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# Economic Contribution of Federal Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) Program Funding in Minnesota: 1983-2014

**A Report of the Economic Impact Analysis Program**

**Authored by Brigid Tuck and Gabriel Appiah**

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A REPORT OF THE ECONOMIC IMPACT ANALYSIS PROGRAM

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**ECONOMIC CONTRIBUTION: Small Business Innovation Research and Small Business Technology Transfer**

**Programs**

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## EXECUTIVE SUMMARY: ECONOMIC CONTRIBUTION OF FEDERAL SMALL BUSINESS INNOVATION RESEARCH (SBIR) AND SMALL BUSINESS TECHNOLOGY TRANSFER (STTR) PROGRAM FUNDING IN MINNESOTA: 1983-2014

Small businesses in Minnesota have the opportunity to leverage federal funding through the SBIR/STTR programs to support innovation, research, and commercialization of ideas and concepts with commercial potential in many industry sectors. The following is a summary of the economic contribution of federal SBIR and STTR funding between 1983 and 2014.

- *Direct Contribution:* Between 1983 and 2014, small businesses received \$683.6 million (in 2015 dollars) of federal SBIR and STTR funding. Federal funding directly created an estimated 2,912 jobs and an estimated \$258.1 million (in 2015 dollars) in labor income in Minnesota. Since these are direct effects, they include jobs and income created at the businesses receiving federal funding.
- *Total Contribution:* Between 1983 and 2014, projects receiving federal support generated an estimated \$1.4 billion (in 2015 dollars) of economic activity in Minnesota, including an estimated \$510.2 million (in 2015 dollars) in labor income. The funding supported employment for 7,790 people. The total impact, as described, is the summation of the annual impacts, and care should be taken in interpretation. Each employee supported by SBIR and STTR funding, on average, generates \$179,400 of output in the Minnesota economy.
- *Total Effects by Industry:* Between 1983 and 2014, the scientific and research design industry (R&D) *directly* received the largest portion of federal funding, and thus created the largest contribution at an estimated \$1.3 billion (in 2015 dollars) and 7,276 jobs.
- *Benefiting Industries:* Beyond understanding the total contribution of federal SBIR and STTR funding in Minnesota, knowing which industries *indirectly* benefited most significantly from indirect and induced effects is also useful information. The highest ripple effects are in the real estate sector, employment services, and management consulting services.
- This is a conservative analysis, focused primarily on funding leveraged via the SBIR and STTR programs. The economic activity spurred by the success of small businesses (for example, private investment or value generated by public offerings) are not included in this analysis.

## PROJECT OVERVIEW

The Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) funding programs provide critical, non-dilutive capital for small businesses in Minnesota to support innovation, research, and commercialization of ideas and concepts with potential in many industry sectors.

The SBIR program was established under the Small Business Innovation Development Act of 1982 (Public Law 97-219) to strengthen the role of innovative small business concerns in federally-funded research and development (R&D). In December 2000, Congress passed the Small Business Research and Development Enhancement Act (P.L. 102-564). The program was reauthorized until September 30, 2008 by the Small Business Reauthorization Act of 2000 (P.L. 106-554). Subsequently, Congress passed numerous extensions, the most recent of which extends the SBIR program through 2017.

Modeled after the SBIR program, STTR was established as a pilot program by the Small Business Technology Transfer Act of 1992 (P.L. 102-564, Title II). Government agencies with R&D budgets of \$1 billion or more are required to set aside a portion of these funds to finance STTR activity. In 2001, Congress passed the Small Business Reauthorization Act of 1997 (P.L. 105-135). The program was reauthorized until September 30, 2009, by the Small Business Technology Transfer Program Reauthorization Act of 2001 (P.L.107-50). Subsequently, Congress passed numerous extensions, the most recent of which extends the STTR program through 2017. The goal of the STTR program is to facilitate the transfer of technology developed by a research institution through the entrepreneurship of a small business concern.

Small businesses in Minnesota have leveraged federal funding under both programs since their inception. In recent years, MN-SBIR has assisted small businesses with accessing federal SBIR and STTR funding. MN-SBIR is the state's primary way of providing SBIR and STTR coaching and mentoring to Minnesota businesses. Prior to MN-SBIR, other agencies and organizations assisted Minnesota businesses in accessing SBIR and STTR funding.

Each year, Minnesota businesses are competitively awarded SBIR and STTR funding from any one of eleven federal agencies. With SBIR and STTR grants and contracts, these businesses create economic activity in the state—including additional output (or sales) in the economy, jobs, and labor income. The new sales, jobs, and labor income injected into the economy, in turn, result in additional economic activity for the businesses and industries that support small businesses and their employees. Input-output models can capture the indirect and induced (or ripple) effects generated by small businesses that receive federal funding.

MN-SBIR is interested in quantifying the effects (both the initial effects for the business directly receiving federal funds and the associated ripple effects) generated by businesses that have received federal SBIR and STTR funding between 1983 and 2014. To do so, MN-SBIR contracted with University of Minnesota Extension to conduct an economic contribution analysis. The results of the analysis are provided in this report and presented in two ways. First, the economic contribution of federal funding is reported by year. Since the analysis covers a span of years, it is necessary to adjust the dollar figures to a single year to allow for proper interpretation and comparison. All dollar figures were adjusted to 2015 using the Bureau of Labor Statistic's Consumer Price Index (CPI).

Second, the economic contribution of federal funding is reported by the main industry affected by the federal investment. For example, awards for research in the area of bioscience would likely be categorized as "scientific research and design" and awards for the manufacture of new medical

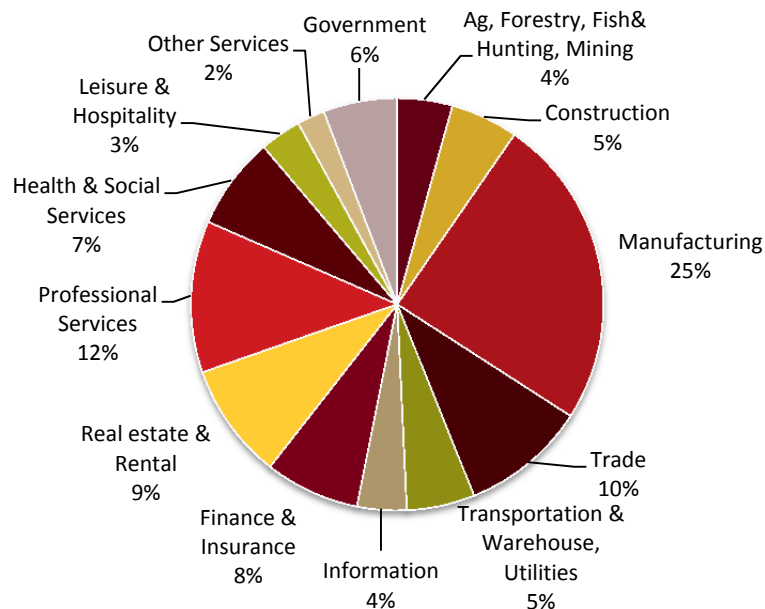
technology would likely be categorized as “surgical and medical instrument manufacturing.” Extension categorized each of the awards based on information provided by MN-SBIR.

## PROFILE OF THE STUDY AREA ECONOMY

The study area for this analysis is the state of Minnesota. It was chosen because small businesses in any community in Minnesota are eligible to participate in the federal programs. The federal SBIR and STTR funding impacts detailed in this report can be compared to a total of \$588.2 billion of output generated by all sectors of Minnesota’s economy in 2013.<sup>1</sup> There were 3.6 million jobs in all sectors of the state.

Chart 1 shows total output in Minnesota by industry category. The manufacturing sector contributes 25 percent of total output to the state’s economy. The service sectors, in total, contribute 47 percent of output to the state’s economy. Of the service sector categories, the professional services sector (12 percent) comprises the largest component. Scientific and research development activity is part of the professional services sector. In 2013, scientific research and development companies in Minnesota generated \$7.7 billion of output (sales).

**Chart 1: Output by Industry Minnesota 2013**



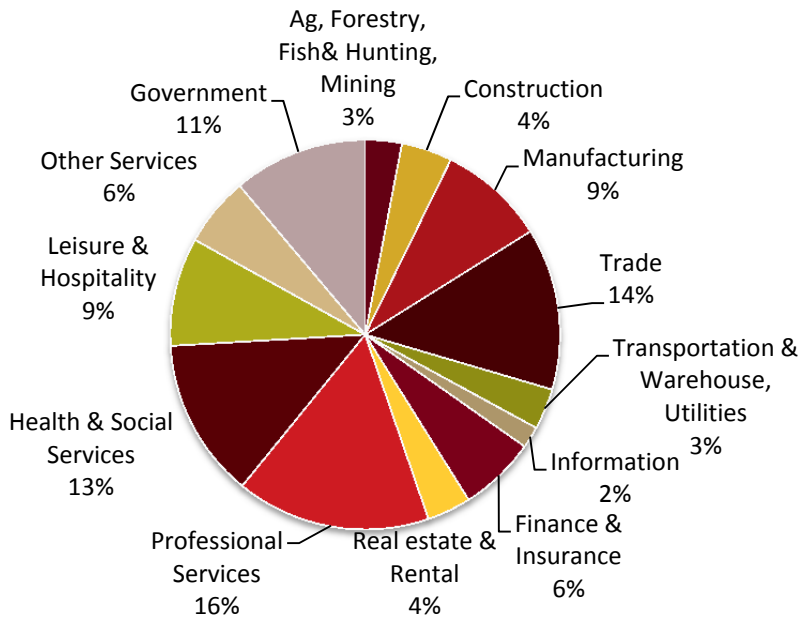
Employment by industry category is shown in chart 2. The service sectors have the largest share of employees in Minnesota (56 percent). Of all industries, professional services, trade, and health and social services have the largest shares, respectively. In 2013, there were 35,100 scientific and research development jobs in Minnesota.

While manufacturing creates 25 percent of output, it only employs 9 percent of all workers. There are two possible reasons for this observation. First, in the database, one job is one job, regardless of its status as part-time, full-time, or seasonal. Since the service sectors tend to employ more part-time employees while manufacturing tends to employ more full-time, manufacturing’s share of

<sup>1</sup> Output and employment figures for Minnesota retrieved from the IMPLAN database. IMPLAN measures output (or total sales in the economy). This is not the same as GDP. The most recent IMPLAN dataset available is 2013.

employment may appear lower. Second, manufacturing workers can produce more output per employee in comparison to workers in many other industries.

**Chart 2: Employment by Industry Minnesota 2013**



## ECONOMIC CONTRIBUTION

Total economic contribution is equal to the summation of direct, indirect, and induced effects. The direct effect is the output, employment, and labor income directly created by an industry or activity, such as the research and development activities spurred on by federal investment. The direct effect triggers additional economic activity to occur, therefore setting off ripples in the local economy. These ripples fall into two categories: indirect effects (created by business-to-business transactions) and induced effects (created by consumer-to-business transactions). In an economic impact contribution, researchers quantify the direct effects. An input-output model then measures the indirect and induced impacts. The input-output model used was IMPLAN (MIG, Inc.).<sup>2</sup>

### Direct Effect

The direct effect of federal funding leveraged in Minnesota via the SBIR and STTR programs between 1983 and 2014 is equal to total federal funding provided. Between 1983 and 2014, Minnesota businesses received \$683.6 million (in 2015 dollars) of federal funding through 2,099 awards (Table 1). According to the IMPLAN model, federal funding directly created or supported an estimated 2,912 jobs and resulted in the generation of an estimated \$258.1 million (in 2015 dollars) of labor income in Minnesota. Since this is the direct effect, these are the jobs and income created *at the businesses* receiving funding from federal sources. The

<sup>2</sup>The IMPLAN model version 3.0 with SAM multipliers was implemented in this analysis ([www.implan.com](http://www.implan.com)).

effects of each award year are annual for that particular year, so while they can be summed, note the total effect was spread over time.

In 2014, the final year included in this analysis, Minnesota small businesses were competitively awarded \$27.5 million in federal funding through 73 awards. Scientific research and development in Minnesota, meanwhile, was a \$7.7 billion industry.

The 2014 federal small business awards created (based on the IMPLAN database) an estimated 121 jobs at small businesses and \$10.7 million of labor income in Minnesota. In comparison, there were 35,100 research and development jobs in Minnesota.

Since the analysis covers a span of years, the dollar figures needed to be adjusted to a base year to adequately account for inflation. All dollar figures were adjusted to 2015 using the Bureau of Labor Statistic's Consumer Price Index (CPI).

**Table 1: Direct Effect of Total Federal Funding Leveraged in Minnesota Via the SBIR and STTR Programs, 1983 to 2014**

Year	Output (federal funding) millions of 2015 dollars	Employment	Labor Income millions of 2015 dollars	Number of Awards
<b>Total</b>	<b>\$683.6</b>	<b>2,912</b>	<b>\$258.1</b>	<b>2,099</b>
1983	\$0.6	3	\$0.2	6
1984	\$3.7	16	\$1.4	15
1985	\$5.9	26	\$2.3	30
1986	\$9.9	43	\$3.8	31
1987	\$6.3	27	\$2.4	33
1988	\$9.5	42	\$3.7	41
1989	\$8.2	35	\$3.1	38
1990	\$14.5	61	\$5.4	55
1991	\$11.7	51	\$4.6	51
1992	\$10.7	47	\$4.1	45
1993	\$11.9	56	\$5.0	50
1994	\$12.5	55	\$4.8	66
1995	\$24.5	107	\$9.4	79
1996	\$28.8	123	\$10.8	69
1997	\$25.6	108	\$9.5	74
1998	\$17.2	72	\$6.4	68
1999	\$21.5	80	\$7.2	63



2000	\$20.8	81	\$7.3	75
2001	\$21.2	88	\$7.8	85
2002	\$34.0	144	\$12.7	111
2003	\$39.2	168	\$14.8	121
2004	\$30.3	132	\$11.7	80
2005	\$35.0	152	\$13.4	90
2006	\$32.4	136	\$12.2	105
2007	\$27.6	118	\$10.5	83
2008	\$39.3	164	\$14.6	78
2009	\$35.4	154	\$13.6	86
2010	\$30.4	127	\$11.4	83
2011	\$24.7	107	\$9.5	73
2012	\$32.2	138	\$12.3	79
2013	\$30.8	130	\$11.5	63
2014	\$27.5	121	\$10.7	73

\*Columns may not sum due to rounding

Output data provided to Extension by MN-SBIR;  
employment and labor income estimated with IMPLAN model

### Indirect and Induced Effects

After quantifying the direct effect, data is entered into an input-output model. Input-output models trace the flow of dollars throughout a local economy. The model can then estimate the indirect and induced, or ripple, effects of an economic activity.

Indirect effects are those associated with a change in economic activity due to spending for goods and services directly tied to the small businesses receiving federal funding. In this case, these are the changes in the local economy occurring because businesses need to purchase inputs (raw goods) and related services (training and accounting, for example). These are business-to-business effects.

Induced effects are those associated with a change in economic activity due to spending by the employees of businesses (labor) and by households. Primarily, in this study, these are economic changes related to spending by the employees of businesses receiving federal funding. It also includes household spending related to indirect effects. These are business-to-consumer effects.

### Total Effect

The sum of the direct, indirect, and induced effects equals the total effect. The total effect of projects leveraged in Minnesota with federal SBIR and STTR funding is shown in Table 2. Between 1983 and 2014, projects receiving federal support generated an estimated \$1.4 billion (in 2015 dollars) of economic activity in Minnesota, including an estimated \$510.2 million (in 2015 dollars) in labor income. In addition, the funding supported employment for an estimated 7,788 individuals. The total impact, as described, is the summation of the annual impacts. Please note the impacts of awards are considered annual—for example, those 7,788 jobs may include individuals employed multiple years by the same small business, if the business received multiple grants over time.

Overall, the average economic contribution generated per employee is \$179,400. In other words, on average, each employee supported by SBIR and STTR funding generates \$179,400 of output in the Minnesota economy.

Federal SBIR and STTR awards supported \$56.8 million of economic activity in Minnesota in 2014. In comparison, Minnesota businesses and enterprises across all industries generated \$588.2 billion in economic activity.

**Table 2: Total Economic Contribution (Direct, Indirect, and Induced) Federal Funding Leveraged in Minnesota via the SBIR and STTR Programs, 1983 to 2014**

Year	Output millions of 2015 dollars	Employment	Labor Income millions of 2015 dollars	Average Contribution per Employee 2015 dollars (rounded)
<b>Total</b>	<b>\$1,397.2</b>	<b>7,788</b>	<b>\$510.2</b>	<b>\$179,400</b>
1983	\$1.3	7	\$0.5	\$185,700
1984	\$7.5	42	\$2.8	\$178,600
1985	\$12.1	68	\$4.5	\$177,900
1986	\$20.3	114	\$7.5	\$178,100
1987	\$12.8	71	\$4.7	\$180,300
1988	\$19.5	110	\$7.2	\$177,300
1989	\$16.9	94	\$6.2	\$179,800
1990	\$29.3	162	\$10.6	\$180,900
1991	\$24.0	136	\$8.9	\$176,500
1992	\$21.9	124	\$8.1	\$176,600
1993	\$24.6	144	\$9.5	\$170,800
1994	\$25.7	145	\$9.5	\$177,200
1995	\$50.4	283	\$18.6	\$178,100
1996	\$58.7	326	\$21.4	\$180,100
1997	\$52.2	290	\$18.9	\$180,000

1998	\$35.1	193	\$12.7	\$181,900
1999	\$44.4	242	\$15.3	\$183,500
2000	\$43.0	237	\$15.1	\$181,400
2001	\$43.0	237	\$15.5	\$181,400
2002	\$69.1	384	\$25.2	\$178,000
2003	\$80.2	447	\$29.3	\$179,400
2004	\$62.3	351	\$23.0	\$177,500
2005	\$72.0	405	\$26.5	\$177,800
2006	\$66.0	363	\$24.0	\$181,800
2007	\$56.1	312	\$20.6	\$179,800
2008	\$78.7	434	\$28.6	\$181,300
2009	\$72.6	408	\$26.8	\$177,900
2010	\$61.5	339	\$22.4	\$181,400
2011	\$50.7	284	\$18.7	\$178,500
2012	\$65.9	368	\$24.2	\$179,100
2013	\$62.6	347	\$22.8	\$180,400
2014	\$56.8	321	\$21.0	\$176,900

\*Columns may not sum due to rounding

Estimates by University of Minnesota Extension

### Total Effect by Industry

Analyzing the data by year provides one view of the contribution of federal funding secured via SBIR and STTR in Minnesota. Another view is based on the industry receiving the funding.

Between 1983 and 2014, the scientific and research design industry (research and development) received the largest portion of federal funding, and thus created the largest contribution at an estimated \$1.3 billion (in 2015 dollars) and 7,276 jobs (Table 3).

Many of the funding opportunities were in specific industries (such as research and development in aerospace); however, since the projects were primarily about research versus commercial manufacturing or sale, the projects were classified as scientific and research design. University of Minnesota Extension classified the projects by industry.

**Table 3: Total Effect of Federal Funding Leveraged in Minnesota Via the SBIR and STTR Programs by Industry:**

## 1983-2014

Industry	Output millions of 2015 dollars	Employment	Labor Income millions of 2015 dollars
Scientific and research design	\$1,292.0	7,276	\$476.2
Data processing, hosting, and related services	\$60.4	326	\$20.3
Surgical and medical instrument manufacturing	\$20.4	87	\$6.5
Aircraft manufacturing	\$11.3	23	\$1.5
Computer systems design	\$6.9	58	\$4.0
Pharmaceutical preparation and manufacturing	\$2.5	8	\$0.7
Electronic computer manufacturing	\$2.4	7	\$0.5
Electromedical/electrotherapeutic apparatus manufacturing	\$1.3	5	\$0.4

Estimates by University of Minnesota Extension

## TOP INDUSTRIES AFFECTED

Beyond understanding the total contribution of federal SBIR and STTR funding in Minnesota, knowing which industries benefited most significantly from the ripple effects is also useful information. The highest ripple effects are in the real estate sector, employment services, and management consulting services (Chart 3).

**Chart 3: Top Industries Affected (Indirect and Induced Effects) by Federal Funding Leveraged Via the SBIR and STTR Programs, 1983-2014**

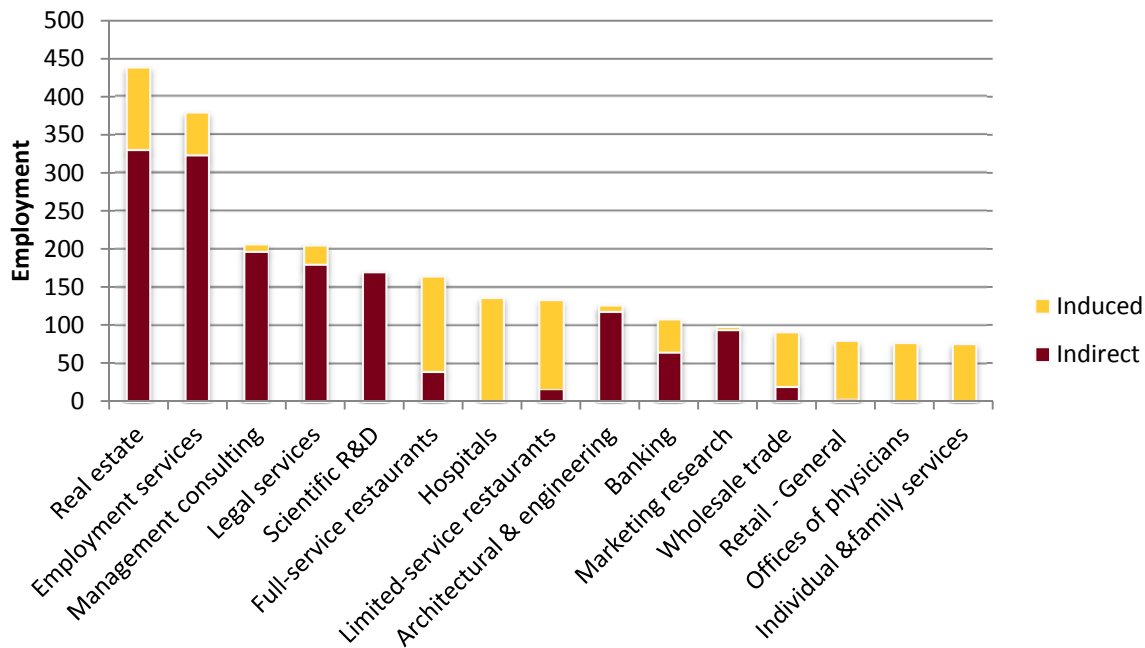


Chart 3 differs from Table 3 in that Table 3 highlights the industries receiving the highest direct effect (or the industries receiving federal funding), while Chart 1 highlights the industries with the highest indirect and induced effects. Direct federal funding is not included in Chart 1.

## APPENDIX: METHODOLOGY

Special models, called input-output models, exist to conduct economic contribution analysis. There are several input-output models available. IMPLAN (IMPact Analysis for PLANning, MIG) is one such model. Many economists use IMPLAN for economic contribution analysis because it can measure output and employment impacts, is available on a county-by-county basis, and is flexible for the user. IMPLAN has some limitations and qualifications, but it is one of the best tools available to economists for input-output modeling. Understanding the IMPLAN tool, its capabilities, and its limitations help ensure the best results from the model.

One of the most critical aspects of understanding economic contribution analysis is the distinction between the “local” and “non-local” economy. The local economy is identified as part of the model-building process. Either the group requesting the study or the analyst defines the local area. Typically, the study area (the local economy) is a county or a group of counties that share economic linkages. In this study, the study area is the entire state of Minnesota.

A few definitions are essential in order to properly read the results of an IMPLAN analysis. The terms and their definitions are provided below.

### Output

Output is measured in dollars and is equivalent to total sales. The output measure can include significant “double counting.” Think of corn, for example. The value of corn is counted when it is sold to the mill, again when it is sold to the dairy farmer, again as part of the price of fluid milk, and yet again when it is sold as cheese. The value of the corn is built into the price of each of these items, and then the sales of each of these items are added up to get total sales (or output).

### Employment

Employment includes full- and part-time workers, as well as seasonal workers. Employment is measured in annual average jobs, not full-time equivalents (FTE’s). IMPLAN includes total wage and salaried employees, as well as the self-employed, in employment estimates. Because employment is measured in jobs and not in dollar values, it tends to be a very stable metric.

### Labor Income

Labor income measures the value added to the product by the labor component. So, in the corn example, when the corn is sold to the mill, a certain percentage of the sale goes to the farmer for his/her labor. Then when the mill sells the corn as feed to the dairy farmer, it includes some markup for its labor costs in the price. When the dairy farmer sells the milk to the cheese manufacturer, he/she includes a value for his/her labor. These individual value increments for labor can be measured, which amounts to labor income. Labor income does *not* include double counting. Labor income includes wages, benefits, and salaries. Both employee compensation and proprietor income are part of labor income.

### Direct Impact

Direct impact is equivalent to the initial activity in the economy. In this study, it is the expenditures of businesses receiving federal funding via the SBIR and STTR programs.

## **Indirect Impact**

The indirect impact is the summation of changes in the local economy that occur due to spending for inputs (goods and services) by the industry or industries directly impacted. For instance, if employment in a manufacturing plant increases by 100 jobs, this implies a corresponding increase in output by the plant. As the plant increases output, it must also purchase more inputs, such as electricity, steel, and equipment. As the plant increases purchases of these items, its suppliers must also increase production, and so forth. As these ripples move through the economy, they can be captured and measured. Ripples related to the purchase of goods and services are indirect impacts. In this study, indirect impacts are those associated with spending by small businesses to purchase inputs.

## **Induced Impact**

The induced impact is the summation of changes in the local economy that occur due to spending by labor; that is, spending by employees in the industry or industries directly impacted. For instance, if employment in a manufacturing plant increases by 100 jobs, the new employees will have more money to spend to purchase housing, buy groceries, and go out to dinner. As they spend their new income, more activity occurs in the local economy. This can be quantified and is called the induced impact. Primarily, in this study, the induced impacts are those economic changes related to spending by employees of small businesses receiving federal funding.