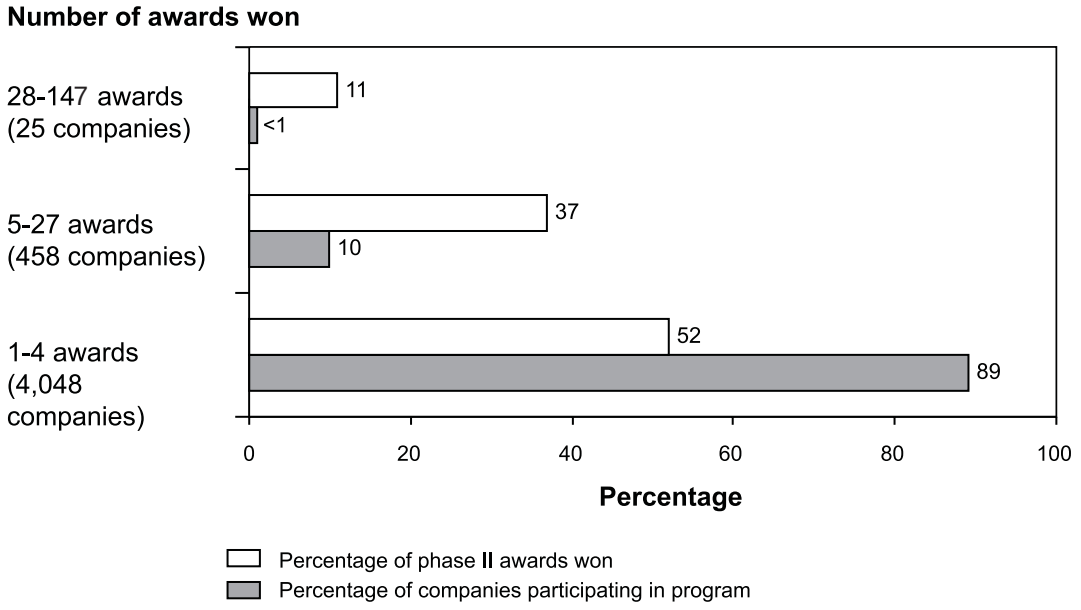
Frequent and Infrequent Winners Are Major SBIR Players, but Frequent Winners and Certain States Have Won a Large Share of the Program's Resources

The 25 companies with the most phase II awards, which represent fewer than 1 percent of the companies participating in the program, have won about 11 percent of these awards over the life of the program. They have accumulated over $900 million in total phase I and II awards; the leading frequent winner has received $108 million. However, thousands of companies have received between one and four phase II awards since the start of the program; in addition, first-time winners accounted for about one-third of the participants from fiscal year 1993 through fiscal year 1997. This percentage of first-time participants amounts to about 750 companies annually. Concern about the concentration of awards has also focused on their geographic distribution. Companies in a small number of states, especially California and Massachusetts, have submitted the most proposals and won the majority of awards, although the distribution of awards generally follows the pattern of distribution of non-SBIR expenditures for R&D, venture capital investments, and academic research funds. In response to congressional concerns about this concentration, agencies have undertaken efforts to broaden the geographic distribution of awards. The National Science Foundation's use of a special program to support research in states that have historically received lesser amounts of federal R&D funding has increased the number of SBIR awards to these states. Other agencies also have such programs but have not used them to assist their SBIR participants. Several agencies are considering such an initiative to increase their outreach efforts in the SBIR program.

An Overview of Awards Made by the SBIR Program

We divided participants into three distinct groups of phase II award winners in order to examine the distribution of awards over the life of the program. These groups are (1) the 25 companies with the most awards, (2) companies with between 1 and 4 awards, and (3) a middle group with between 5 and 27 awards. Figure 2.1 highlights the distribution of phase II awards to these three categories of companies from fiscal year 1984, when the first phase II awards were made, through fiscal year 1997, the latest year for which complete data are available.

Figure 2.1: Percentage of Phase II Awards Won by Various Program Participants, Fiscal Years 1984-97



Source: GAO's analysis of data from SBA's SBIR database.

The companies in the top group have been the focus of concern because of their large number of awards. As the figure shows, the 25 most frequent winners, representing fewer than 1 percent of the participants, account for about 11 percent of the phase II awards. The concentration of awards is also shown by combining this group with the intermediate group and looking at companies with 5 or more phase II awards in general. The two top groups represent 11 percent of the program's participants and have received almost half of all phase II awards. The third group, the infrequent winners, constitutes almost 90 percent of the program's participants and has received slightly more than 50 percent of the phase II awards. Thus, while a relatively small percentage of companies has received a large share of the phase II awards, thousands of companies participating in the program have each won a few awards.

Frequent Winners' Share of the Program's Resources

Table 2.1 provides a detailed view of the top 25 winners, including the number and total dollar value of their awards over the life of the program (fiscal years 1983-97), and, when available, the percentage of their revenue derived from the program in fiscal year 1998.

Table 2.1: An Overview of the Top 25 Frequent Winners, Fiscal Years 1983-97

Company	Phase II awards	Total awards	Dollar value	Percentage of revenue from SBIR (1998)
Foster Miller	147	573	108.2	20
Physical Optics	96	377	71.2	68
Creare	87	281	61.4	64
Physical Sciences	76	290	57.2	42
Spire	75	351	59.4	26
Radiation Monitoring Devices	59	187	43.3	38
Bend Research	58	166	34.3	23
EIC Laboratories	53	188	38.1	33
Mission Research	50	196	39.8	8
Science Research Laboratory	49	147	33.4	76
Advanced Technology Materials	48	208	38.4	10
Advanced Fuel Research	42	154	27.8	52
Ultramet	38	140	28.4	37
Aerodyne Research	35	134	27.5	36
CFD Research	35	107	24.7	52
Sparta	35	162	28.3	[a]
TDA Research	35	127	19.5	70
Thermacore	35	102	25.8	[a]
American Research Corp. of Virginia	34	102	19.3	80
Waterjet Technology	34	102	21.5	[a]
Scientific Research Associates	33	113	24.0	[a]
Giner	30	110	22.1	70
Schwartz Electro-optics	30	104	20.1	6
Bio-Metric Systems	29	89	18.5	[a]
Satcon Technology	28	119	22.2	44

(Table notes on next page)

[a]Information was not available.

Source: GAO's analysis of data from SBA's SBIR database.

The 25 companies that have received the most phase II awards account for a total of 4,629 phase I and II awards worth over $900 million. The most frequent winner, Foster Miller, has received $108 million. All of these companies have participated in the program for at least 10 years.

As table 2.1 shows, we also obtained information on the percentage of total annual revenue that these companies attributed to their SBIR awards. These data, provided by a DOD contractor, indicate that the awards contributed about 43 percent of their total annual revenue, on average, for fiscal year 1998.[1] However, this figure varied enormously by company, from a low of 6 percent to a high of 80 percent.

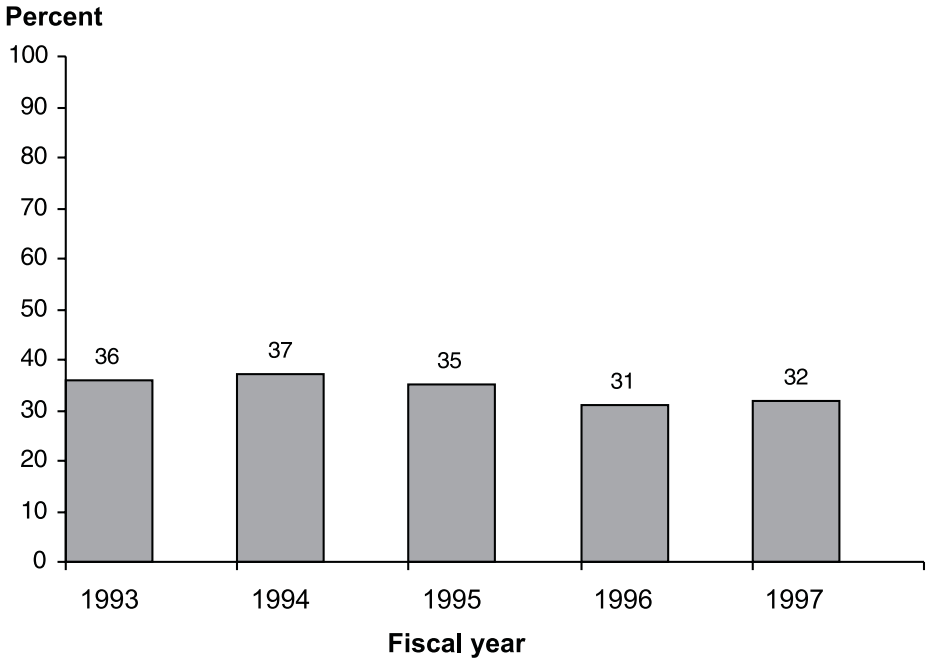
Infrequent Winners' Share of the Program's Resources

We examined two groups of infrequent winners, including (1) companies with between one and four phase II awards and (2) first-time winners of phase I awards. We found that companies with between one and four phase II awards have also played a major role in the program. These 4,048 companies constitute almost 90 percent of the phase II award winners. They have received over one-half of the program's total resources (about $4.5 billion out of a total $8.4 billion). They are relative newcomers when compared with the 25 most frequent winners. Slightly over half of them received their first phase II award in fiscal year 1992 or later.

First-time winners have also been successful in obtaining awards, winning about one-third of the phase I awards in recent years. Figure 2.2 shows the percentage of first-time winners in the program from fiscal year 1993 through fiscal year 1997—the last 5 years for which complete data were available. On average, 750 companies won an award for the first time in each of these years.

[1]This figure is based on information provided by the 20 companies for which information on annual revenue from the SBIR program was available.

Figure 2.2: Percentage of Companies Winning First-Time Phase I Awards, Fiscal Years 1993-97



Source: GAO's analysis of data from SBA's SBIR database.

As the figure shows, the percentage of new participants has remained steady. In our view, this level of participation by first-time winners shows the program's substantial capacity to attract new participants each year.[2]

SBIR Awards and the Program's Resources Are Concentrated in Several States

SBIR awards, like total U.S. R&D expenditures, are heavily concentrated in several states. A recent SBA study reported that companies in one-third of the states received 85 percent of all SBIR awards and funds from fiscal year 1983 through fiscal year 1996.[3] Companies in two states—California and Massachusetts—received by far the highest number of awards. According to the study, the 17 states with companies that won the most awards also have the bulk of the federal R&D expenditures, venture capital investments,

[2]In commenting on our draft report, the National Aeronautics and Space Administration noted that about 46 percent of the companies that received phase II awards from it in award years 1993-97 were first-time winners.

[3]An Analysis of the Distribution of SBIR Awards by States, 1983-1996, SBA, Office of Advocacy (Jan. 1998).

and academic research funds.[4] Hence, the study observes that the number of small high-technology firms in a state, its R&D resources, and its access to venture capital are important factors in the distribution of SBIR awards and that the distribution of these awards tends to mirror the distribution of R&D funds in general.

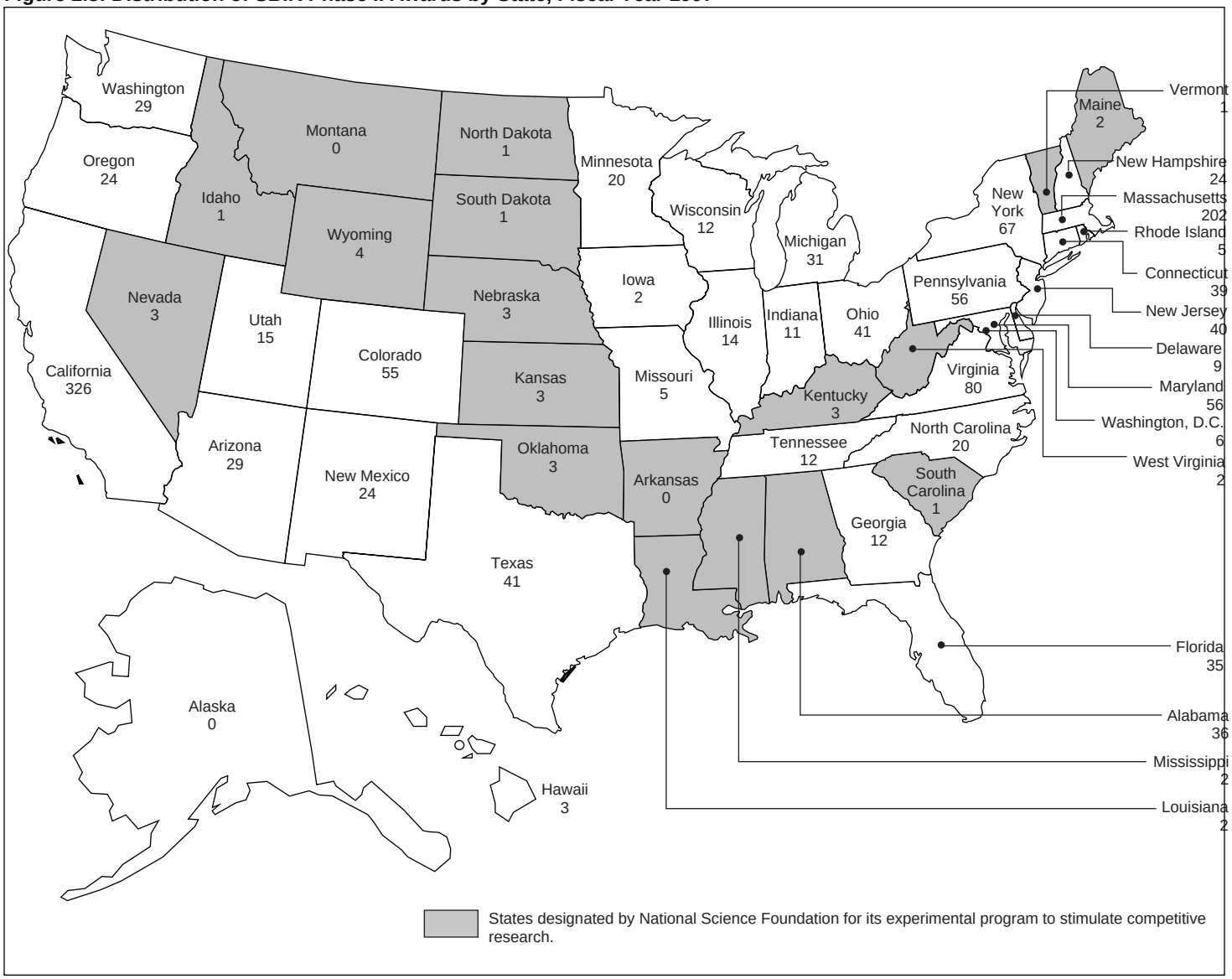
In fiscal year 1997, the geographic distribution of awards was similar to their distribution over the life of the program. California and Massachusetts had the highest concentrations of phase II awards, with California companies receiving 326 and Massachusetts companies receiving 202. In five states (Virginia, New York, Maryland, Pennsylvania, and Colorado), companies won between 55 and 80 awards. At the bottom of the list were 19 states where companies received three or fewer awards.[5]

For fiscal year 1998, data on the proposal-to-award ratios show that proposals from companies in states with historically lesser amounts of federal research funding won awards at almost the same rate as proposals from companies in other states. However, these data showed some variation among the individual program agencies. Appendix I provides a snapshot of the proposal-to-award ratios among the agencies in fiscal year 1998. The geographic distribution of phase II awards by state in fiscal year 1997 is presented in figure 2.3.

[4]The 17 states, listed in descending order by number of awards, are California, Massachusetts, Virginia, Maryland, New York, Pennsylvania, Colorado, Connecticut, Texas, Ohio, New Jersey, Washington, New Mexico, Florida, Michigan, Alabama, and Illinois.

[5]The 19 states are Alaska, Arkansas, Hawaii, Kansas, Kentucky, Nebraska, Nevada, Oklahoma, Iowa, Louisiana, Maine, Mississippi, Montana, West Virginia, Idaho, North Dakota, South Carolina, South Dakota, and Vermont.

Figure 2.3: Distribution of SBIR Phase II Awards by State, Fiscal Year 1997



Source: GAO's analysis of data from SBA's SBIR database and from the National Science Foundation.

Federal Agencies' Efforts to Expand the Geographic Distribution of Awards Include Special Funding and Outreach

To encourage greater participation by companies in the states with fewer awards, the National Science Foundation has used a program it established about 20 years ago to support research in states with historically lesser amounts of federal research funding. Eighteen states and the Commonwealth of Puerto Rico participate in the program.[6] The Foundation and other agencies have also conducted outreach conferences in such states and used the Internet to increase access to the program. Constraints on the amount of funding available to administer the program, according to program managers, have limited the agencies' efforts to reach out to the states with fewer awards.

National Science Foundation's Efforts Have Been Effective

One effort that has been effective in increasing the number of awards to small businesses in states with fewer awards is the Foundation's Experimental Program to Stimulate Competitive Research (EPSCoR), which began in 1981 and was funded at about $49 million in fiscal year 1999. For nearly two decades, the Foundation has used this program to support federally funded research in states that have received relatively little federal research funding and have demonstrated a commitment to develop their research bases and improve science and engineering research and education programs at their universities and colleges. Since 1994, the Foundation's SBIR program has used EPSCoR to increase its assistance to potential SBIR participants in EPSCoR states. The Foundation assists these small businesses in two ways. First, through EPSCoR, the Foundation's SBIR program offers a "phase zero" award to help small businesses put together a competitive phase I proposal.[7] Second, phase I proposals from EPSCoR states that were ranked in the "highly recommended" or "recommended" category in the proposal review process but were not selected because of funding constraints receive a second review and an opportunity to be funded through EPSCoR.

Since 1994, EPSCoR has awarded 82 phase I SBIR grants valued at over $7 million. In the fiscal year 1999 solicitation, EPSCoR awarded 17 phase I grants.[8] According to April 1998 testimony by the director of the

[6]The states are Alabama, Arkansas, Idaho, Kansas, Kentucky, Louisiana, Maine, Mississippi, Montana, Nebraska, Nevada, North Dakota, Oklahoma, South Carolina, South Dakota, Vermont, West Virginia, and Wyoming.

[7]Under the phase zero initiative, small businesses may receive about $5,000 to prepare themselves for the phase I competition. Companies use these funds for such things as preliminary data acquisition, analyses, or visits to SBIR agency personnel.

[8]Two of the proposals were cofunded using both SBIR and EPSCoR funds. In addition, the Foundation funded eight phase I proposals in EPSCoR states through the normal proposal review process in the fiscal year 1999 SBIR phase I competition.

Foundation's Industrial Innovation Program before the House Committee on Small Business, EPSCoR has enabled a steady increase in participation in the SBIR program in many of the rural states. In June 1998 testimony before the Senate Committee on Small Business, a consultant who conducts SBIR outreach in states in the northern Rocky Mountains and Great Plains stated that the Foundation's approach is highly effective and should be considered for implementation at other agencies.

DOD, the Department of Energy, the National Institutes of Health, and the National Aeronautics and Space Administration also have programs to support federally funded research in states with lesser amounts of federal research funding. However, there was no linkage between these agencies' SBIR programs and their programs to support research in these states. Their programs were established in the early to mid-1990s, have smaller budgets than the Foundation's program, and generally direct their funding toward researchers in academic institutions, not small businesses. Nonetheless, the executive director of the National Aeronautics and Space Administration's SBIR program is currently evaluating how EPSCoR might enable the agency to expand outreach to potential SBIR participants in states with fewer awards. The program manager for the Ballistic Missile Defense Organization, a DOD component with an SBIR program, told us that it would be appropriate for DOD's SBIR program and its program to work together to assist such states, but no decision has been made to take this step.

Three of the agencies with smaller SBIR programs—the Department of Agriculture, the Department of Commerce, and the Environmental Protection Agency—also have programs to support research in states with lesser amounts of federal research funding. As with the agencies with larger SBIR programs, there was no linkage between the agencies' SBIR programs and their programs to support research in these states. The manager of Agriculture's SBIR program stated that he maintains a list of states with the fewest awards from the Department; he is prepared on a case-by-case basis to skip the strict numerical ranking of proposals and make an award to a company to fill a geographic gap, provided the company was ranked in the "should fund" category (approximately the top 30 percent) during the regular review process. The Department of Commerce, through its Experimental Program to Stimulate Competitive Technology, recently awarded $300,000 to the University of Mississippi to increase the state's competitiveness for the SBIR program. At the Environmental Protection Agency, the SBIR program manager is

considering whether and how to link his program with the agency's program that assists states with lesser amounts of research funding.

Despite Administrative Funding Constraints, Agencies Have Undertaken Other Outreach Efforts

The program's statute prohibits agency officials from using SBIR funds to pay for the administrative costs of the program, such as the costs of salaries, support services, and outreach efforts. Despite this constraint, agencies have tried to encourage participation by small businesses in states with fewer awards. For example, they have held outreach conferences, offered help for small businesses in the proposal preparation and review processes, and used the Internet to increase access to the program. According to a consultant who has specialized in helping small businesses in states in the northern Rocky Mountains and Great Plains win SBIR awards, the agencies have been working effectively to broaden the distribution of awards but could use additional administrative funds to increase their outreach if the restrictions were lifted. In his view, additional outreach to these states could increase the submission of high-quality proposals from small businesses in these states, a key to improving the geographic distribution of awards.

Several participating agencies described outreach trips they have made to states or regions of the country that have won a relatively small share of awards. For example, DOD's program director told us that in 1998 DOD program managers went to Alaska, Maine, and Oregon to discuss the SBIR program. DOD is also cosponsoring regional conferences. It has scheduled conferences in Iowa, Kansas, and Missouri in 1999. If the regional conferences are successful, according to the program director, DOD will conduct more of them. In addition, DOD plans to use about $20,000 to help companies in such states prepare effective proposals. The National Institutes of Health's former program director told us that in 1998 he traveled to Alaska, Arizona, Hawaii, Idaho, Kentucky, Oklahoma, Oregon, Missouri, North Carolina, and Wyoming to discuss the Institutes' program.

Officials from the departments of Education, Transportation, and Agriculture told us that maintaining an equitable geographic distribution of awards is generally not a problem for their agencies' programs. However, they also described their special efforts to reach out to small businesses in states with fewer awards. For example, Transportation's program manager has explored ways in which states can work with small businesses to develop a manufacturing capability for the results of SBIR research. Agriculture's program manager gives small businesses from states that

have won the fewest awards from the Department special consideration for a phase I award.

Each participating agency has established a Web page on the Internet to provide up-to-date information on its SBIR program, including agency contacts, information on preparing a proposal, and upcoming events. In addition, some of the agencies have developed state outreach notebooks used by small businesses and agency officials. For example, the Ballistic Missile Defense Organization publishes on the Internet a comprehensive state outreach notebook that provides key agency and state contacts. The notebook is used by several agencies, including those within DOD as well as other program agencies. For example, the manager of Education's program told us that he placed calls to each of the state officials listed in the Ballistic Missile Defense Organization's book to inform them about the program. The Environmental Protection Agency also publishes a state outreach notebook with key state and agency contacts.

Several program directors told us that the prohibition on using the program's funds for administrative expenses has limited their ability to conduct outreach to states with fewer awards. Some of the agencies with smaller SBIR programs, in particular, have travel funds that provide for only a few long-distance trips each year. Several agency officials told us that if additional administrative funds were available, they would use the money, in part, to reach out to the states with fewer awards. For example, the Department of Commerce's program manager told us that with a moderate increase in administrative funds, Commerce could initiate an outreach program that would focus on broadening the distribution of awards.

SBA Is Developing an Outreach Program for States With the Fewest Awards

In 1998, the Congress made available $1 million for SBA to provide technical assistance to the states that receive the fewest SBIR awards. The Congress directed SBA to use the funding for awards to states that received less than $5 million in awards in fiscal year 1995. The eligible states may receive up to $100,000 with a $50,000 state match for efforts such as outreach to small businesses and assistance in applying for awards. Twenty-three states, the District of Columbia, and Puerto Rico qualify for

the assistance and may submit proposals.[9] SBA published the program announcement in March 1999 and plans to make the first awards in the spring of 1999.

[9]The states are Alaska, Arkansas, Delaware, Hawaii, Idaho, Indiana, Iowa, Kentucky, Louisiana, Maine, Mississippi, Missouri, Montana, Nebraska, Nevada, North Dakota, Oklahoma, Rhode Island, South Carolina, South Dakota, Vermont, West Virginia, and Wyoming. Sixteen of the states on SBA's list and Puerto Rico are also on the Foundation's list of EPSCoR states. However, two states—Alabama and Kansas—are not on SBA's list but do receive special assistance in the SBIR competition from the Foundation because they are EPSCoR states. In fiscal year 1997, Alabama was ranked 12th among the states in the number of phase II awards it received, and Kansas was ranked 34th. In addition, SBA's list includes several non-EPSCoR states, such as Alaska, Delaware, Hawaii, Indiana, Iowa, Missouri, Rhode Island, and the District of Columbia.

Agencies Are Considering Commercial Potential in Making Awards, but the Emphasis on Commercialization Raises Questions

In reauthorizing the program in 1992, the Congress emphasized commercialization. The act required agencies to consider commercial potential in making awards and to collect data on companies that have received more than 15 phase II awards during the preceding 5 years. These requirements reflected a concern on the part of some Members of Congress that certain companies, especially frequent winners, were poor commercializers. In response, agencies are weighing the commercial potential of all proposals and have collected data on frequent winners. At the same time, the emphasis on the goal of commercialization raises questions about the role of companies' commercialization records and the program's other goals in evaluating proposals. First, the role of the commercialization record in evaluating the commercial potential of new proposals remains unclear. In addition, agencies have made little use of their data on commercialization by frequent winners, in part because of uncertainty about how to use the information appropriately. Second, despite the greater emphasis on commercialization, the program's other goals remain important to the agencies. By itself, according to some of the program managers, limited commercialization may not signal "failure" because a company may have achieved other goals, such as innovation or responsiveness to an agency's research needs. Because the 1992 reauthorization and SBA's 1993 policy directive do not define the role of the commercialization record in determining commercial potential and the relative importance of the program's goals, different approaches have emerged in agencies' evaluations of proposals. For example, DOD was preparing plans that would have greatly increased the importance of the commercialization record and resulted in significantly lower scores on companies' proposals, making it harder for them to win awards, if they were perceived as poor commercializers. None of the other agencies was taking such an approach. Early tests of DOD's approach indicated that it would have had the unintended effect of lowering the scores of companies with relatively few awards and no sales while having no adverse impact on winners with many awards and only modest sales. DOD has revised its approach to avoid these unintended consequences.

Agencies Are Considering Commercial Potential to Varying Degrees in Making Awards

As required by the 1992 reauthorization act, agencies are taking into account four indicators of the commercial potential of all proposals identified in the legislation.[1] Taken together, these four indicators, or pieces of evidence, account for a substantial portion of a proposal's rating, amounting to as much as one-third of the total score. However, as just one of the four indicators, a company's commercialization record plays a limited role in the evaluation of commercial potential and an even more limited role when viewed along with the other, noncommercial factors, such as technical merit, that are also considered in an evaluation. At DOD, for example, the commercialization record currently accounts for about one-fourth of the commercial score and about one-twelfth of the total score for a proposal; at the Department of Energy it accounts for about one-eighteenth of the total score. Hence, even a poor commercialization record has thus far exercised only a limited influence on the evaluation process. The following section discusses SBA and the participating agencies individually.

SBA's Role in Implementing the Legislation

Beyond the 1992 reauthorization's emphasis on commercialization, SBA's policy directive provides little or no guidance for participating agencies when considering a proposal's commercial potential. The directive states that SBA may monitor whether follow-on nonfederal funding commitments obtained by phase II awardees for phase III were considered in the evaluation of phase II proposals as required by the law. As of March 1998, according to the Assistant Administrator for Technology, SBA had taken no steps to monitor this aspect of the program.

DOD's Evaluation of Commercial Potential

DOD evaluates proposals according to (1) their scientific and technical merit and degree of innovation, (2) the qualifications of key investigators, and (3) the proposals' commercial potential. According to the program director, the commercial potential typically accounts for about one-third of the total score, although its weight varies somewhat across DOD agencies. One part of the commercial potential is the commercialization record, whose weight also varies somewhat from one DOD agency to another. The main tool for ascertaining the record is a form, Appendix E, contained in DOD's solicitation. Appendix E requires information from all

[1]Under the 1992 reauthorization legislation, commercial potential is 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." 15 U.S.C. 638(e)(4)(B).

companies on their commercialization record for each of their phase II awards.

In evaluating the commercial potential of a current proposal, DOD reviews the proposal's funding commitments, if any, and the company's commercialization strategy (a 1- or 2-page document that must accompany the proposal). DOD also affords a special opportunity to companies that obtain a cash investment linked with their phase II proposal; in such cases, companies qualify for a "fast-track" review that greatly boosts their chances of winning an award. The percentage of phase II proposals receiving an award rises from 40 percent without a fast-track review to 90 percent with such a review. The threshold for the additional investment that qualifies a proposal for a fast-track review is one-fourth of every DOD dollar if the company has never won a phase II award and one-for-one matching dollars if the company has previously won a phase II award. Discussing the relative weight that DOD gives to a company's commercialization record and the commercial potential of the current proposal, the program director said that the commercial potential accounts, on average, for about one-third of the total score, as noted above, and past performance accounts for about one-fourth of the total commercial potential. Thus, the actual weight of the commercialization record accounts for only about one-twelfth of the total score.

The program director told us that deliberations at higher policy-making levels indicate a trend toward greater emphasis on commercialization. He said that the Under Secretary of Defense for Acquisition and Technology intends to focus the program more directly on phase III sales to DOD and the private sector. In response to this effort to enhance commercialization, the program director briefed the Under Secretary in September 1998 and presented three approaches: (1) making more effective use of data on past commercial performance, (2) establishing measures of success for phase III (which will rely on our 1992 report), and (3) increasing the involvement of DOD's acquisition programs. The Under Secretary has approved these plans. Their implementation is scheduled for May 1999. As part of their implementation, the program director will report semiannually to the Under Secretary on commercialization results in phase III.

The National Science Foundation's Evaluation of Commercial Potential

The Foundation uses only two criteria, the quality and impact of research, in evaluating proposals. The latter criterion includes commercial potential. No specific percentage is assigned to either criterion. As part of its evaluation of commercial potential, according to the program director, the

Foundation reviews the history of phase II awards to companies that submitted proposals. Attachment N of its solicitation, which was modeled on DOD's Appendix E and introduced in 1997, is one of the means of obtaining this information. Technical reviewers do not see it, but program managers use it when factors besides the strict technical review of quality are taken into account. The 8 to 10 program managers are able to provide special expertise in the selection process because of their detailed knowledge of the proposals and the companies.

The program director said that, for the selection of phase I awards, the information in Attachment N functions mainly as a tiebreaker if the technical merit of two proposals has been judged as equal. He noted that the agency's reliance on a broad nonnumerical rating system gives the program managers more flexibility to use Attachment N as a tiebreaker. He could not say how often the commercialization record plays a tie-breaking role, but he told us that it could do so for about half of the Foundation's awards. He added that, if two companies submit proposals of equal technical merit and one company has a poor commercialization record while the other company is a newcomer with no record, he will choose the newcomer.

The National Aeronautics and Space Administration's Evaluation of Commercial Potential

The National Aeronautics and Space Administration's program manager stated that commercial potential accounts for about 25 percent of the total possible score, although the solicitation does not specifically indicate this percentage. In evaluating this area, consideration is given to (1) the commercial potential of the technology, (2) the demonstrated commercial intent of the company, and (3) the capability of the company to bring successfully developed technology to commercial application. In evaluating the company's commercialization record, the program manager told us that he applies a subjective sense of a company's record in general. He added that the agency has conducted an extensive survey of phase II commercial outcomes that may enable it to take a more structured approach in evaluating the record. The results of the survey, which covered companies that won phase II awards from 1984 through 1994, are currently being tabulated and analyzed. To date, the survey data have been used in an aggregate way to answer questions about commercialization. The program manager told us that although little emphasis has been placed so far on the records of individual companies, the data could provide this information. The agency is now weighing what influence the survey data should have on future awards.

The Department of Energy's Evaluation of Commercial Potential

Energy's scoring system for selecting proposals focuses on three criteria: the strength of the technical approach, the company's ability to carry out the project, and the project's impact (which includes commercial potential). Each criterion counts as one-third of the overall rating. The program manager commented that a company with poor commercial potential needs to be judged as almost perfect under the other two criteria to receive an award. He added that Energy does not require a commercialization plan in connection with phase II proposals, in part because he believes that (1) it is too early for such a plan to be meaningful, (2) agency personnel are not qualified to review it, and (3) important information concerning possible commercialization is included with the proposal in a section called "Anticipated Benefits;" this section discusses the expected product or process, the likelihood that it could lead to a marketable product, and the significance of the market.

In evaluating commercial potential, the program manager told us that he interprets the four points in the 1992 legislation literally. He noted that only one of the four refers to a company's commercialization record and this record, in turn, is weighted proportionally in the evaluation of commercial potential. (The impact criterion is divided into two parts. The commercialization record accounts for one-third of one of these parts, or one-sixth of the impact criterion. This impact score then accounts for one-third of the total score. Thus, the commercialization record accounts for about one-eighteenth overall.) He added that although the commercialization record accounts for only a small percentage of the total score, it could make an important difference in a tight competition.

In obtaining data on commercialization, Energy requires companies, as a condition of their phase II grant, to provide the program manager with an annual report on phase III funding at the end of phase II and for 3 years after their project's completion. This report is to detail the sources and amounts of the nonfederal funding used to continue support for, or commercialize the research funded by, the award. The program manager said that 1994 was the first year that Energy began to formally use commercial potential as a criterion in evaluating proposals. Prior to 1994, information on commercialization was used only as a tiebreaker in specific instances.

The National Institutes of Health's Evaluation of Commercial Potential

The Institutes' current solicitation includes commercial potential as one of its criteria, but neither commercial potential nor any of the Institutes' other six criteria is assigned a definite weight in the grants program, which

provides about 95 percent of the Institutes' SBIR awards. For the contract awards that constitute the remaining 5 percent, the program manager told us, commercial potential accounts for 10 percent of a proposal's score. All proposals receive a peer review in which an average of three reviewers represent the small business community and 10 to 15 doctors and scientists represent the biomedical community. The small business representatives are included for scientific balance and special business-related knowledge, according to the program manager, but the other peer reviewers (research scientists and physicians) can also comment on the proposals' commercial potential. Each peer review leads to a summary statement that incorporates the major comments, including those relating to commercial considerations. The program manager said the scoring of commercial potential was subjective. He was unaware of any instances in which a company's commercialization record had influenced the choice of proposals.[2]

The Five Smaller Programs and Their Evaluation of Commercial Potential

The five smaller programs are emphasizing commercial potential, but only the Environmental Protection Agency indicated that the commercialization record plays a potentially significant role in making awards.

At the Environmental Protection Agency, the director of the Environmental Engineering Research Division told us that the biggest single change in the agency's program since the 1992 reauthorization has been the increased emphasis on commercialization. He said that commercialization used to be one of six criteria used in judging proposals; now, it is one of five. For phase I proposals, the agency requires a 2- to 3-page commercialization plan. For phase II proposals, it requires a fully developed plan. In a peer review of phase II proposals, a commercialization reviewer is responsible for rating the quality of the complete plan. One effect of this increased emphasis is that a company's commercialization plan and record play a greater role in the peer review's final rating of a proposal. Specifically, according to the director, if a company has a poor plan and record, its proposal will have much more difficulty obtaining a "very good" or "excellent" rating (required for the proposal to be eligible for funding), particularly if, technically, the proposal is in the borderline area between "good" and "very good."

[2]In commenting on our draft report, the National Institutes of Health stated that some of their staff take past commercialization success into account. However, those data have not been tracked by a central office in the Institutes, which may be why the program manager was unaware of any instances.

Agriculture sent a questionnaire to all phase II winners from the start of the program through 1995 and found that more than 50 percent reported some commercial sales. The Department's SBIR program manager said that it would be rare for a company with a poor commercialization record to be penalized on a phase I proposal; instead, he said, a commercially successful company might receive a boost from its previous success. At phase II, more attention is given to commercial potential, but the two most important review criteria are (1) the degree to which phase I objectives were met and technical feasibility was demonstrated and (2) the technical merit of the phase II proposal.

Transportation's program manager stated that Transportation reviewers consider technical merit and commercial potential when reviewing proposals. He added that a company's commercialization record has little, if any, bearing on the selection of proposals and that the record has never been used to make or break a proposal. Commerce has developed guidelines for a commercialization plan to be included in phase II proposals. The program manager said that this plan, which documents how the company will convert its research into a commercial product, is critical to winning a phase II award. Commerce has not found the commercialization record to be a significant factor in its selections. Education's criteria for phase I awards include the potential commercial applications of the research. Past commercialization success is among the criteria for phase II awards.

Penalties for Poor Commercialization Records May Have Unintended Consequences

Agencies have collected data on commercialization by companies, including frequent winners. According to SBA's Assistant Administrator for Technology, the 1992 reauthorization directs agencies to collect information on commercialization by companies with 15 or more phase II awards but does not clarify how they are supposed to use it.[3] Without such clarification, agencies may establish different sets of rules that will be confusing to companies, many of which have received SBIR awards from more than one agency. For example, as discussed later in this chapter, DOD planned to implement an approach that would have greatly increased the

[3]The act requires agencies in their annual reports to include an accounting of the phase I awards made during the reporting period to entities that have received more than 15 phase II awards during the preceding 5 fiscal years. 15 U.S.C. 638(l)(2). The act also required SBA to modify the SBIR program directive to provide for procedures to ensure that these companies, when they submit phase I proposals, are able to demonstrate the extent to which they have been able to secure phase III funding for their previous phase II awards. 15 U.S.C. 638(j)(2)(H). The policy directive requires that companies document the extent to which they have secured phase III funding to develop concepts resulting from their phase II awards and for agencies to collect and retain such information. SBIR Policy Directive para. 15c.

importance of the commercialization record. In addition, DOD's approach would have led to unintended consequences, as early tests of its plan indicated. None of the other agencies developed such an approach.

SBA's Role in Addressing Frequent Winners

In response to a requirement in the 1992 legislation, SBA included a section in its 1993 policy directive requiring agencies to collect and retain documentation on companies receiving 15 or more phase II awards in the previous 5 years. The section restated the law while furnishing no additional details. The Assistant Administrator for Technology told us that, in his view, the legislation requires agencies to collect information on commercialization but provides no guidance on what should be done with it.

DOD's Response to Frequent Winners

DOD's program director told us that all companies' proposals are given equal scrutiny when being ranked for commercial potential. The only way "frequent winners" will be given somewhat greater scrutiny is connected with the development of a past performance index. This index applies to companies that won five or more phase II awards from fiscal year 1984 through fiscal year 1995. DOD's focus on companies with five or more awards during this period is broader than the focus on multiple winners specified in the 1992 act. DOD's approach potentially includes hundreds of companies, whereas, according to an SBA official, the law leads to a list of only 24 frequent winners for fiscal years 1993-97, the latest period for which data were available.

DOD has had difficulty making effective use of the commercialization records obtained from frequent winners. The problem has arisen because of the large number of phase II awards and the volume of information. For example, the program director told us that the company with the most phase II awards over the life of the SBIR program has submitted information on 94 completed phase II awards in a 19-page document.[4] According to the program director, many of the technical reviewers have little familiarity with the program and therefore lack the background to grapple with so much information and reach a "bottom line" about the company's commercialization record.

To alleviate this problem, the program director plans to create a past performance index for the program's frequent winners. Each of these

[4]He noted that the company should also have provided information on its 54 ongoing phase II awards but did not do so.

companies will be required to submit an electronic file of the commercialization results of its phase II awards that will be used to calculate how the company's sales and additional developmental funding compare with the DOD-wide average per award. The output will be a number showing a company's commercialization record as a percentage of the DOD-wide average. The company will be asked to include this figure in each new proposal so that the technical evaluators will see for the first time a snapshot of the company's past commercial performance level. In discussing the weight that will be given to the index in evaluating proposals, the program director said that, in general, DOD would not prescribe any particular use for the data.

According to the program director, the only requirement that will govern all of DOD's SBIR agencies applies to companies that have received five or more phase II awards since the start of the program and have achieved only 5 percent or less of the DOD-wide average for sales and additional developmental funding per award.[5] For these companies, at the agency's discretion, the rating on commercial potential may be "capped" at half of the total possible score. This cap will increase the weight for the commercial record from the current one-twelfth of the total score to one-sixth, a change that could reduce the number of awards to this group of companies. (On a 100-point scale, DOD's "cap" would decrease a proposal's score by about 16 points, a substantial penalty). This policy, however, permits an exception if the program manager recommends that the company be exempted from this requirement and the contracting officer approves the exception.

In November 1998, the DOD support contractor implementing the index pointed out some difficulties in making the index work effectively and set the stage for the revised approach. The contractor noted that two-thirds of all phase II awards in DOD show no sales. Against this backdrop, even frequent winners with relatively low sales could turn out to be "above average." The leading frequent winner, for example, came out above average simply because it had achieved limited sales with its numerous phase II awards. The support contractor pointed out that the index did not allow for important factors, such as recent awards to companies that have not had time to commercialize them. In addition, it did not distinguish between technologies such as software, which may be commercialized quickly, and hardware, which may require a manufacturing step that takes longer to commercialize. The support contractor concluded that much

[5]Initially set at 25 percent, this figure was lowered to 5 percent under DOD's revised approach. As a result, significantly fewer companies are potentially affected by DOD's plan, and their level of commercialization is significantly lower than under the earlier plan.

more testing needed to be done before the index could become an effective tool. The support contractor expressed concern about the number of companies that might be affected and said that if it was too high, the threshold would need to be adjusted. Further work by the support contractor in April 1999 increased DOD's concern about the unintended consequences of the Department's plan and led to important revisions, including the lowering of the threshold.[6]

The Department of Energy's Response to Frequent Winners

Energy has collected data on commercialization by its awardees, including frequent winners. The program manager told us that these data do not indicate a significantly lower level of commercialization by frequent winners in general. For example, awardees with five or fewer phase II awards from fiscal year 1984 through fiscal year 1996 averaged $1 million in sales per project. Companies with nine or more phase II awards during the same period averaged $854,000 per project. If the frequent winner with the poorest record among the 10 companies with nine or more phase II awards is removed from the calculation, the average rises to $939,000. Of the two companies that received the most phase II awards from Energy from fiscal year 1984 through fiscal year 1996, the company with 16 awards averaged $1.3 million and the company with 17 awards averaged $1.7 million in sales per project.

Because Energy has developed detailed commercialization data on its frequent winners, we asked the program manager whether this information might have led to penalties during evaluations of proposals from frequent winners with poor commercialization results. He told us that he has not used this information to penalize any company beyond considering commercial potential in phase II, as discussed previously. He said that the law instructs the agencies to collect the data but, in his view, does not tell them how to use it effectively in dealing with frequent winners, even those that are clearly poor performers. He concluded that if the Congress wants the agencies to monitor frequent winners and have the data make a difference in the award process, then the law itself may have to be clarified.

Other Agencies' Responses to Frequent Winners

Other agencies have given only limited attention to the concern about frequent winners. For example, program managers at the National Science

[6]In commenting on the draft report, DOD's SBIR program director stressed that the past performance index is one among many informational tools that DOD will use in evaluating proposals. He further noted that, for a company with a strong commercialization record, the index offers an opportunity for a favorable rating that may lead to a higher score on the company's proposals.

Foundation and the National Aeronautics and Space Administration were uncertain whether the legislation defined a frequent winner as a company with 15 awards in a 5-year period from a single agency or from all agencies combined. They interpreted the law to mean awards from a single agency and found virtually no companies that belonged in this category at their agencies, so they did not focus further on the issue. The program manager at the National Institutes of Health told us that his agency collected the information, as required, but that officials were uncertain how to use the information effectively and said that it played a minimal, if any, role in the evaluation of proposals. In general, the five agencies with smaller programs have taken no special steps to focus on frequent winners.

The Emphasis on Commercialization Raises Questions About the Role of Other Goals in Evaluating Companies' Performance

Despite the greater emphasis on commercialization, the program's other goals remain important to the agencies when evaluating companies' accomplishments and subsequent proposals. According to some of the program managers, a relatively low level of commercialization may not signal failure because a company may have achieved other goals. The difficulty, for agencies, of using any particular goal as a key criterion for selecting future proposals for funding stems from their not having (1) a clear definition of the program's goals, (2) information on the relative weight that should be given to these potential goals, and (3) criteria for judging whether these goals have been achieved.

Finding practical ways to define and measure the SBIR program's goals in order to evaluate proposals has been difficult. For example, efforts to define and measure technological innovation, which was one of the program's original goals, have posed a challenge. Although definitions vary, there is widespread agreement that technological innovation is a complex process, particularly in the development of sophisticated modern technologies. Technological innovation can involve many steps, including research, engineering, prototype testing, and product development. Because technological innovation occurs in many different ways, no one indicator is an accurate measure of it. Differences among firms' operating styles can also create measurement problems. Some innovative firms will file many patent applications (which are sometimes used as measures of innovation), while others will prefer to retain trade secrets. Similarly, according to SBA's Assistant Administrator for Technology, the 1992 reauthorization lacks a clear definition of "commercialization," and he has sometimes differed with agencies on its meaning. This absence of a definition makes it more difficult, in his view, to determine when a frequent winner is "failing" to achieve a sufficient level of

commercialization and how to include this information in an agency's review of the company's proposal.

The relative weight that should be given to the goals when evaluating proposals remains unclear. Innovation and responsiveness to an agency's needs, for example, may compete with the achievement of commercialization. In the view of many program managers, innovation involves a willingness to undertake R&D with a higher element of risk and a greater chance that it may not lead to a commercial product; responsiveness to an agency's needs involves R&D that may be aimed at special niches with likewise limited commercial potential. Striking the right balance between encouraging new, unproven technologies and achieving commercial sales is, according to the program managers, one of the key ingredients in the overall success of the program. A former director of the Ballistic Missile Defense Organization's program told us that commercialization could be significantly boosted. He added, however, that he would oppose the use of commercial success as an exclusive measure for the program because innovation and support for higher-risk projects would then be virtually eliminated as goals.

Agencies have also not agreed on criteria for what constitutes "success" in relation to these goals. The former program manager of the Ballistic Missile Defense Organization put the problem clearly: How much commercialization is "enough?" If an exclusive focus on commercial success might signal that the program was "picking winners" and sacrificing innovation, then what is the appropriate mix of higher-risk projects that lead less frequently to commercial outcomes and lower-risk projects that lead more frequently to successful products?

The difficulty caused by this lack of criteria is compounded by other factors, such as the high concentration of commercial success in only a handful of projects in the program. For example, as shown by our 1992 report, 1.5 percent of the projects accounted for almost half of all the sales at that time. A 1996 survey by the DOD support contractor of DOD projects from 1984 to 1992 also found that 1.5 percent of these projects accounted for 50 percent of the sales and 4 percent accounted for 75 percent of the sales. For a program in which the great majority of projects achieve no sales or only very limited sales, the evaluation of subsequent proposals from individual companies becomes more difficult if commercialization is considered the primary goal. As the SBA contractor stated in a presentation at the National Academy of Sciences in November 1998, this high concentration of success necessitates large-scale surveys of the program

because the outcomes achieved by smaller subsets of winners or individual companies may be significantly influenced by the presence or absence of just a few major successes. In a separate discussion, the SBA contractor noted that Creare, one of the most frequent winners mentioned in chapter 2, generated $110 million in actual and $90 million in anticipated sales through a single phase II award entitled "Numerical Modeling for Chemical Vapor Deposition."

As the emphasis on commercialization has grown, so have concerns that noncommercial successes may not be captured at all. For example, the president of the Innovation Development Institute in Massachusetts expressed concern that the growing emphasis on commercialization was occurring at the expense of innovation and agencies' R&D needs. She believed that some of the higher-risk projects that received awards in the mid-1980s and led to "technology leaps" would not now be seriously considered for awards because they would be judged too time-consuming and too risky. She was also disturbed by the suggestion that firms doing high-quality work and meeting the needs of a federal agency in an innovative manner are somehow deficient. There was no suggestion, however, of a valid methodology for assessing success in meeting the program's other goals.

Program managers also expressed concern that noncommercial accomplishments may not be adequately recognized. For example, the Navy program manager described a software project for a special military need with limited sales potential; he said it was very helpful in reducing the agency's expenditures but believed that the savings would not be captured in typical measurements of commercialization. Likewise, the program manager at the National Institutes of Health cited instances of special medical equipment, such as pediatric heart devices, with limited markets. He pointed out that emphasizing commercialization as the primary goal would discount achievements in these areas. In general, we found that program managers valued both noncommercial and commercial successes and feared that the former might be ignored in emphasizing the latter.

Conclusions

The existing legislation has generally increased participating agencies' consideration of the commercial potential associated with new phase II proposals. It directs the agencies to consider the commercial potential (including the company's commercialization record as one of four types of evidence) of each phase II proposal but does not clarify the extent to

which this potential should be a factor in making awards. This lack of clarity about the role of commercialization is further evident in the provision dealing with frequent winners. It directs the agencies to collect information from companies submitting phase I proposals that have received more than 15 phase II awards during the preceding 5 years to demonstrate the extent to which they have been able to secure phase III funding for these awards. However, the law provides no guidance on how this information should be used. In turn, the emphasis on commercialization has raised questions about the role of the program's other goals in the evaluation of companies' proposals. Program managers and others have expressed concern that the other goals and accomplishments may not be sufficiently recognized.

Lacking guidance on these issues, agencies must determine their own responses, and differences among agencies have emerged. In particular, DOD developed a unique approach that would have led to lower scores on proposals from companies with 5 or more phase II awards if they were perceived as poor commercializers. DOD has revised its approach to account for differences in the number of awards to specific companies and to avoid the unintended consequences of its plan. Despite this improvement, the lack of clarity in the legislation remains a concern.

Matter for Congressional Consideration

When the Congress considers the reauthorization of this program, it may wish to clarify the relative emphasis that agencies, in evaluating companies' proposals, should give to a company's commercialization record as part of the goal of commercialization and to the program's other goals. This clarification would help ensure uniformity in the program and a clear set of standards by which to determine whether, and to what extent, commercialization and the program's other goals should be considered in evaluations of proposals.

Agency Comments and Our Evaluation

Only the National Institutes of Health expressed concern about the matter for congressional consideration. The Institutes believed that the matter's focus on uniformity would miss the fact that different relative emphases on the commercialization record may be appropriate to agencies' different missions. The Institutes also questioned what they considered to be the report's close association between success and commercialization. In general, we do not believe that an effort to clarify the relative emphasis on commercialization and the program's other goals will lead to a focus on uniformity or insensitivity to the agencies' divergent missions. Moreover,

the report does not equate success and commercialization. This chapter discussed the way in which the emphasis on commercialization raises questions about the role of the program's other goals and stated that despite the greater emphasis on commercialization, these other goals remain important to the agencies when evaluating a company's accomplishments and subsequent proposals. We made no changes to the matter as a result of the comments provided by the National Institutes of Health.

SBA Has an Opportunity to Standardize Evaluations of the Program's Outcomes

Commercialization is only one of the program's objectives but has become the main outcome for measuring its effectiveness. Studies of commercialization have proliferated as agencies have tried to obtain data on commercial activity. In the 1990s, studies by GAO, individual agencies, and academic specialists have focused on sales, developmental funding, "success stories," and a variety of other measures. A review of these studies shows that although they rely on different approaches, they contain some common criteria for success, and it suggests a further opportunity for standardizing the measurement of commercialization. Two of the main steps toward establishing a standard approach would involve the development of uniform criteria for success and an improved SBIR database at SBA that captures information on commercial outcomes. Established before the passage of the Results Act, SBA's database contains information emphasizing input data (such as company names and awards) while giving virtually no attention to results. As SBA develops a new database, called Tech-Net, which is scheduled for full implementation in 1999, it has an opportunity to include outcome-related measures that can be used to track commercialization and other indicators of success.

Various Methods With Similar Criteria for Success Have Been Used in Attempting to Measure Outcomes

Various methods have been used to quantify commercialization and related outcomes of the program. Some of the major methods include the approach in our 1992 report on commercialization, the Department of Energy's emphasis on a company's products and services (derived from SBIR technology) rather than on individual SBIR projects (an approach that sometimes has the effect of "clustering" awards), reliance on "success stories," and an academic approach. A frequent winner has also developed a method of its own. Although the methods have differed, many of the key criteria for success focus on common concerns, such as levels of sales and developmental funding. The following section gives an overview of these methods but is not intended to include every study of commercialization in the program.

Survey Criteria for the 1992 Report Identified Outcomes

Our 1992 report responded to a congressional mandate that we report on the commercial outcomes of the program. We surveyed companies that had won phase II awards from 1984 through 1987 and received information on the outcomes of 1,457 projects. The survey instrument contained about 40 questions. One of the key questions was the following: "Has the technology associated with this project led to additional developmental funding and/or sales, and is further work on this technology under way?" This question was intended to divide projects into four major categories

according to their phase III outcomes. It identified projects that (1) had achieved funding and/or sales and had further work under way, (2) had not yet achieved funding and/or sales and had further work under way, (3) had achieved funding and/or sales and had no further work under way, or (4) had achieved no funding and/or sales and were discontinued. The remainder of the questionnaire focused mainly on obtaining further information about projects falling into each of these categories. For example, for projects that remained active in phase III, we asked detailed questions about the amounts of additional developmental funds and sales, the sources of their funds and the markets for their sales, and the levels of financial activity expected in the future.

This approach has also been used in later surveys of the program. In 1996, a DOD support contractor used it to survey all of DOD's phase II awards. The contract manager kept the basic structure intact but streamlined it by eliminating certain questions that had not led to findings in our own 1992 review. In 1997, SBA asked the same DOD support contractor to conduct a governmentwide survey of SBIR commercialization using the same questionnaire. Additional use of this approach is being made by individual agencies. In 1998, USDA sent a questionnaire to its phase II awardees that uses similar outcome-related criteria. The National Aeronautics and Space Administration has also focused on the outcomes associated with individual phase II awards. Its survey asks for information on sales to government agencies and the private sector, additional developmental funding, the number of spin-off firms and patents, and other measures of outcomes. As mentioned in chapter 3, the agency has sent the questionnaire to its phase II awardees.[1]

Energy's Approach Differs, Permitting the Clustering of Awards to Measure Outcomes

The Department of Energy's approach differs from GAO's 1992 approach in that a company is asked to report on products and services derived from SBIR technology instead of on individual awards. (As noted in ch. 3, Energy has required its phase II awardees to provide annual reports on phase III funding—i.e., on sales and further developmental funding—at the end of phase II and for 3 years.) The data summary that Energy sends to companies includes a list of all of their previous phase II awards. For each product or service identified, the companies are instructed to identify which phase II projects (as many as appropriate) contributed to that product or service. As a result, Energy found, multiple SBIR projects

[1]In commenting on our draft report, the National Aeronautics and Space Administration stated that its survey of phase II projects provides relatively current information on commercial activities. It stated that its survey is being implemented as an ongoing effort rather than as a single effort that would quickly become outdated.

sometimes contributed to the same product or service, and, conversely, multiple products and services were sometimes derived from the same SBIR project. The program manager believes that companies find it easier and more reliable to trace their commercial results to their own products and services rather than to a single award. He is concerned that the attempt to capture the results of each award individually may lead to "double counting," since more than one award sometimes leads to the same product and, thus, to the same commercial result.

Despite the difference in methodology, Energy's approach relies on outcome-related criteria for success. For example, it asks about products or services, sales and developmental funding, partners, and abandoned projects. In addition, the program manager noted that, in most cases, companies responding to the form have ascribed their products and other commercial outcomes to an individual award, which further reduces the apparent difference between the two approaches. At our request, he reviewed the responses from a sample of 143 companies (about half of all companies with phase II awards in the first 10 years of the program) and found that about four-fifths of the companies responded in terms of individual awards.

The "Success Stories" Approach Has Similar Basic Criteria for Success but Also Has Important Limitations

The National Science Foundation, DOD, the National Aeronautics and Space Administration, and other agencies have presented success stories stemming from their awards. The purpose of these stories varies from agency to agency. For example, the National Science Foundation has used this approach to document the most significant results of its awards. By contrast, the National Aeronautics and Space Administration places little value on the approach as a measure of the program's results and uses it primarily to help companies market their technologies.

The National Science Foundation has used this approach three times. Its first review of success stories was completed in September 1996 and was entitled "50 Examples of SBIR Commercialization." In carrying out the study, the Foundation's contractor obtained the information through telephone and personal interviews, usually with the company president at the time of the original award and through the early growth period. The key questions included the following: (1) Did any of the Foundation's SBIR research awards make a significant difference to the performance and growth of your company? (2) Did the project result in commercial sales? As a follow-up question for discussion, the person being interviewed was asked to include results that probably would not have occurred without

the SBIR program or the Foundation's SBIR award, or sales, investment, and other actions that would not have taken place in the same period. The survey used these criteria for success to explore the results in an "open-ended" way rather than relying on a more detailed and structured set of questions.

This approach led to summaries of 50 of what the Foundation considered its major successes showing a wide variety of commercial outcomes. Overall, as the program director testified in April 1998, the success stories approach led the Foundation to find that, with respect to the private sector's commercialization of technology, the top 50 successful small business grantees (representing about 10 percent of the Foundation's phase II grantees) have grown until they account for direct sales of $2.7 billion and 10,000 jobs created. Given that the Foundation's total investment in the SBIR program throughout its history is $350 million, the program manager concluded that the Foundation had received a 7-to-1 return on its investment.

The program director told us that a second contractor is resurveying the same 50 companies to verify the original information and gain more insight into these companies. The Foundation has also let a third contract to study 20 additional companies. The program director said that these studies of 70 companies would capture a significant percentage of the success achieved with the Foundation's awards.

DOD's program director told us that all of DOD's major SBIR agencies have used the success stories approach. He cited problems with this approach, including the lack of a consistent method among DOD's separate agencies and the vagueness of the resulting information. He said that each component, including the SBIR headquarters office in the Office of the Secretary of Defense, goes its own way in asking questions of companies and that no systematic approach or evaluation has been attempted. Moreover, he said that the resulting information, when companies are asked to describe their outcomes, frequently leads to vague phrases such as "advancing the state of the art." He commented that, if the success stories approach is to prove valuable, companies should be asked a better set of questions.

The National Aeronautics and Space Administration has relied on its questionnaire survey to obtain information on commercial outcomes; by contrast, according to the SBIR program manager, the agency's use of success stories has served mainly to market companies' technologies

rather than to measure results. The agency lets the companies prepare and publish their success stories in such publications as its Tech Briefs magazine, which reaches an audience of about 220,000 readers. The agency's only role in this effort has been to provide a common format for the stories. The format requires the companies to present their stories in a four-step series: (1) a description of the innovation, (2) the accomplishments, (3) commercialization, and (4) government/science applications.

In general, our review of the "success stories" approach indicated that it is being used extensively but that its purpose varies. The National Science Foundation's approach is intended to provide a comprehensive survey of commercialization results, whereas the National Aeronautics and Space Administration uses "success stories" mainly to help its winning companies market their technologies. In addition, the success stories approach has not led to the development of carefully structured questions. The approach is "open-ended," meaning that it can be used to develop a detailed story for individual companies but does not lend itself to greater systemization. A further shortcoming is its omission of less successful projects, which tends to bias the results of this approach.

An Academic Approach Illustrates a Different Set of Methods but Contains Similar Criteria About Sales and Job Creation

Academic studies have also focused on the program's commercial outcomes. One of the leading specialists in this area stated in a paper presented in October 1998 at a National Research Council workshop on SBIR that, as the number of public venture capital programs such as SBIR has grown, policymakers and economists are increasingly grappling with the question of how to assess these programs. The paper pointed out that one of the main academic approaches is to examine the long-run impact of participation in public venture capital programs on the growth of the firms themselves, relative to a matched set of firms.

This approach is directly related to the discussion of commercialization in this chapter. The specialist at the workshop provided an example of it in another paper.[2] The paper analyzed a sample of firms that had received SBIR awards and compared them with a closely matching set of firms that had not received awards during the same time period. The comparison focused on the impact of participation in the program on sales and employment. The analysis found that the mean increase in both employment and sales from the end of 1985 to the end of 1995 was higher

[2]Josh Lerner, The Government as Venture Capitalist: The Long-Run Impact of the SBIR Program, Working Paper 5753, National Bureau of Economic Research (Sept. 1996).

for SBIR firms (a boost of 26 versus 5 employees and $5 million versus $2 million in sales). The specialist pointed out several limitations of this approach, including the fact that it does not measure the increase in a firm's value. Because over 98 percent of the firms were privately held, assessing the valuation and profitability of the awards was very difficult.

A Frequent Winner Has Developed a Method for Evaluating Commercialization

The chief executive officer of a frequent winner developed a new approach in a March 1998 paper.[3] The paper states that although numerous methods could be used to gauge the SBIR program's success, his approach focuses on the follow-on funding, or sales, achieved. It also states that SBIR awards span a wide range of commercial potential, from those awards aimed at highly commercializable technologies to those that address narrow, mission-specific requirements with little or no follow-on potential. It adds that, for awards in the latter category, it is important not to penalize the contractor who successfully responds to such solicitations. It then separates projects into agency-specific, commercially viable, and dual-use categories and contends that the ability to accurately apply such classifications was confirmed by relatively little deviation among various observers, including an advisory board representing six venture capital firms. Subsequently, in calculating the company's return on the SBIR investment, it eliminates the "agency-specific projects" that are judged at the outset to have virtually no commercial potential. It concludes that when these projects are deducted, the company shows a successful rate of return on the SBIR investment. A more detailed analysis, according to the paper, reveals that only three or four of the phase II awards in the "commercially viable" category accounted for more than two-thirds of all follow-on funding over a 10-year period and that, in each of these cases, the follow-on business could not have been reliably predicted. At the end, the paper strongly recommends that an analysis of other multiple-award winners be carried out in this manner.

[3]Robert F. Weiss, "Analysis of Follow-on Funding Generated by Major SBIR Award Winners—The Case of Physical Sciences Inc.", Physical Sciences, Inc. (Mar. 1998).

A Standard Approach Involves the Use of Uniform Criteria for Success and Improvements in SBA's New Database

The methods we identified do not provide consistent information across agencies on the program's results. The use of a single method with uniform criteria for success focusing on outcomes would produce such information, enabling SBA and the agencies to satisfy the requirements of the Results Act. The expansion of SBA's SBIR database affords an opportunity to standardize the reporting of results. The previous SBA database contained two general data fields for the results of SBIR awards, but they were vague, optional, and seldom used. To overcome this limitation, standard criteria can be identified and turned into specific data fields, capturing a variety of commercial and other measures. This approach, if implemented, will make available—for the first time—a central database for the program that allows for the effective evaluation of its commercial outcomes and other measures of success.

An Opportunity Exists to Respond to the Results Act by Using Standardized Criteria for Success and Capturing Outcomes in SBA's New Tech-Net Database

The Government Performance and Results Act of 1993 was intended, among other purposes, to improve the effectiveness of federal programs and enhance public accountability by promoting a new focus on results. In 1997, the Congress specified that information on the SBIR program must be included by each federal agency in the updates or revisions to its strategic plan required by the Results Act. (15 U.S.C. 638(t)). As the central administrative agency for the program, SBA has maintained a governmentwide database that brings together the data submitted by the individual agencies participating in the program. According to the Assistant Administrator for Technology who oversees the program, SBA has used the database primarily to develop its annual reports on the program and to accomplish other purposes as required by the SBIR legislation. Currently, however, SBA is developing a new database called Tech-Net. This effort provides a unique opportunity to address the shortcomings of the previous database. It may also help agencies respond to the Results Act by using standardized criteria for success and capturing the commercial and other outcomes of SBIR activities.

For the purpose of measuring these outcomes, the original SBA database has had two major shortcomings. First, because it was developed long before the Results Act emphasized the measurement of outcomes, the database reflects the earlier attention given to inputs. It consists of 62 "fields," or specific pieces of information, such as the name of each company and the amount of funding that it received. Although the database includes two fields for information on the results of awards, according to the database manager, these fields capture only the companies' general expectations of benefits (such as cost savings or more

efficient service) at the time of receiving a phase I or phase II award. In addition, the use of these data fields was optional, so some of the companies did not fill them out. In general, companies have not provided information on the actual (as opposed to the anticipated) results of their research. Second, the database contains unreliable information. One key reason for unreliable data is the lack of a unique identifying code for each company in SBA's current database. Identification has depended simply on the company's name. Slight variations in spelling, however, have created difficulty because the database is not able to recognize these differences and thus counts each separate spelling as a separate company.

In June 1998, SBA announced the introduction of a new database called Tech-Net at a meeting of program managers. This new system is an Internet-based database containing SBIR awards, as well as awards and information associated with other technology programs. SBA describes Tech-Net as an electronic gateway of technology information and resources for and about small high-technology businesses. It provides a search engine for researchers, scientists, and government officials; a marketing tool for small firms; and a potential link to investment opportunities for investors and other sources of capital. It will enable agencies to update their information on SBIR awards and companies to update key information on their activities. The previous information will be preserved in a special archive. The entire abstract of each award will be a source of keywords, allowing searches not only of the current information but also of the data saved in the archives. Thus, a key feature of the system will be its ability to show changes in the program over time.

SBA is taking steps to implement Tech-Net and to ensure that it keeps a more accurate record of company names than the previous database. SBA's Assistant Administrator for Technology emphasized that implementing Tech-Net by the spring of 1999 was a priority. As part of this effort, he plans to send a letter to every company that has received an award since the start of the program. The letter will contain a unique user-identification number for each company to prevent confusion over the identity of participants. In December 1998, SBA sponsored a technical meeting of SBIR database managers representing numerous agencies to determine how much difficulty, if any, they would have in submitting the data required by Tech-Net in a common electronic format. The managers, whose agencies are required by law to submit data on the program to SBA, were optimistic about their ability to provide whatever data SBA requested. In talking with us about the inclusion of outcome-related data fields, the

database managers at SBA were also optimistic about their ability to expand Tech-Net to capture this information.

Conclusions

The commercial outcomes of the SBIR program have been the subject of numerous evaluations that have not followed the same approach but have focused on many of the same criteria for measuring the program's success. An opportunity exists to identify the most useful and uniform criteria for success and to build the answers to them into the new Tech-Net database at SBA.

Recommendation to the Administrator, SBA

To respond to the Government Performance and Results Act, we recommend that the Administrator develop standard criteria for measuring the commercial and other outcomes of the SBIR program and incorporate these criteria into the new Tech-Net database. The criteria should include uniform measures of sales, developmental funding, and other indicators of success.

Agency Comments and Our Evaluation

SBA said it concurred with the recommendation, adding that for the recommendation to work, the participating federal agencies must agree to provide SBA with information on the outcomes of their projects. It also stated that any action by the Congress must include a provision that will require the participating federal agencies to provide this critical information to SBA through the new Tech-Net database system. However, agencies are already required to report information on their SBIR awards to SBA. Additional information on the outcomes of projects could be included with this submission. Our recommendation would simply provide for consolidating the information in a uniform format in the Tech-Net database.

The National Aeronautics and Space Administration, the Environmental Protection Agency, and the National Institutes of Health commented on this recommendation. In general, their concerns focused on the entry, maintenance, safeguards, reliability, and commercial emphasis of the data to be captured in the Tech-Net database. The National Aeronautics and Space Administration expressed concerns about data safeguards, data reliability, and incentives to firms to provide the data. It also asked us to furnish specific measurements and details for implementation. The Environmental Protection Agency questioned its ability to require information from the companies. The National Institutes of Health

expressed concern that the Tech-Net database is assumed to be the correct and single approach even though agencies have widely varying missions and preferences for evaluating their own programs. The Institutes raised questions about the commercial emphasis of the data to be entered, who is responsible for entering and validating the data, what level of compliance is to be expected, what incentives exist for grantees to submit data, and how reliable the data are likely to be.

In making this recommendation, we recognized that issues about its implementation such as the agencies have identified would arise. We did not include additional detail because we believe that SBA and the program agencies are in the best position to identify and resolve these issues. The effective implementation of this recommendation will require close cooperation among the participating companies, the program agencies, and SBA.

Our recommendation may be helpful in addressing concerns about the reliability of the data to be submitted. Previous approaches, such as questionnaire surveys, were labor-intensive and the results were difficult to verify. The information in a current, centralized database could be sampled more easily in a systematic way to verify its accuracy. In response to the concern expressed by the National Institutes of Health about the widely differing missions of the agencies, we added a reference to other indicators of success in our recommendation that reflects our recognition of the need for flexibility in identifying successful outcomes.

SBIR Phase I Award/Proposal Ratios in Fiscal Year 1998, by Agency

Agency	Proposals received from non-EPSCoR states	Awards made to non-EPSCoR states	Award/ proposal ratio, in percent, for non-EPSCoR states	Proposals received from EPSCoR states	Awards made to EPSCoR states	Award/ proposal ratio, in percent, for EPSCoR states
Department of Defense	8,543	1,200	14.0	557	59	10.6
National Institutes of Health (grants only)	2,311	667	28.9	129	25	19.4
National Aeronautics and Space Administration	2,183	318	14.6	152	27	17.8
National Science Foundation	1,439	212	14.7	95	22	23.2
Department of Energy	1,120	191	17.1	71	13	18.3
Department of Commerce	351	39	11.1	23	6	26.1
Department of Agriculture	324	57	17.6	96	20	20.8
Environmental Protection Agency	294	35	11.9	27	2	7.4
Department of Transportation	232	19	8.2	14	2	14.3
Department of Education	218	39	17.9	13	2	15.4
Total	**17,016**	**2,777**	**16.3**	**1,176**	**178**	**15.1**

Source: GAO's analysis of data from agencies participating in the SBIR program.

Comments From the Small Business Administration

Note: GAO comments supplementing those in the report text appear at the end of this appendix.

U.S. SMALL BUSINESS ADMINISTRATION
WASHINGTON, D.C. 20416

11 MAY 1999

Ms. Susan D. Kladiva
Associate Director, Energy,
Resources, and Science Issues
United States General Accounting Office
Washington, DC 20548

Dear Ms. Kladiva:

Thank you for the opportunity to review your proposed report entitled Federal Research: Small Business Innovation Research Can Be Strengthened (GAO/RCED-99-114). We generally accept your findings as stated in the report subject to the following comments:

- Title of the Report: We have been informed by your staff that the correct and full title of this report is **Evaluation of the Small Business Innovation Research Program** Can Be Strengthened. (Emphasis added to highlight words incorrectly omitted from the title during the printing of the draft report.) We agree that program evaluation is critical to the success of the program and there is room for improvement; and

- Using the New Tech-Net Database to Develop Standard Criteria for Measuring the Commercial Outcomes of the SBIR Program: We have worked closely with the participating Federal agencies and your staff to build the new Tech-Net database to accomplish this goal. We strongly concur with your recommendation to proceed to establish standard criteria in order to facilitate this process and we have started the process to do so. However for Tech-Net to succeed, the participating Federal agencies must agree to provide us with the information on a regular and timely basis. Failure to provide us this information will undermine Tech-Net and result in incomplete and inaccurate data files.

See comment 1.

I trust that you will find this information helpful and thank you for your ongoing support of the U.S. Small Business Administration and our Small Business Innovation Research program.

Sincerely,

Richard L. Hayes
Associate Deputy Administrator
for Government Contracting and
Minority Enterprise Development

Federal Recycling Program Printed on Recycled Paper

GAO Comment

The following is GAO's comment on the Small Business Administration's letter dated May 11, 1999.

1. This concern is addressed in the discussion of agency comments at the end of the executive summary and of chapter 4.

Comments From the Department of Defense

Note: GAO comments supplementing those in the report text appear at the end of this appendix.

OFFICE OF THE UNDER SECRETARY OF DEFENSE

3000 DEFENSE PENTAGON
WASHINGTON, DC 20301-3000

ACQUISITION AND TECHNOLOGY

April 20, 1999

Ms. Susan Kladiva
Associate Director, Energy, Resources, and
Science Issues
Resources, Community, and Economic
Development Division
U.S. General Accounting Office
Washington, DC 20548

Dear Ms. Kladiva:

The Department of Defense appreciates the opportunity to comment on the draft General Accounting Office (GAO) report entitled Federal Research: Small Business Innovation Research Can Be Strengthened. The report contains very useful findings and insights on several key issues affecting the SBIR program – the distribution of awards, the role of commercial potential, and the measurement of program outcomes. Like GAO's previous reports on the SBIR program, this report will help both the federal agencies and Congress improve this important program.

One finding in the draft report has already proven to be of great assistance to DoD in its management of the SBIR program. The draft GAO report, in commenting on the statistical index we are developing to compare proposers' commercialization track records against the DoD-wide SBIR program averages, identifies a design flaw in our earlier draft version of the index. Specifically, the earlier draft index did not take into account the concept of statistical significance and so (for instance) would have disadvantaged companies that had won 5 previous awards versus companies that had won 50. Based on GAO's comments and subsequent discussion with statisticians and GAO staff, we have revised the index formula to correct the problem in advance of our May 1 implementation date. We appreciate GAO's assistance in this matter and would ask that the report's text be updated to reflect the change we have made.

See comment 1.

We would also like to clarify that this index is just one informational tool for DoD proposal evaluators to consider among many other factors in the proposal evaluation process. As provided in the 1992 SBIR Act, DoD evaluates SBIR proposals based on three criteria – (1) soundness, technical merit, and innovation of the proposed approach, (2) qualifications of the key investigators, and (3) potential for commercialization in military or private sector markets. Under the Act, DoD proposal evaluators look at a company's commercialization track record as one factor in assessing the third criterion, potential for commercialization. Our new statistical index will merely make the information we currently collect on a company's commercialization track record more useful to DoD proposal evaluators by showing how it compares with the DoD-wide SBIR program averages.[1]

[1] The only time the index will have a direct effect on the evaluation score will be if a proposer's index is in the lowest 5 percentile, in which case the proposer's score for the "commercial potential" evaluation criterion will be

We would appreciate it if the report's text could be updated to include this clarification.

Again, thank you for the opportunity to provide input on the report. We look forward to seeing GAO's final report, and to using the information it provides to improve our SBIR program. If you have questions or need additional information, our staff point of contact is Jon Baron, the DoD SBIR program manager (tel. 703/588-8636).

Sincerely,

ROBERT L. NEAL, JR.
Director, Office of Small and Disadvantaged Business Utilization

capped at half the points available. Even in this case, the Component SBIR program manager can make an exception to the cap if the company provides a strong rationale (e.g., by citing recent changes in the company to improve its commercialization performance).

GAO Comment

The following is GAO's comment on the Department of Defense's letter dated April 20, 1999.

1. We agree with the Department's revision of its plan and believe that the new approach will help avoid the unintended consequences that we discussed in our report. We have updated our report to reflect the Department's revision.

Comments From the Department of Commerce

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
CHIEF FINANCIAL OFFICER/CHIEF ADMINISTRATIVE OFFICER

APR 21 1999

Ms. Susan D. Kladiva
Associate Director, Energy,
Resources, and Science Issues
United States General Accounting Office
Washington, D.C. 20548

Dear Ms. Kladiva:

Thank you for the opportunity to review the General Accounting Office report entitled "Federal Research: Small Business Innovation Research Can Be Strengthened," Report No. GAO/RCED-99-114. We believe the information contained in the report is factual to the best of our knowledge as it relates to the overall program. Further, the specific information as it relates to the Department of Commerce, including the chart found in Appendix I entitled "SBIR Phase I Award/Proposal Ratios in Fiscal Year 1998, by Agency" is factual.

Sincerely,

Paul F. Roberts

Printed on Recycled Paper

Comments From the Department of Education

UNITED STATES DEPARTMENT OF EDUCATION

WASHINGTON, D.C. 20202-_____

APR 27 1999

Ms. Susan D. Kladiva
Associate Director
Energy, Resources, and Science Issues
U.S. General Accounting Office
Washington, D.C. 20548

Dear Ms. Kladiva:

Thank you for the opportunity to review the draft report entitled Federal Research: Small Business Innovation Research Can Be Strengthened (GAO/RCED-99-114). The Secretary has asked me to respond.

Copies of this report have been distributed to the appropriate offices within the Department. In particular, we have focused on those sections of the report, which reference or focus on our involvement with the Small Business Innovation Research (SBIR) Program.

Your references to the Department's SBIR process are accurate. There is only one specific statement on page 34 of the draft report, which should be changed. The last sentence of the first paragraph reads as follows:

> "The manager of Education's program told us that he placed calls to each of the state officials listed in the ***Environmental Protection Agency's*** book to inform them about the program." (Emphasis added)

The reference to the "Environmental Protection Agency" should be changed to the "Ballistic Missile Defense Organization."

If you need any further clarification, please contact me. I may be reached on 219-2004.

Sincerely,

Lee Eiden
Program Coordinator
Small Business Innovation Research
Program

Comments From the Department of Transportation

U.S Department
of Transportation

**Research and
Special Programs
Administration**

John A. Volpe
National Transportation
Systems Center

Kendall Square
Cambridge, Massachusetts 02142

May 4, 1999

Susan Kladiva
Associate Director, Energy Resources and Science Issues
U.S. General Accounting Office
441 G Street, NW
Washington, DC 20548

Dear Ms. Kladiva:

In response to your request for a fact check on DOT's comments that were included in the GAO Draft Report, Federal Research, Small Business Innovation Research Can Be Strengthened," the "facts" relating to DOT's SBIR Program cited in this report are accurate. The report overall is very comprehensive, and addresses, from a program manager's point of view, key issues and concerns.

If I may be of any further assistance, please contact me at (617) 494-2712.

Sincerely,

Joseph D. Heneburry
DOT SBIR Program Director

Comments From the Department of Agriculture

Note: GAO comments supplementing those in the report text appear at the end of this appendix.

United States Department of Agriculture

Cooperative State Research, Education, and Extension Service

Washington, DC 20250

APR 2 6 1999

Ms. Susan D. Kladiva
Associate Director
Energy, Resources, and Science Issues
U.S. General Accounting Office
441 G Street, NW., Rm. 2T23
Washington, D.C. 20548

Dear Ms. Kladiva:

This is in response to your request of April 9, 1999, for comments on the GAO Draft Report, RCED-99-114, "FEDERAL RESEARCH: Small Business Innovation Research Can Be Strengthened." In general the draft report reads very well and accurately discusses various issues related to commercialization results from the Small Business Innovation Research (SBIR) program. There are three small changes that the Department of Agriculture would recommend.

1. On page 32, the sentence that begins "The manager of Agriculture's SBIR ..." should be modified by adding the section that is underlined so that it reads as follows: "The manager of Agriculture's SBIR program stated that he maintains a list of states with the fewest awards from his department; he is prepared on a case-by-case basis to skip the strict numerical ranking of proposals and make an award to a company to fill a geographic gap, providing that company was in the "should fund" category (approximately the top 30 percent) as a result of the regular review process."

2. On page 43, the paragraph that starts "Agriculture's program manager ..." needs to be changed. It is recommended that the following wording be substituted for this paragraph.

> Agriculture sent a questionnaire to all Phase II winners from the start of the program through 1995 and found that more than 50 percent reported some commercial sales. The Agriculture program manager said that it would be rare for a company with a poor commercialization record to be penalized on a Phase I proposal; instead, he said that a commercially successful company might receive a boost from its previous success. At Phase II more attention is given to commercial potential, but the two most important review criteria are: 1) degree to which Phase I objectives were met and technical feasibility demonstrated, and 2) the technical merit of the Phase II proposal.

See comment 1.

Ms. Susan D. Kladiva
Page 2

3. On page 51, the paragraph that starts "The difficulty causes ..." presents only part of the picture in terms of commercial success. As stated in this paragraph, it is true that there have been a very small number of successful projects that account for a majority of the commercial success.

However, this discussion fails to document the breadth of the commercial success that has been achieved in the SBIR program. In the survey of Phase II winners conducted by Agriculture, more than 50 percent reported commercial sales ranging from $10,000 to more than $50 million. Other SBIR programs have reported similar results. Thus, GAO is encouraged to include, either in this paragraph or elsewhere in the report, information that emphasizes the breadth of success that has been achieved in the SBIR program.

Sincerely,

Colien Hefferan

COLIEN HEFFERAN
Acting Administrator

cc: I. M. Gonzalez, REE
G. Spory, ARS
J. Hill, OIG

GAO Comment

The following is GAO's comment on the Department of Agriculture's letter dated April 26, 1999.

1. While we recognize the commercial breadth exhibited by the Department's reported results, governmentwide surveys performed in 1996 and 1998 by a support contractor for the Department of Defense and SBA showed that only 39 percent of the projects responding to the surveys reported sales. The concern about using commercialization as the primary goal for evaluating SBIR proposals remains valid in view of the great concentration of commercial success in a very small percentage of projects.

Comments From the National Aeronautics and Space Administration

Note: GAO comments supplementing those in the report text appear at the end of this appendix.

National Aeronautics and
Space Administration
Office of the Administrator
Washington, DC 20546-0001

APR 22 1999

Ms. Susan D. Kladiva
Associate Director
Energy, Resources, and Science Issues
U.S. General Accounting Office
Washington, DC 20548

Dear Ms. Kladiva:

Thank you for your letter dated April 9, 1999, to Administrator Daniel S. Goldin. Enclosed are NASA's comments on the draft report titled Federal Research: Small Business Innovation Research Can Be Strengthened (GAO/RCED-99-114).

NASA has reported to GAO auditors the implementation of an annual survey of firms having received NASA phase II awards dating back to the beginning of the SBIR program in 1983. The objectives of the survey include an assessment of commercial activity associated with NASA's SBIR program. We are compiling and assessing commercial activity data obtained from more than 70 percent of the NASA phase II firms. Prior approval of this survey's instrument and methodology was obtained from the Office of Management and Budget.

The findings of GAO's draft report are generalized, given that GAO's scope includes all ten of the Federal agencies implementing the SBIR program. There are few references specific to NASA-related data, but we have addressed some of these differences in the enclosure. Also, GAO's sole recommendation is that the Small Business Administration's Tech-Net concept should be implemented. NASA does not object to this recommendation. However, NASA does recommend that a sufficient discussion of the Tech-Net concept, to include its potential merits and limitations, be included in the GAO report to support GAO's recommendation. Also, the Tech-Net concept should be properly vetted among SBIR agencies, especially regarding specification of metrics, metric definitions, and implementation elements. Additional recommendations by the GAO regarding specific metrics and details on implementation of Tech-Net would therefore be useful.

See comment 1.

If you wish to discuss these comments or have any questions, please contact Dr. Robert L. Norwood, Director, Commercial Technology Division, at 202-358-2320.

Sincerely,

J. R. Dailey
Associate Deputy Administrator

Enclosure
Comments to GAO Report

GAO Comment

The following is GAO's comment on the National Aeronautics and Space Administration's letter dated April 22, 1999.

1. We agree with this point about the need for close cooperation and have made additional comments at the end of the executive summary and of chapter 4.

Comments From the Environmental Protection Agency

Note: GAO comments supplementing those in the report text appear at the end of this appendix.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

APR 21 1999

OFFICE OF
RESEARCH AND DEVELOPMENT

Ms. Susan D. Kladiva
Associate Director for Energy,
Resources, and Science Issues
U.S. General Accounting Office
441 G Street, N.W., Room 2T23
Washington, DC 20548

Dear Ms. Kladiva:

Thank you for providing us the opportunity to review the GAO Draft Report, Small Business Innovation Research Can Be Strengthened (GAO/RCED-99-114). In response to your request of April 9, 1999, to Environmental Protection Agency (EPA) Administrator, Carol M. Browner, we have reviewed those portions of the draft report where EPA is specifically cited. In addition, we have provided comments on the findings and recommendations that affect all agencies. Our comments and clarifications are enclosed.

If you have any questions or require further information, please contact Dr. Jim Gallup of my staff on (202) 564-6823.

Sincerely,

Norine E. Noonan

Norine E. Noonan, Ph.D.
Assistant Administrator

Enclosure

Enclosure

**Agency Comments on GAO's Draft Report on
Small Business Innovation Research Can Be Strengthened (GAO/RCED-99-114)**

The following sections provide comments and clarification of information provided by EPA.

- We concur with the information presented in Chapter 2 and references to EPA information on distribution of awards.

- Chapter 3 discusses commercialization potential as a factor used by EPA and other agencies when evaluating company proposals. GAO has suggested that Congress clarify the emphasis that agencies give to a company's commercialization record in evaluating proposals. We agree that it is important to consider a company's commercialization record in evaluating proposals and that some clarification of Congressional intent may be appropriate. However, we believe that another important aspect of evaluating commercialization potential for the proposed project is the inclusion of a brief commercialization plan with the proposal for Phase I and a more expanded plan with the Phase II proposal. EPA requires an abbreviated 2-3 page outline of the company's technology commercialization plan as part of the Phase I proposal. Following award, we offer commercialization technical assistance during Phase I, require a complete commercialization plan in the Phase II proposal and encourage companies to continue commercialization technical support during Phase II. These improvements have resulted in better technology commercialization and better peer review evaluations of commercial potential. We hope these comments will be useful in reviewing commercialization questions.

- Chapter 4 recommends that SBA develop standard criteria for measuring the commercial outcomes (e.g., sales and job creation) of the SBIR Program and include these criteria into the new Tech-Net database. The report cites DOE as now requiring that non-federal funding information be reported by SBIR companies for 3 years after completion of the project period. EPA concurs with this recommendation to establish uniform criteria; however, EPA's ability to require information from companies ends when the contract conditions are completed, usually two years after award. While some agencies may be able to require information from companies after completion of the technology development project, EPA would only be able to obtain information voluntarily, and could report to the SBA only the information received.

See comment 1.

- EPA agrees with the numbers of EPA proposals and EPA awards listed in the Appendix I report. Please note that the percentage (award/proposal ratio in percent for EPSCoR states) in the last column should be 7.4%, not 15.4 %.

GAO Comment

The following is GAO's comment on the Environmental Protection Agency's letter dated April 21, 1999.

1. We have noted the Environmental Protection Agency's concern at the end of chapter 4. SBA and the program agencies will have to coordinate their efforts to resolve this and other issues.

Comments From the Department of Energy

Note: GAO comments supplementing those in the report text appear at the end of this appendix.

Department of Energy
Washington, DC 20585
April 22, 1999

Ms. Susan Kladiva
Associate Director, Energy, Resources
and Science Issues
Resources, Community and Economic
Development Division
U.S. General Accounting Office
Washington, D.C. 20548

Dear Ms. Kladiva:

Thank you for providing the Department of Energy (DOE) with the opportunity to review and comment on the General Accounting Office (GAO) draft report entitled, "Federal Research: Small Business Innovation Research (SBIR) Can Be Strengthened." Our comments, which appear below, were prepared by Dr. Robert Berger, the SBIR Program Manager for the Department of Energy.

First, the Department is cited as being "unwilling to significantly reduce a proposal's score even if it perceives a company as a poor commercializer" (page 3, "Executive Summary") and, "The Department of Energy, for example, has collected information on the commercialization records of companies, but the Department has not used the information because of uncertainty over its appropriate use" (page 6, "Executive Summary," and page 52, "Conclusions"). We disagree with these findings for the following reasons:

(1) These statements are not developed and analyzed in the body of the draft report.

(2) The DOE uses the commercialization record as a criterion in its Phase II evaluation. In a tight competition, this record can be the difference between winning and losing a Phase II award.

(3) In the evaluation of Phase I proposals, no agencies use the Phase III funding data provided by those companies with 15 Phase II awards in the previous 5 years.

(4) DOE's performance is presented in contrast to a Department of Defense plan to penalize poor commercializers. However, the DOD plan has not been implemented, and, as stated in the GAO report, has unintended adverse consequences.

See comment 1.

These specific references to DOE should be deleted.

Secondly, there are inaccuracies and misstatements in four different sections that refer to the DOE program: (1) pages 41-42, in the section titled, "The Department of Energy's Evaluation of

Printed with soy ink on recycled paper

See comment 2.

See comment 3.

Commercial Potential," (2) page 48, in the section titled, "The Department of Energy's Response to Frequent Winners," (3) page 54, in the reference to the Department of Energy, under "Various Methods With Similar Criteria for Success Have Been Used in Attempting to Measure Outcomes," and (4) page 56, in the section titled, "Energy's Approach Differs in Clustering Awards to Measure Outcomes but Contains Similar Criteria for Success." Attachment 1 identifies all corrections and suggested changes.

Thirdly, we have some comments on the use of commercialization information in the evaluation of SBIR proposals:

(1) The GAO draft report uses the term, "commercialization record," to describe a similar condition under two distinct circumstances, which may confuse the reader. According to P.L. 102-564, companies that submit Phase I proposals, and that have received 15 Phase II awards in the previous 5 years, must demonstrate the extent to which they have secured Phase III funding. This is identified as the "commercialization record" in the draft report. P.L. 102-564 also requires agencies to consider a company's commercial potential when evaluating Phase II proposals. The law specifies four pieces of evidence for commercial potential, one of which is the small business's record of successfully commercializing SBIR or other research. This record is also referred to as the "commercialization record" in the draft report.

(2) The second paragraph of the Executive Summary states that GAO was asked to review "the extent to which federal agencies are considering *commercial potential* ... in making their awards." We interpret "commercial potential" to be in the context of the evaluation of *Phase II* proposals as defined in P.L. 102-564. However, the draft report focuses on the *commercialization record* of companies submitting both *Phase I and Phase II* proposals. We recommend that the use of commercialization data be analyzed separately for Phase I and Phase II proposals.

(3) The report implicitly suggests a problem exists regarding the degree to which agencies are considering commercialization results in the evaluation of SBIR proposals. The GAO should clearly distinguish between Phase I and Phase II in this regard. The law has different requirements regarding the evaluation of commercialization potential and/or results for the two phases. There is no requirement for Phase I, and there is an explicit requirement concerning commercial potential for Phase II. The Small Business Administration's Policy Directive contains the same requirement for Phase II. For Phase I, the Policy Directive is not as clear about whether and how agencies are to use commercialization information in evaluating proposals. Page 12 of the Policy Directive states that agencies "shall give primary consideration to the scientific and technical feasibility of the proposal *along with its potential for commercialization.*" (This statement appears in the GAO draft report, page 15.) However, the Policy Directive does not define what is meant by the "potential for commercialization" with regard to Phase I proposals, nor does it suggest how this should be evaluated. Page 37 of the

Policy Directive provides a specific list of Phase I evaluation criteria but does not mention the use of commercialization potential and/or results.

(4) The use of commercialization potential and/or results in the evaluation of SBIR proposals may not lead to the desired outcomes. Possible problems include:

Unverified data: With respect to identifying whether or not commercialization has resulted from SBIR projects, the GAO should point out that, so far, all data (collected by the agencies or by the GAO) has come from the companies themselves, and, therefore, the accuracy of this data is suspect. It is in the companies' interest to inflate commercialization results, and, to our knowledge, no investigator has ever attempted to verify the accuracy of these reported data.

Suspect commercialization plans: The report suggests that it would be a good idea for agencies to require and review a commercialization plan submitted with SBIR proposals. We believe that (a) such plans are premature, even when submitted with a Phase II proposal, and (b) agencies neither possess, nor can they cost-effectively assemble, the resources required to conduct such a review.

Finally, we offer specific recommendations for other changes to the draft report. These are contained in Attachment 2.

We hope that these comments will be helpful in the preparation of the final report. If you have any questions, please contact Bonnie Lasky on 301-903-2158.

Sincerely,

Martha A. Krebs
Director
Office of Science

Attachments

cc:
Juanita McDuffie, Chief Financial Officer

GAO Comments

The following are GAO's comments on the Department of Energy's letter dated April 22, 1999.

1. We revised the report to delete these references.

2. We revised the report to reflect the Department's specific suggestions.

3. The Department commented that our use of the term "commercialization record" to describe information required for evaluating commercial potential and information required from companies with 15 or more phase II awards may be confusing. To avoid any confusion, we continue to use the term in connection with the evaluation of commercial potential and revised the report to avoid the use of the term in connection with frequent winners. The Department notes that the policy directive does not define what is meant by the potential for commercialization with regard to phase I proposals, nor does it suggest how this potential should be evaluated. However, the reauthorization act specifies that phase I ideas "appear to have commercial potential" as described in the law under phase II.

Comments From the National Institutes of Health

Note: GAO comments supplementing those in the report text appear at the end of this appendix.

DEPARTMENT OF HEALTH & HUMAN SERVICES — Public Health Service

National Institutes of Health
Bethesda, Maryland 20892

APR 27 1999

Ms. Susan Kladiva
Associate Director, Energy, Resources,
and Sciences Issues
U.S. General Accounting Office
Washington, D.C. 20548

Dear Ms. Kladiva:

The National Institutes of Health (NIH) appreciates the opportunity to comment on the Draft GAO report, *Small Business Innovation Research (SBIR) Can Be Strengthened.*

NIH has the following attached comments on this draft report. More general comments have been presented first, followed by more specific comments on individual items in the report. For the most part, this report gave thoughtful consideration to the need to evaluate the SBIR/Small Business Technology Transfer (STTR) program in a more uniform manner. We understand that the emphasis on commercial impact is related to the Government Performance and Results Act and the ease with which sales can be measured, but we urge some caution in taking too-focused a look at this impact. The NIH is pleased that the commercialization rate for our SBIR grants is so high; however, the full impact of that rate on biomedical research advances is more difficult to measure. It is important to emphasize that, as the title "Small Business Innovation Research" suggests, the focus of the SBIR program is clearly on research advances and not simply on commercial outcomes.

We hope that you find our comments to be valuable. If you have any questions, please contact Paul Coppola in the Office of Management Assessment at (301) 496-2464.

Anthony L. Itteilag

Enclosure

See comment 1.

General Comments:

1. The GAO draft report does not adequately address differences between supporting SBIRs through a grant (a financial assistance mechanism providing money, property, or both to an eligible entity to carry out an approved project or activity) as compared to through a contract (an award instrument establishing a binding legal procurement relationship between a funding agency and the recipient, obligating the latter to furnish an end product or service and binding the agency to provide payment therefor.)

- Only for NIH does the report address the two types of SBIR awards. The use of contracts, grants, or grants/contracts should be specified for other agencies as well. This point has particular impact in the evaluation process when the report discusses the weighting of the score attributable to past commercialization. It is also worth noting that, not only do the funding mechanisms differ among agencies, but also the review and award procedures vary widely.

  - Unlike the technical evaluation criteria, which are weighted for NIH contract proposals, the review criteria for NIH grant applications are not weighted. The appropriate "weighting" of various review criteria (and award criteria) is a function of the professional judgement of the grant application reviewers and NIH scientific program directors.

  - Equally important to note is that the criterion, potential for commercial application **or societal impact**, is only one of seven review criteria currently used by the NIH. The NIH seeks a balanced view of the different components of the scientific review.

See comment 2.

2. A second general concern is the very close association between success and commercialization.

- This assumption permeates the document, and is sometimes made quite explicit (e.g., p. 54, 1st paragraph). While this point (equating success and commercialization) is highlighted by the NIH comment to the contrary on p. 52, 1st full paragraph, the draft Report underplays the importance of assessing non-commercial benefits of the SBIR program, or the benefits that may have delayed commercial impact. We would hope that the NIH viewpoint could be incorporated into the Executive Summary as a counterbalance. Specifically, NIH recommends the following language be added to the end of the section of the Executive Summary entitled MATTER FOR CONGRESSIONAL CONSIDERATION:

1

"The program's non-commercial goals include the ability to stimulate technological innovation (e.g., fund high-risk research and development which by itself has no immediate commercial impact, but which produces leaps in technical capabilities with long-term economic and societal benefit.) Other non-commercial goals which comprise important benefits of the program are to use small business to meet federal research and development needs, to increase small business participation in federal research and development, to improve the Federal Government's dissemination of information concerning the SBIR program, and to foster and encourage participation by women and minority and disadvantaged persons in technological innovation, as indicated in Public Law 102-564 [Section 102 (b)]."

- The discussion of commercialization is one of the four goals of the *initial* legislation, but there is also the use of small businesses to meet federal research and development needs. The report does not adequately discuss the need for *all* of the SBIR program goals to be considered in the context of agency mission goals. One particular Institute at NIH, National Institute of General Medical Sciences (NIGMS), is about to launch a major effort in structural biology. Small businesses may be well positioned to contribute to this effort; however, the short term commercial potential of the work may be very limited.

- The Matter for Congressional Consideration on p. 7 (and reiterated on p. 53) suggests that Congress clarify the relative emphasis that agencies should give to commercialization records. This focus on uniformity misses the opportunity to highlight the fact that different relative emphases may be appropriate to differing agencies' missions.

- Also of concern is the idea of automatically equating commercial potential with a company's previous commercialization results. Such an attempt does not take into account new small companies or the fact that some agencies' awardees do not realize commercialization results for 7-10 years after completion of the Phase II project period. In addition, often the Phase I and Phase II have commercial potential but do not result in commercializable results until subsequent R&D (sometimes subsequent PhI/Ph II projects) is performed to bring the actual end-product/service to market. Moreover, what one company accomplishes in Phase I/Phase II could contribute to the success of *another* Phase I/Phase II project.

- The aggregation of information across all agencies in this report and in proposed future evaluations of the SBIR/STTR programs may result in important details to be ignored. Successful commercialization likely means different things to and within different agencies. For example, in NIGMS, a commercial success may be one where the project produces a research tool that enables future fundamental research. This may mean a very small commercial success in dollars, but a large success in terms of

advancing a scientific field, the further development of which may also include the contribution of small businesses.

- The emphasis on pure statistics in the report gives no sense of the reasons WHY commercialization has or has not been successful in certain cases that are singled out for attention (e.g., the "frequent winners"). There may be valid reasons why a company would be successful in obtaining SBIR funding, but unable to commercialize the product -- particularly in the case of restricted markets. It would be helpful to know how many of these cases are grants and how many are contracts or what the agency expectation was.

- For the NIH, we believe strongly that the issue of commercial potential cannot be based solely on the potential dollars in sales -- that is, a product useful for a rare disease or disorder might have limited dollar potential for commercialization but yet may be of substantial help to those suffering from the disease or disorder. A commercial "success" that provides a product that is desperately needed for a small population should not be penalized because there are not a larger number of people suffering from a disease.

3. The NIH has serious concerns about the recommendations to develop standard criteria for all ten agencies to use in measuring commercial outcomes and to incorporate these criteria in a single "Method to Improve the Measurement of Program Results."

See comment 3.

- The Tech-Net database is simply assumed to be the correct and single approach regardless of widely varying agencies' missions. The database appears to have some merit as a useful tool to monitor what is happening; however, it is less clear that it will have any effect on the judgements made of submitted grant applications and the overall direction of the program, which is primarily driven by (1) what investigators submit; and, (2) what reviewers think of the proposed projects.

- The NIH recognizes the importance of evaluation and tracking awards made through the SBIR program. However, each federal agency should be given flexibility in determining evaluation approaches and criteria for program success. It will likely be difficult to develop standard criteria for measuring the commercial outcomes based on the points raised in this section.

- While collecting sales, developmental funding, and job creation data through the Tech-Net database *might* help standardize some of these data, this approach does not address the real issue which is how to interpret and utilize these data. The NIH does not agree that commercialization results should be the main or only measure used to evaluate the success of the program.

- The NIH has strong concerns about the need for Congress to "clarify" in any rigid and quantitative fashion the "relative emphasis that agencies should give to commercialization records." Furthermore, it is not clear that "uniformity in the program" is an objective in itself (p. 53) given that the ten participating agencies all have different primary missions.

- It is not clear how these data could be used, given the large variation that must exist among SBIR projects in the size of the potential markets, the costs of the technologies being developed, differences in sales growth curves, etc. There would also be many cases in which it would be difficult to attribute these data values to particular SBIR grants.

- There also remains the problem of how to weigh any of these measures of commercialization against the other goals of the SBIR program. There will certainly be differences among fields in the extent to which commercialization is currently a realistic goal, yet significant benefits of the SBIR program could be achieved through technological innovation or more participation of small businesses in the R&D enterprise. NIH has a strong history in commercialization -- as noted by other reviews of the program -- but placing too much of an emphasis on commercialization could decrease innovative ideas, and the stimulation of innovation is also an important SBIR goal.

- Finally, it's not clear what level of commercialization should be expected (e.g., what level of sales, or rate of commercialization would be considered successful?). There will be differences among areas of research and technology development, and differing opinions on this within fields.

- From a logistical standpoint, it is not clear who (grantees, agency staff, or others) will be responsible for entering and/or validating these data. This is not a workload NIH program staff would be able to assume. Also, in many cases, commercialization would likely not be done in a timely fashion, and whoever is tracking this would be challenged with following SBIR awardees for a period of time to see whether some commercial payoff ensued after NIH funding ceased. If the responsibility is placed on the grantee, it is not clear what level of compliance can be expected, or what incentives exist for grantees to submit the data. Who will be responsible for the very labor-intensive task of making sure that grantees enter the data? This issue also raises the question of the ability of the government to require some types of business information that may include sensitive company data. It is not clear who will have access to these data.

- Obtaining the data for Tech-Net appears to be a major undertaking with the potential for significant bias. "Sending a letter to every awardee since the start of the program" can be done, but some will be out of business (probably not a sign of success), many

See comment 4.

others will have been bought out by other firms (probably a sign of success), others will have changed names, addresses, or corporate features. This is a major undertaking, and there is every reason to expect significant bias in the responses.

4. NIH raises several issues with regard to the section entitled, "Awards Go to Both Frequent Winners and New Applicants, and Agencies Are Trying to Broaden the Geographic Distribution of Awards."

- The distribution of SBIR awards parallels the distribution of other awards, which in turn parallel population, research infrastructure, intellectual capital, etc. The data are presented without any covariant data analysis.

- As noted in the report, NIH has recently increased its outreach to the EPSCoR states. However, companies cannot be created in a vacuum. NIH funds research on a national competitive basis. One statistic does stand out-- the success rate for proposals from non-EPSCoR states is 28.9%, while that from EPSCOR states is 19.4%. This may, in part, reflect differences in "grantsmanship," and the NIH is currently focusing on efforts to help the investigators present more competitive proposals. An example includes posting copies of SBIR conference presentations on our Small Business Funding Opportunities website and creation of an SBIR ListServ to allow potential applicants to view "webisodes" of information on the NIH SBIR grants, review and award process.

Specific Comments:

p.2: It is not clear what is meant by "*other factors*" in the sentence, "One new provision requires agencies to consider each proposal's commercial potential, which includes a company's commercialization record, commitments accompanying the proposal for developmental funding from sources other than the SBIR program, and other factors." As mentioned under "General Comments" above, this issue raises the question of the ability of the government to require some types of business information that may include sensitive company data, and it is not clear who will have access to the data.

p.3: In the Executive Summary, in the middle of the first paragraph, is the sentence: "From fiscal year 1993 through fiscal year 1996, companies in one-third of the states received 85 percent of the program's awards, in part because companies in these states submitted the most proposals." The last segment of the sentence ("in part. . .") is not subsequently addressed in the body of the report. Consequently, if it is only "in part," the reader is unaware of what other factors are at play.

5

p.6: The 8th line, first full paragraph should read, "Unintended consequences may occur in the implementation of the **Defense** Department's plan, which is scheduled for May 1999."

p. 8 (and again on p. 64): The last sentence should read . . . "The criteria should include uniform measures of sales, developmental funding, job creation, **research products, research tools, services, equipment, and publications.**" This is an extremely important point as the criteria for measuring commercial outcomes must include relevant examples more appropriate to the NIH and the NSF.

p. 42: There are many changes:

- The last paragraph, 3rd line, the sentence should read "about **95%** of all the Institutes SBIR awards."

- The last paragraph, 8th line, the sentence should end: "represent the **biomedical** community."
- The last paragraph, 8th line, the sentence should read, "The small business representatives are included for **scientific** balance and special business-related knowledge, according to the program manager, but the **other peer reviewers (research scientists and physicians)** can also comment on commercial potential."

- Correction under the section entitled, "The National Institutes of Health's Evaluation of Commercial Potential": Some NIH staff already do take past commercialization success into account. However, those data have not been tracked by a central NIH office, which may be why "he was unaware of any instances . . . ."

p. 50: With regard to the 6th line, it follows then that the definition of successful commercialization for the NIH would be different from that of the DOD.

p.61: In the 3rd line from the bottom, the sentence should end ". . . . capturing a variety of commercial and other measures of success."

GAO Comments

The following are GAO's comments on the National Institutes of Health's letter dated April 27, 1999.

1. While we recognize the inherent differences between grants and contracts, these differences do not eliminate the need to clarify the relative emphasis on commercialization and the program's other goals. We made no changes in response to the Institutes' comment. We also recognize that agencies differ in their evaluations of proposals but believe that, without such clarification, these differences may lead to unintended consequences, such as those that would have resulted from DOD's emphasis on the commercialization record.

2. We addressed this issue in our evaluation of agency comments at the end of the executive summary and of chapter 3.

3. The Institutes express concern about developing standard criteria to measure commercial outcomes while at the same time acknowledging that the database appears to have some merit as a useful tool. Certain criteria, such as sales and additional funding, that agencies might agree upon would increase the ability of Congress to evaluate the program across agencies. Nevertheless, we do not envision this database being used to circumvent the judgments of individual agencies in making awards.

4. The draft report reviewed by the National Institutes of Health also noted that the concentration of SBIR awards in certain states tends to reflect the concentration of federal research resources in general. The report acknowledges the Institutes' and other agencies' efforts to reach out to businesses in states with comparatively few SBIR awards.

Comments From the National Science Foundation

NATIONAL SCIENCE FOUNDATION
4201 WILSON BOULEVARD
ARLINGTON, VIRGINIA 22230

OFFICE OF THE
DIRECTOR

May 13, 1999

Ms. Susan D. Kladiva
Associate Director, Energy,
Resources, and Science Issues
United States General Accounting Office
Washington, DC 20548

Re: Federal Research Small Business Innovation Research Can be Strengthened
(GAO/RCED-99-114)

Dear Ms. Kladiva:

Thank you for sending us an advance draft copy of your report dated April 9, 1999. The National Science Foundation (NSF) is referred to in detail under four sections:

1) National Science Foundation efforts have been effective – pp. 30, 31
2) The National Science Foundation's evaluation of Commercial Potential – pp. 39, 40
3) Other agencies response to frequent winners – pp. 48, 49
4) The "success stories" approach has similar basic criteria for success, but also has important limitations – pp. 57, 58.

1) We appreciate your favorable comments on partnership between EPSCoR and SBIR programs within NSF.
2) You have captured the role of the commercialization potential, and, in particular, the role the commercialization record plays in the selection process for SBIR and STTR Phase I awards at NSF.
3) You have correctly noted that NSF has not awarded any small business firms more than fifteen Phase II awards in the past 5 years.
4) You have captured our objective of gathering comprehensive commercialization results in our "success stories" report.

We appreciate your favorable review of the SBIR program at NSF and thank you once again for giving us an opportunity to comment on your draft report.

Sincerely,

Rita R. Colwell
Director

Major Contributors to This Report

Resources, Community, and Economic Development Division, Washington, D.C.	Dennis Carroll Curtis Groves Kathy Hale Brad Hathaway Victor Rezendes
Office of General Counsel	Mindi Weisenbloom

Ordering Information

The first copy of each GAO report and testimony is free. Additional copies are $2 each. Orders should be sent to the following address, accompanied by a check or money order made out to the Superintendent of Documents, when necessary. VISA and MasterCard credit cards are accepted, also. Orders for 100 or more copies to be mailed to a single address are discounted 25 percent.

Orders by mail:

U.S. General Accounting Office
P.O. Box 37050
Washington, DC 20013

or visit:

Room 1100
700 4th St. NW (corner of 4th and G Sts. NW)
U.S. General Accounting Office
Washington, DC

Orders may also be placed by calling (202) 512-6000 or by using fax number (202) 512-6061, or TDD (202) 512-2537.

Each day, GAO issues a list of newly available reports and testimony. To receive facsimile copies of the daily list or any list from the past 30 days, please call (202) 512-6000 using a touchtone phone. A recorded menu will provide information on how to obtain these lists.

For information on how to access GAO reports on the INTERNET, send an e-mail message with "info" in the body to:

info@www.gao.gov

or visit GAO's World Wide Web Home Page at:

http://www.gao.gov

United States
General Accounting Office
Washington, D.C. 20548-0001

Bulk Rate
Postage & Fees Paid
GAO
Permit No. G100

Official Business
Penalty for Private Use $300

Address Correction Requested