

NATIONAL ECONOMIC IMPACT of the DEPT. of the NAVY SBIR/STTR PROGRAM

Fiscal Years 2000 – 2013

REPORT SUMMARY

The Naval mission is to maintain, train and equip combat-ready forces capable of winning wars, deterring aggression and maintaining freedom of the seas. Continuous SBIR/STTR investment in innovation by America's unmatched small business talent helps ensure this Navy and Marine Corps capability. Naval commitment to improving "the business of science", through the SBIR/STTR program, results not only in decisive breakthrough technologies, but in powerful economic impact as these technologies are integrated into undersea, surface and air platforms and systems.

What resulted from the Naval SBIR/STTR investment of nearly \$2.3 billion, FY2000 to 2013?

Commercialization results:

- \$7 billion in sales of new capabilities and products to the U.S. military
- \$14.2 billion in total sales of new products and services
- 64% of SBIR/STTR contracts with subsequent innovative technology sales

Other economic results, or impacts:

- 14,973 full-time jobs created *per year* with an average salary of \$68,535
- \$44.3 billion in total economic output nationwide, in all 50 states
- \$22.2 billion in new wealth creation, or value added
- \$4.9 billion in new federal, state, and local tax revenues
- \$14.4 billion in labor income
- 97.4% of firms had fewer than 10 Phase II awards – a broadly democratic distribution

This data, from a study conducted by TechLink (a Dept. of Defense-funded technology transfer center at Montana State University-Bozeman), answered the question. TechLink, working with the Bureau Research Division (BRD) of the Leeds School of Business at the University of Colorado-Boulder, queried 1,199 small firms awarded 2,734 SBIR or STTR Phase II contracts awarded during the study period. With a 95% response rate, TechLink produced Naval SBIR/STTR investment data that supports this report.

REPORT PURPOSE

Department of the Navy (DON) SBIR/STTR leadership commissioned the TechLink study to measure commercialization and related economic impacts of nearly \$2.3 billion in DON SBIR/STTR Phase II contractual investment over FY2000 – 2013. During that period, DON SBIR/STTR made 2,734 separate Phase II awards to 1,199 small businesses in virtually every U.S. state.

Congressional discussion of SBIR/STTR reauthorization stimulated discussion in the Nation's innovation community about quantifying SBIR/STTR Phase II investment results. Historically, Naval SBIR/STTR "success stories" had been published to highlight technology delivered to warfighters. But apart from a 2014 study of economic outcomes – i.e., impacts - of Air Force SBIR/STTR investment, no other assessments of sales, employment, tax revenues or other indicators were available. SBIR/STTR program performance had been favorably studied by the National Research Council, Government Accountability Office, Office of the Inspector General, RAND Corporation and others – but economic impact indicators were not studied.

Therefore, this report uses TechLink study findings to answer four questions:

- What were the **sales and other commercialization outcomes** of the Naval SBIR/STTR investment of ~ \$2.3 billion in Phase II contracts from 2000 – 2013?
- What was the **economic impact** of this investment, using five key indicators: output, employment, tax revenues, labor income and value added?
- What was the **small business impact** as measured by distribution of awards?
- From a fiscal perspective, what notably **successful examples** of delivering DON SBIR/STTR technologies into warfighters' hands are available for FY2000 – 2013?

PRINCIPAL FINDINGS

For FY2000 – 2013, nearly 1,200 DON SBIR/STTR-awarded firms reported \$14.17 billion in total sales including nearly \$7 billion in military product sales from 2,734 Phase II contracts. Other significant economic outcomes included: outside (non-SBIR/ STTR) investment funding of nearly \$646 million; 91 companies sold to larger corporations with a total acquisition value of at least \$1.8 billion; 130 technologies licensed to other companies; and a total of 49 new spin-out companies. Less than 3% of these firms won 10 or more SBIR/STTR awards.

Substantial economic impacts were recorded: economic output, employment, labor income, value added and tax revenues. From this additional analysis, total economy-wide sales, as measured by output, were estimated at over \$44 billion. Value added, representing new wealth creation in the economy, was estimated at \$22.2 billion. Labor income in 2015 alone was estimated at \$14.4 billion. Employment impacts included 209,627 total job years, or an average of 14,973 jobs per year, with an average wage of \$68,535. Total tax revenues to federal, state, and local jurisdictions were estimated at \$4.9 billion, but may be significantly higher.

DON SBIR/STTR PROGRAM AT A GLANCE

During the early 1980s, Congress made strategic government research and development (R&D) investments to counter the loss of national economic competitiveness and harness the innovative potential of U.S. small business—both to help meet the high-priority technology needs of the federal government and to benefit the national economy.

The Small Business Innovation Development Act of 1982 established the **SBIR Program** as a three-phased process of soliciting proposals and awarding funding agreements for R&D, production, services, or any combination of these to meet agency needs or missions. The SBIR statute affirmed that technological innovation creates jobs and increases productivity, competitiveness, and economic growth. It also recognized that small businesses are the principal source of U.S. innovation, and are generally more cost-effective in conducting R&D than corporations, universities or government laboratories. Finally, Congress asserted that small businesses are more capable of converting R&D results into new products than these competing entities. The statute set four goals:

- Spur technological innovation in the United States
- Help meet federal R&D needs
- Increase private sector commercialization of SBIR technology innovations
- Foster and encourage participation by minority and disadvantaged persons

The **STTR Program**, established by Congress in 1992, closely models SBIR, but requires the small business to partner with a university, federal laboratory, or a qualified non-profit research institution. The small business, as prime contractor, performs at least 40% of the work, with the research partner performing at least 30%.

The 11 federal agencies with extramural R&D budgets that exceed \$100 million are required to allocate a designated portion of their R&D budgets to SBIR each fiscal year: 3.0 percent in FY 2016 and 3.2 percent in FY 2017. In addition, five federal agencies with extramural R&D budgets exceeding \$1 billion, which includes the Department of Defense (DoD), are required to expend 0.45% of their extramural R&D budgets for STTR in FYs 2016 and 2017.

Approximately \$2.5 billion is awarded annually through federal SBIR/STTR programs. DoD is the largest participant, with over \$1 billion in SBIR/STTR contracts annually. Within DoD, the Dept. of the Navy offers among the largest SBIR/STTR programs, with an FY 2017 budget of \$369 million. *In FY2016, the DON SBIR/STTR budget accounted for approximately 27 percent of the DoD total and nearly 12 percent of the entire federal SBIR/STTR budget.*

Each agency determines its own R&D topics; the DON SBIR/STTR Program mainly targets needs and interests of the Naval acquisition community on behalf of warfighters, providing small firms of 500 or fewer employees the opportunity to join the national technology base that feeds both military and private sectors. On a schedule coordinated by DoD, DON annually releases technical topics that describe areas of interest and need for

DON System Commands in three separate SBIR/STTR announcements. About 80% of topics come from PEOs and the Future Naval Capabilities program. The program has three phases:

- **Phase I¹** - A feasibility study to determine the scientific or technical merit of an idea or technology that may provide a solution to DON needs or requirements.
 - SBIR Phase I base periods were typically up to six months with a base amount not to exceed \$80,000 and a Phase I option not to exceed \$70,000 for up to six months, with some SYSCOM variance.
 - STTR Phase I base periods were typically seven months with a base amount not to exceed \$80,000 and a Phase I option not to exceed \$70,000 for six months.

- **Phase II** - A demonstration phase in which prototypes are typically built and tested. If the Phase I effort is successful, a company may apply for Phase II funding according to provisions detailed in SBIR/STTR Broad Agency Announcements.
 - SBIR and STTR Phase II base periods and option awards vary across SYSCOMs using a gated process. Awards are typically \$500,000 to \$1,500,000 and the period of performance is generally 24 months.²
 - 20% of SBIR funds are dedicated to expand transition funding to selected existing Phase II projects, thus accelerating transition.

- **Phase III** - Work that derives from, extends, or completes an effort made under prior SBIR funding agreements, but is funded by federal or private sources other than SBIR/STTR. The purpose is to transition a company's SBIR/STTR effort into hardware or software products, processes or services that benefit the DON warfighters. Through a key SBIR/STTR authority, Phase III awards are made by statute direction, since competition requirements were satisfied under Phases I and II. The ***DON SBIR/STTR Phase III Guidebook*** is a desk reference widely-used by acquisition professionals across DoD agencies. Extensive execution of Phase III contracts is a distinguishing hallmark of DON SBIR/STTR.

SALES AND OTHER COMMERCIALIZATION OUTCOMES

64% of DON SBIR/STTR Phase II contracts resulted in commercialization: of the 2,734 Phase II contracts, 1,753 resulted in sales.³ Of the rest, 845 (31%) did not result in

¹ Descriptions of SBIR/STTR phases are found on the SBA SBIR/STTR website, www.sbir.gov; the DoD SBIR/STTR website, <https://sbir.defensebusiness.org>; and the DON SBIR/STTR website, www.navysbir.com.

² For detailed Phase II period of performance and funding structure at the SYSCOM level, see <http://www.navysbir.com> "Phase II".

³ This commercialization level is significantly higher than the 48 percent reported for DoD SBIR/STTR Phase II projects as a whole in the NRC study, National Research Council, 2014, *SBIR at the Department of Defense*, Washington, DC: The National Academies Press. It also is higher than the 58 percent commercialization level achieved by Phase II recipients in the Air Force economic-impact study previously discussed, available online at <http://static.techlinkcenter.org/techlinkcenter.org/files/economic-impacts/USAF%20SBIR-STTR%20Economic%20Impact%20Study%20FY2015.pdf>.

sales and 136 (5%) had contracts for which sales information, if any, was unavailable. Ultimately, the commercialization level achieved by these DON SBIR/STTR Phase II contracts may be much higher, as it may take up to eight years to convert a new technology into a product. Many newer contracts have not yet resulted in sales.

*Total cumulative sales from DON SBIR/STTR Phase II contracts were nearly \$14.2 billion, with average sales of approximately \$8.1 million for each of the 1,753 contracts that achieved commercialization. **This sales figure is nearly ten times the average contract amount of \$827,177.** The average sales per contract, when considering all of the DON Phase II awards, including those without commercialization success, was nearly \$5.5 million. **This is about seven times the size of the average contract amount,** showing that the DON SBIR/STTR Program achieved substantial commercialization success.*

Home runs: The most productive SBIR/STTR Phase II contract generated over \$1.2 billion in total combined sales. This amount was nearly twice as large as sales from the second most successful Phase II contract, which had approximately \$675 million in sales. **23 Phase II contracts had sales exceeding \$100 million; 233 had sales exceeding \$10 million;** 825 had sales of more than \$1 million; and 912 had sales larger than \$827,177, which was the average size of the DON SBIR/STTR Phase II contract.

Table 1. Sales from DON SBIR/STTR Phase II Contracts, FYs2000-2013

DON SBIR/STTR Phase II Contracts	Total Number of Contracts	Percent of Total	Total Sales \$ Billions
Total Contracts	2,734	100	\$14.174
Contracts with sales	1,753	64	\$14.174
Contracts without sales	845	31	--
Companies not responding	136	5	--

As previously noted, the "Total Sales" category includes all of the following sources of revenue from commercialization of the technologies developed with DON SBIR/STTR Phase II funding:

- **Sales of new products and services**, including both commercial (civilian) sales and sales to the U.S. military

- **Follow-on (non-SBIR/STTR) R&D contracts** to further develop these DON SBIR/STTR-developed technologies for specific applications (treated as sales of R&D services)
- **Royalties** accruing to the DON SBIR/STTR Phase II contract recipients from sales by licensees of the technologies developed with the DON funding
- **Sales by licensees** of the DON SBIR/STTR-developed technologies—when this information could be obtained
- **Sales by spin-out companies** that were commercializing the DON SBIR/STTR-developed technologies—when this information was available

Table 2 shows the total sales from the DON SBIR/STTR Phase II contracts, broken down by sales category:

- **Commercial (civilian) product and service sales** totaled nearly \$3 billion and accounted for 21% of the total sales.

- **Military product and service sales** were nearly \$7 billion and constituted 49% of the total.

This high level of sales indicates that the DON SBIR/STTR Program is achieving its objective of developing new technology to support the DON mission.

Table 2. Sales from DON SBIR/STTR Phase II Contracts, by Sales Category

Sales Category	Total Sales \$ Millions	Percent of Total
Commercial Product/Service Sales	\$2,992	21
Military Product/Service Sales	\$6,960	49
Follow-on R&D Contracts	\$3,489	25
Royalties from Licensees	\$136	1
Sales by Licensees	\$382	3
Sales by Spin-out Companies	\$215	2
Total	\$14,174	100

Note: Totals may not tally due to rounding

Follow-on R&D contracts to further develop the technologies generated with DON SBIR/STTR funding totaled nearly \$3.5 billion and accounted for 25% of the total. This

R&D funding came from the government and private sectors and included Phase III contracts. However, this category did not include additional SBIR/STTR awards.⁴

Royalties resulting from licensee sales of the technologies developed with DON Phase II funding were nearly \$136 million. This category is important because a significant number of companies engaged in SBIR/STTR research choose to remain R&D companies and license successfully developed technologies to other companies for future sales.

Sales by licensees were reported to be \$382 million, based on limited responses.

Sales by spin-out companies, 49 in number, totaled \$215 million. Creating spin-out companies is another major way that companies engaged in SBIR/STTR research choose to commercialize SBIR-developed technology. Together, the last three categories accounted for slightly more than 5% of the total sales.

Figure 1 presents a graphic summary of the total sales from all DON SBIR/STTR Phase II contracts that were completed during the FY 2000-2013 period, broken down by sales category.

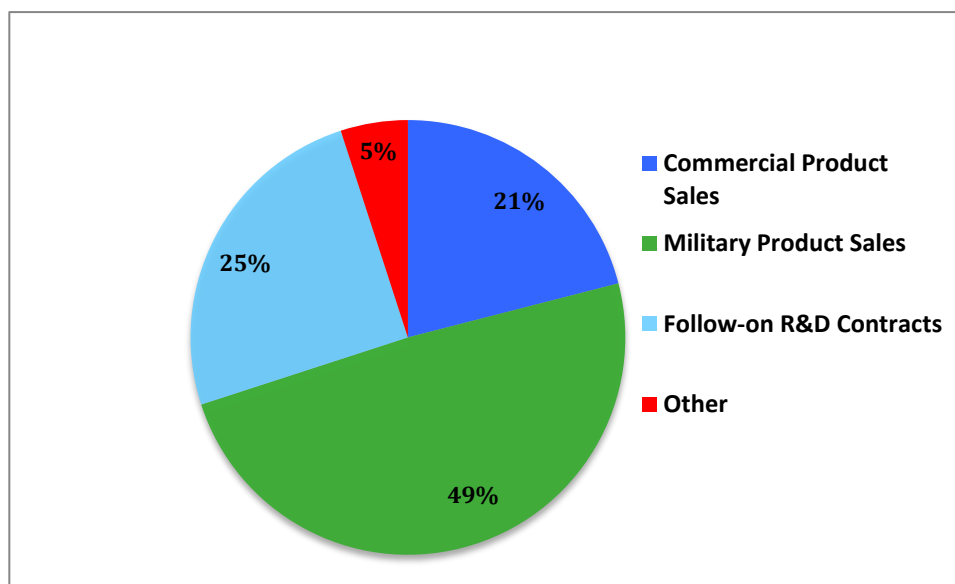


Figure 1. Sales Results by Sales Category

As impressive as these numbers appear, DON SBIR/STTR sales figures understate the reality. For several reasons, total sales figures obtained by this survey may be significantly smaller than the actual total sales resulting from DON SBIR/STTR Phase II contracts completed during the FY 2000-2013 period. Reasons include the following:

⁴ The Air Force SBIR/STTR economic-impact study did include follow-on SBIR/STTR awards from non-Air Force SBIR/STTR programs.

- *Non-responding companies.* Sales information was not available from a significant number of companies. As previously noted, 168 companies did not participate in the study—100 because they declined to participate and 68 that could not be contacted because they had ceased to operate as corporate entities. Several of these companies are believed to have substantial sales. A sizeable number were Phase II recipient companies that had been acquired by large corporations because of the commercial strength of the technologies developed with Navy SBIR/STTR funding.
- *Licensee sales information generally unavailable.* The total sales figures also do not include most of the licensee sales. The study noted a total of 130 technology licenses; however, the TechLink team was able to obtain sales information for only 38 (29%) of these licensed technologies. Many companies declined to identify their licensees or to divulge what they knew of licensee sales. In cases where the licensees were identified and contact information was provided, the licensees resisted disclosure and in general did not feel obligated to participate in this study.
- *Licensee underreporting of sales and underpayment of royalties.* Another reason why the total reported sales, as well as the royalties from such sales, are believed to be substantially larger than this survey discovered is that underreporting is common in the licensing world. Historic royalty audit data from the Invotex Group, a well-established accounting and intellectual property management company, reveals that over 80 percent of licensees underreport and underpay royalties to their licensors.⁵
- *Sales information for spin-out companies generally unavailable.* The total sales figures do not include most of the sales by companies spun out of the Phase II recipient companies to commercialize the technologies developed with DON SBIR/STTR funding. A total of 49 companies reported that they had created spin-out companies; however, the TechLink team was able to obtain sales information for only 16 of these companies (33%). As with licensees, most spin-out companies contacted did not feel obligated to participate in this study and were not responsive.
- *Inflation.* Finally, inflation contributes to an under-valuation of earlier sales in this study. (There were no adjustments for inflation.) All sales figures were aggregated and the timing of sales by year is not known. Some sales date back to the early 2000s. Aggregation of company sales values does not preserve the relatively higher value of sales that occurred earlier in the 2000-2013 study period. For example, a dollar in 2015 was worth 27% less than a dollar in 2000, and 18% less than a dollar in 2005.⁶

⁵ D.R. Stewart and J.A. Byrd, "The Significance of Underreported Royalties-2007 Update: The Magnitude and Meaning of Royalty Misreporting," Invotex Group, Baltimore, MD, February 2007, online at: www.lawseminars.com/materials/07LICIL/licil%20m%20stewart2.pdf; D.R. Stewart and J.A. Byrd, "89% of Royalty Revenue is Underreported! Top Five Questions You Should Ask Your Licensee to Avoid Becoming a Statistic," Invotex Group, Baltimore, MD, April 2012, online at: www.invotex.com/assets/2012_Royalty_Audit_Article.pdf.

⁶ U.S. Bureau of Labor Statistics Consumer Price Index (CPI) Inflation Calculator, available online at <http://data.bls.gov/cgi-bin/cpicalc.pl>.

For all of the above reasons, the total sales figures reported in this survey are conservative and may substantially understate the actual total sales resulting from DON SBIR/STTR Phase II contracts completed during the FY 2000-2013 period.

ECONOMIC IMPACT

In summary, the DON SBIR/STTR Program made a substantial contribution to the Nation's economy during FY 2000 – 2013 through results from Phase II investment. Results in Table 3 below, in devalued 2015 dollars, are presented for five impact categories:

- **Employment** - the number of jobs created by an economic activity; the number of workers (full-time or equivalent) expressed in "job years" (one full-time position per year).
- **Labor income** - employee compensation and income received by the self-employed.
- **Value added** - the difference between a firm's output and inputs, i.e., the difference between a product's sale price and its production cost.
- **Output** - the total value of all goods or services produced during a given period.
- **Tax revenues** - Total taxes collected by federal, state, and local government entities.

Table 3. Nationwide Economic Impacts from DON SBIR/STTR Phase II, FY 2000-2013

Impact Type	Employment (Job Years)	Labor Income (In Billions)	Labor Income Per Job	Value Added (In Billions)	Output (In Billions)	Tax Revenue (In Billions)
Direct Effect	58,088	\$5.63	\$96,840	\$7.58	\$16.44	\$1.57
Indirect Effect	63,433	\$4.27	\$67,266	\$6.79	\$13.42	\$1.48
Induced Effect	88,106	\$4.47	\$50,788	\$7.85	\$14.41	\$1.85
Total Effect	209,627	\$14.37	\$68,535	\$22.23	\$44.27	\$4.90

Source: Business Research Division, Leeds School of Business, University of Colorado, Boulder; 2014 IMPLAN National Model

Note: Totals may not tally due to rounding

In addition to these five primary economic impact categories, responding companies reported significant economic impacts in five additional categories:

- **Total outside investment funding:** \$645,785,104
- **Number of companies that were acquired:** 91
- **Total acquisition value of companies acquired⁷:** \$1,795,100,022

⁷ *However, most acquired companies declined to disclose actual acquisition detail.*

- **Number of technologies licensed to other companies:** 130
- **Number of spin-out companies created:** 49

ECONOMIC IMPACT ASSESSMENT DETAIL

Upon receiving the company sales and 6-digit NAICS code data from TechLink (see **Study Methodology**, below), the Business Research Division (BRD) at the Leeds School of Business, University of Colorado Boulder, used the national IMPLAN input-output model to determine the economic impacts of the DON SBIR/STTR Phase II contracts completed during the FY 2000-2013 study period. The BRD undertook this task in two stages:

- IMPLAN analysis of the economic impacts resulting from the nearly \$2.3 billion in Phase II R&D activity.
- IMPLAN analysis of the sales of the innovations resulting from this R&D.

Economic impacts were assessed in five primary categories: employment, labor income, value added, output and tax revenues.

• Employment

DON SBIR/STTR Phase II R&D Activity. The national IMPLAN model estimated that 8,377 job years were directly created economy-wide by the nearly \$2.3 billion in Phase II R&D activity. Indirect effects were responsible for an additional 10,076 job years and the induced effects for 13,372 job years. The IMPLAN model estimated that, altogether, **31,825 job years nationwide resulted from the direct, indirect, and induced effects of DON SBIR/STTR Phase II R&D activity** (see Table 4).

Sales of DON SBIR/STTR Phase II Innovations. According to the national IMPLAN model, the \$14.17 billion in sales directly created an estimated 49,711 job years economy-wide. Indirect effects were responsible for an additional 53,358 job years and the induced effects for 74,734 job years. The IMPLAN model estimates that, altogether, **177,802 job years nationwide resulted from the direct, indirect, and induced effects of the sales of DON SBIR/STTR Phase II innovations** (see Table 5).

• Labor Income

DON SBIR/STTR Phase II R&D Activity. The national IMPLAN model estimated that labor income directly associated with the nearly \$2.3 billion in Phase II R&D activity was \$0.87 billion in 2015, or approximately \$103,812 per job (see Table 4). This was 115

percent higher than the annualized average U.S. wage of \$48,320 in 2015.⁸ The indirect labor income was estimated at \$0.63 billion, or approximately \$62,863 per job. The induced labor income was estimated to be \$0.68 billion, or \$50,786 per job. Average wages for the indirect and induced jobs were substantially lower than the average wage for the jobs directly created because many of these jobs were in lower-paid manufacturing and service sectors. The total economy-wide labor income resulting from the DON SBIR/STTR Phase II R&D activity was \$2.18 billion. **The average wage of the approximately 31,825 jobs created as a result of the DON SBIR/STTR Phase II activity was \$68,567, approximately 42 percent higher than the average U.S. wage of \$48,320 in 2015.**

Sales of DON SBIR/STTR Phase II Innovations. According to the national IMPLAN model, the labor income directly associated with the \$14.17 billion in sales reported by companies was \$4.76 billion in 2015, or \$95,665 per job (see Table 5). **This was nearly twice the average U.S. wage in 2015.** The indirect labor income was estimated at \$3.63 billion, or approximately \$68,097 per job. The induced labor income was estimated to be \$3.8 billion, or \$50,788 per job. The total economy-wide labor income resulting in 2015 from sales of the DON SBIR/STTR Phase II innovations was \$12.18 billion. **The average wage of 177,802 job years created (est.) via DON SBIR/STTR Phase II contracts was \$68,530, which is 42 percent higher than the average U.S. wage in 2015.**

• Value Added

This measure recognizes that companies buy goods and services from other companies in order to create products of greater value than the sum of the goods and services used to make these products. As estimated by IMPLAN, value added is equal to the total sales (plus or minus inventory adjustments) minus the cost of the goods and services purchased to produce the products sold. In the current study, value added measures the real contribution that DON SBIR/STTR Phase II contract recipients made to the economy.

DON SBIR/STTR Phase II R&D Activity. According to the national IMPLAN model, the initial **nearly \$2.3 billion in R&D contracts generated \$3.36 billion in value added impact** economy-wide. Of this total, \$1.16 billion was generated directly, \$1 billion was generated indirectly, and \$1.19 billion was generated from the induced effect (see Table 4).

Sales of DON SBIR/STTR Phase II Innovations. Subsequent IMPLAN analysis estimated that the **\$14.17 billion (2015 \$) in sales reported by companies generated \$18.87 billion in value added impact** economy-wide: \$6.41 billion generated directly, \$5.79 billion indirectly, and \$6.66 billion from the induced effect (see Table 5).

• Output

DON SBIR/STTR Phase II R&D Activity. According to the national IMPLAN model, the nearly \$2.3 billion (\$2,261,502,616) in DON SBIR/STTR Phase II R&D contracts provided to small businesses throughout the United States generated a total of \$6.1 billion in economic

⁸ <http://www.bls.gov>

output nationwide. Of this amount, around \$1.65 billion was generated indirectly as the result of inter-industry purchases (firms purchasing from each other), and \$2.19 billion was generated from the induced effect, the result of households spending payroll on goods and services economy-wide (see Table 4).

Dividing the economy-wide output (\$6.10 billion) by the direct value of the DON SBIR/STTR Phase II contracts (\$2.26 billion) yields an output multiplier of 2.70. **Result: For every dollar in economic activity directly attributable to the DON SBIR/STTR Phase II R&D, an additional \$1.70 in economic activity was generated nationwide.**

Table 4. Economic Impact of Navy SBIR/STTR Phase II R&D Activity, FY 2000-2013

Impact Type	Employment (Job Years)	Employment (Av. Per Year)	Labor Income (In Billions)	Labor Income Per Job	Value Added (In Billions)	Output (In Billions)
Direct Effect	8,377	598	\$0.87	\$103,812	\$1.16	\$2.26
Indirect Effect	10,076	720	\$0.63	\$62,863	\$1.00	\$1.65
Induced Effect	13,372	955	\$0.68	\$50,786	\$1.19	\$2.19
Total Effect	31,825	2,273	\$2.18	\$68,567	\$3.36	\$6.10

Note: Totals may not tally due to rounding

Sales of DON SBIR/STTR Phase II Innovations. This study also examined the output from the subsequent sales of the innovations resulting from this R&D. According to the IMPLAN model, **\$14.17 billion (2015 \$) in direct sales of new products and services generated an additional \$24 billion in sales economy-wide.** Of this amount, \$11.77 billion was generated indirectly through inter-industry purchases, and \$12.23 billion generated from households spending payroll on goods and services. The total economy-wide output from sales of DON SBIR/STTR Phase II-developed technology was \$38.17 billion (see Table 5).

Dividing total economy-wide output (\$38.17 billion) by the direct output of companies selling products and services related to their DON SBIR/STTR Phase II contracts (\$14.17 billion) yields an output multiplier of 2.69. **Result: For every dollar in sales directly attributable to the DON SBIR/STTR Phase II contracts, an additional \$1.69 in sales was generated economy-wide.**

Table 5. Economic Impact of Subsequent Company Sales, FY 2000-2013

Impact Type	Employment (Job Years)	Employment (Av. Per Year)	Labor Income (In Billions)	Labor Income Per Job	Value Added (In Billions)	Output (In Billions)
Direct Effect	49,711	3,551	\$4.76	\$95,665	\$6.41	\$14.17
Indirect Effect	53,358	3,811	\$3.63	\$68,097	\$5.79	\$11.77
Induced Effect	74,734	5,338	\$3.80	\$50,788	\$6.66	\$12.23
Total Effect	177,802	12,700	\$12.18	\$68,530	\$18.87	\$38.17

Note: Totals may not tally due to rounding

• Tax Revenues

Tax revenues were estimated for the nearly \$2.3 billion in DON Phase II R&D activity and \$14.17 billion in subsequent sales, including their associated economy-wide indirect and induced effects. These tax revenues included social insurance taxes such as Social Security and Medicare (paid by employers, employees, and the self-employed), personal income taxes, motor vehicle licenses, property taxes, corporate profits taxes and dividends, and indirect business taxes (comprised mainly of excise and property taxes, fees, licenses, and sales taxes). **Total taxes collected by federal, state, and local government entities were estimated at \$4.90 billion.** This included \$1.57 billion in tax revenues on direct sales, \$1.48 billion on indirect sales, and \$1.85 billion on induced sales (see Table 3).

SMALL BUSINESS IMPACT

Of 1,199 companies interviewed in the TechLink study 480, or 40%, had two or more Navy SBIR/STTR Phase II contracts. Of this group, 243 companies (20%) had three or more DON Phase II contracts, and just 161 (13% of the study sample) had four or more contracts. Further, only 31 companies (2.6%) had ten or more completed Phase II contracts, suggesting a wide distribution of awards to small firms rather than a narrow distribution.

STUDY METHODOLOGY

This study was undertaken in three major phases. First, during the *Data Gathering* phase, the research team contacted all companies that had completed DON SBIR/STTR Phase II contracts during the FY 2000-2013 time frame. This phase lasted for ten months – from October 2015 through the end of July 2016. Second, during the *Data Analysis* phase, the research team analyzed the information gathered and used IMPLAN economic-impact assessment software to estimate the total economic impacts resulting from (1) the initial Phase II funding for R&D and (2) subsequent sales of new products and services derived from the innovations generated by the R&D. This second phase took three months and extended from June 2016 through August 2016. The *Final Study Generation* phase occupied most of the August-September 2016 period.

Data Gathering

To enable TechLink to undertake this study, the DON SBIR/STTR Program provided essential information on all DON SBIR/STTR Phase II contracts that were *completed* (per established DON criteria) during the FY 2000-2013 period.⁹

⁹ Navy Phase II SBIR/STTR award structures vary considerably by Navy Systems Command. Navy Phase II awardees must generally meet specific performance criteria during their initial Phase II performance period in order to receive full funding to complete their Phase II projects. Navy SBIR/STTR award information is available online at <https://www.navysbirprogram.com/navysearch/search/search.aspx> or <https://www.navysbirsearch.com/>

Information provided for each completed Phase II contract was entered into a custom database developed for this study, to facilitate data gathering and analysis. Essential Phase II contract information included the company name and location; the contract number and award amount; the start and completion dates of the award, including any contract extensions; and the names and contact information for the principal investigator and company executive at the time of the award. Award titles and abstracts, which provide background information on the technology being developed, helped establish connections to any resulting commercial technologies and were especially useful when analyzing companies with multiple SBIR/STTR awards.

A team of five TechLink economic research specialists used the Phase II information and databases to survey the companies involved. They attempted to contact, by email and telephone, all 1,199 Phase II recipients about the outcomes of their 2,734 DON Phase II contracts.

Survey Questions. Companies were asked a series of questions that focused on the economic outcomes and impacts related to their DON SBIR/STTR Phase II contracts:

- 1) Did your company develop any new products or services based on your DON SBIR/STTR Phase II contract(s)? If so, what were the total cumulative sales of these new products or services for each contract?¹⁰
- 2) Of the total sales for each DON Phase II contract, what was the dollar value of sales to the U.S. military, either directly or through a prime contractor?
- 3) Did the Phase II contract(s) lead to any follow-on (non-SBIR Phase I or II) R&D contracts for further development of the technology or technologies resulting from Phase II? If so, what was the total dollar value of these contracts?
- 4) Did you license any of the technologies developed with DON Phase II funding to another company? If so, what were the total royalties received from each licensee?
- 5) Did you create a spin-out company to commercialize any of the technologies developed with DON SBIR/STTR Phase II funding?
- 6) Did you receive any significant subsequent investment funding, such as venture capital or angel funding, directly related to the technology developed or commercialized? If so, what was the total amount of these investments?
- 7) Was your company acquired as a direct result of the technology or technologies developed with DON SBIR/STTR Phase II funding? If so, what was the acquisition amount?

¹⁰ Companies were not asked to report their sales *by year* because this would have greatly increased the burden of responding to the survey and, consequently, lowered the response rate.

Response Rate. Companies surveyed provided definitive information on the outcomes of 2,379 contracts out of the 2,734 total—a response rate of 87 percent. However, TechLink researchers were able to obtain authoritative secondary information on the outcomes of 219 additional contracts from other official sources.¹¹ Including information from these additional awards, this study achieved an *effective response rate* of 95 percent.

NAICS Code Assignments. TechLink next assigned all Phase II recipient companies' contracts to the appropriate 6-digit North American Industry Classification System (NAICS) code or codes.¹²

Many DON SBIR/STTR Phase II contracts had more than one NAICS code. All were assigned one of the primary R&D NAICS code for analysis of the economic impacts resulting from the Phase II R&D activity itself. In addition, if the R&D led to commercial sales or other economic outcomes from the resulting innovations, the research team assigned NAICS codes specific to those economic activities. All contracts were assigned one of the following three primary R&D NAICS codes, listed by order of frequency:

- 541712: Research and Development in the Physical, Engineering, and Life Sciences (except Biotechnology)
- 541720: Research and Development in the Social Sciences and Humanities
- 541711: Research and Development in Biotechnology

Next, the TechLink research team entered company sales and other economic data and NAICS code information into the custom database developed for this study. The database greatly facilitated data entry from the multiple economic research specialists gathering company information. Once data were aggregated and carefully validated by the team, the database provided mechanisms for quickly querying and analyzing the data as well as generating a final dataset for economic-impact modeling.

Data Analysis

The BRD employed a widely used economic-impact analysis software program, IMPLAN, to estimate the economic contribution effects of the total sales resulting from the DON SBIR/STTR Phase II contracts.

IMPLAN draws on a mathematical input-output framework originally developed by Wassily Leontief, the 1973 Nobel laureate in economics, to study the flow of money through a regional economy. IMPLAN assumes fixed relationships between producers and their suppliers, based on demand, and that inter-industry relationships within a given

¹¹ These other official sources included Company Commercialization Reports (CCRs) and the Federal Procurement Data System (www.fpds.gov). Companies are required to submit a CCR with every SBIR or STTR proposal submitted to the DoD. CCRs are intended to provide a record of prior Phase II projects and the sales and investment resulting from innovations developed under these projects. The Federal Procurement Data System (FPDS) is a database of government contracts. It is managed by the Federal Procurement Data Center, part of the U.S. General Services Administration, and contains detailed information on all government contracts exceeding \$3,000.

¹² See Appendix 1 for the NAICS codes assigned to contracts included in the study.

region's economy largely determine how that economy responds to change. Increases in demand for a certain product or service causes a multiplier effect—a cascade of ripples through the economy. This increased demand affects the producer of the product, the producer's employees, the producer's suppliers, the supplier's employees, and others, ultimately generating a total impact on the economy that significantly exceeds the initial change in demand.

Sales were assumed to be in 2015 dollars for IMPLAN modeling. Company sales occurred up to the time that the study was conducted (fall 2015 to summer 2016). Use of 2015 as the reference year represents a conservative approach because it does not reflect the relatively higher value of the earlier sales figures due to inflation: a dollar in 2015 was worth 27 percent less than a dollar in 2000.¹³

RESEARCH TEAM

The base economic-impact study was conducted by TechLink, a DoD-funded technology transfer center at Montana State University-Bozeman, in collaboration with the Bureau Research Division (BRD) of the Leeds School of Business at the University of Colorado in Boulder. Since 1999, TechLink has served as DoD's primary national "partnership intermediary," helping to develop technology transfer partnerships between DoD laboratories and U.S. industry nationwide. TechLink's primary focus is helping DoD labs transfer their inventions to U.S. companies through license agreements. TechLink currently brokers or facilitates approximately 60 percent of all DoD license agreements with industry. (See www.techlinkcenter.org.)

The BRD has been analyzing local, state, and national economies for more than 95 years. It specializes in customized research and economic-impact studies that help companies, associations, nonprofits, and government agencies make informed business and policy decisions. This is the seventh major economic-impact study undertaken by TechLink and the third study it has conducted with the BRD.¹⁴ The principal authors are Dr. Will Swearingen and Ray Friesenhahn of TechLink; and Brian Lewandowski and Dr. Richard Wobbekind of the BRD.

¹³ Per the U.S. Bureau of Labor Statistics, Consumer Price Index (CPI) Inflation Calculator, available online at http://www.bls.gov/data/inflation_calculator.htm.

¹⁴ These studies are available online at <http://techlinkcenter.org/publications/economic-impacts>.