

National Economic Impacts from DoD License Agreements With U.S. Industry

2000-2017



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TechLink and University of Colorado Business Research Division

CONTENTS

3	Executive Summary
5	Purpose of Study
5	Research Team
7	Methodology
15	Results
29	Economic Impact Analysis
33	Summary
35	Appendices



National Economic Impacts from DoD License Agreements with U.S. Industry, 2000-2017

EXECUTIVE SUMMARY

This study quantifies the overall **contribution of Department of Defense (DoD) license agreements to the nation's economy and defense mission**. U.S. government agencies have a legislative mandate to transfer their patented inventions to industry. Patent license agreements are used to transfer these inventions. License agreements enable companies to develop and sell new products and services using these inventions.

In 2018, an independent research team undertook a seven-month study of the economic impacts from DoD license agreements with U.S. industry. The study's primary purpose was to determine the extent to which DoD license agreements active during the 2000-2017 period contributed to **new economic activity and job creation** in the United States. A secondary purpose was to estimate the extent to which these license agreements resulted in the **transition of new technology to U.S. military use**. This study was undertaken at the direction of the Air Force Technology Transfer Program and the Defense Laboratories Office within the Office of the Assistant Secretary of Defense for Research & Engineering. The license agreements involved inventions at 68 different DoD laboratories.

The research team contacted all 915 companies with DoD license agreements active during the 2000-2017 period. Companies were asked to divulge the total sales of new products and services directly related to their license agreements. They were also asked about related economic outcomes, including sales to the U.S. military, follow-on research and development contracts, sublicensing revenue, and sales by sublicensees and spin-out companies.

The response rate was very high—95 percent of the companies with DoD licenses participated in the study. The team was able to obtain full or partial information on the economic outcomes of 1,103 out of 1,137 total DoD license agreements (97 percent). IMPLAN economic impact assessment software was used to estimate the economic impacts related to the sales and other economic outcomes from these agreements.

Study results are believed to significantly understate the actual economic impacts because of non-responding companies, the effects of inflation, and other factors analyzed in the report.

Major findings from the study included the following:

- **\$27 billion** in total sales of new products and services resulting from the DoD license agreements
- **\$4.5 billion** in sales of new products to the U.S. military
- **\$58 billion** in total economic impact nationwide
- **\$6 billion** in new tax revenues (federal, state, and local)
- **214,791 jobs** (11,933 per year) with average compensation of \$74,762

MAJOR FINDINGS

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National Economic Impacts from DoD License Agreements with U.S. Industry, 2000-2017



PURPOSE OF STUDY

U.S. government agencies have a federal legislative mandate to transfer their inventions to the private sector in order to benefit the nation's economy.¹ Patent license agreements are used to transfer these inventions to industry. License agreements enable companies to develop and sell new products and services using these inventions.

This study was undertaken to estimate the contribution to the national economy of license agreements transferring Department of Defense (DoD) inventions to industry.² The study's specific purpose was to determine the extent to which these license agreements have (1) contributed to new economic activity and job creation in the United States, and (2) resulted in the transition of new technology to U.S. military use.

The study had two major phases. First, the research team surveyed all companies having active license agreements with DoD during the 2000-2017 period—a total of 915 companies with 1,137 different agreements. Companies were asked to divulge the total sales of new products and services directly related to their DoD license agreements. Second, the research team used the IMPLAN economic impact assessment model to estimate the total economic impacts related to these sales. IMPLAN is a leading program used by more than 1,500 organizations nationwide to model economic impacts. IMPLAN analysis yielded estimates of economic output, value added, employment, labor income, and tax revenues.

RESEARCH TEAM

TechLink, a DoD-funded technology transfer center at Montana State University, conducted this economic impact study in collaboration with the Business Research Division (BRD) of the Leeds School of Business at the University of Colorado 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 facilitating the transfer of patented inventions from DoD labs to U.S. companies through license agreements. TechLink currently brokers or facilitates over 70 percent of all DoD license agreements with industry. These license agreements enable companies to develop, manufacture, and sell new

¹ 15 U.S.C. 3701 and 3710, *inter alia*.

² This study is an update of previous studies completed in 2013 and 2016, available online at: <https://techlinkcenter.org/about/publications/>.

National Economic Impacts from DoD License Agreements with U.S. Industry, 2000-2017

products and services using DoD inventions.³ This benefits the national economy and also supports the U.S. defense mission.

The BRD has been analyzing local, state, and national economies for more than 100 years. It specializes in customized research and economic impact studies that help companies, associations, nonprofits, and government agencies make informed business and policy decisions.⁴ The BRD has conducted economic impact studies for a wide range of clients, including the National Renewable Energy Laboratory, Xcel Energy, Western Union, the American Petroleum Institute, and CO-

LABS, a consortium of federally funded scientific laboratories, universities, businesses, and local governments in Colorado.

This is the eleventh major economic impact study completed by TechLink and the ninth study it has conducted with the BRD.⁵ The principal authors were Dr. Will Swearingen, Dr. Michael Wallner, and Jeff Peterson of TechLink and Mr. Brian Lewandowski of the BRD. Other members of the research and evaluation team included Matt Rognlie, Joe Hutton, Jessica Kaplin, Ann Peterson, and Ray Friesenhahn of TechLink and Dr. Richard Wobbekind of BRD.



³ For more information, see <http://techlinkcenter.org>.

⁴ For more information, see <http://www.colorado.edu/leeds/centers/business-research-division>.

⁵ These studies are available online at <http://techlinkcenter.org>.

National Economic Impacts from DoD License Agreements with U.S. Industry, 2000-2017



METHODOLOGY

DATA GATHERING

To undertake this study, TechLink first created a database containing essential information on all DoD license agreements active during the 2000-2017 period. This information came from two different sources: TechLink itself, for license agreements that it had brokered or facilitated between DoD labs and industry (approximately 55 percent of the license agreements in the study); and DoD labs, for agreements they had established independently of TechLink assistance. All 68 DoD labs with license agreements participated.


The information gathered for each agreement included the name of the company that had licensed the DoD technology, contact information for the company's designated point person, the patent number(s) or a short description of the licensed technology, and the effective dates of the agreement.

Four TechLink economic research specialists used the database to contact all companies included in the study—a total of 915 companies with 1,137 different license agreements. The number of agreements exceeds the number of companies because a sizeable subset of companies (163, or 18 percent) had two or more license agreements with DoD. Of this group, 37 companies had three or more agreements, including one company with thirteen different agreements.

915
companies surveyed

1,137
license agreements

95%
response rate



National Economic Impacts from DoD License Agreements with U.S. Industry, 2000-2017

Survey Questions

Companies were asked a series of questions that focused on the economic outcomes related to their license agreements with DoD. They were informed that all economic and financial data provided would be kept entirely confidential by TechLink, that any data shared with DoD would be aggregated with data from other companies, and that the final report would not include any company names. Questions included the following:

1. Did your company develop any new products or services based on your license agreement with DoD? If so, what were the total cumulative sales of these new products or services?
2. What was the dollar value of sales to the U.S. military, either directly or through a prime contractor?
3. Did the agreement lead to any follow-on R&D contracts (such as an SBIR award) for further development of the licensed technology? If so, what was the dollar value of those contracts?⁶
4. Did you sublicense the technology to another company? If so, what were the total royalties you received, and what were the total sales by the sublicensee(s)? Please provide the name(s) of the sublicensee(s) so we can follow up to ask about sales.
5. Did you create a spin-out company to commercialize the licensed technology? If so, what were the total sales by the new company? Please provide the name of the company, so we can ask it about its sales.
6. Did you receive any subsequent outside investment funding, such as venture capital

or angel funding, directly related to the licensed technology? If so, what was the dollar amount of the investment?

7. Was your company acquired as a direct result of the licensed technology?
8. What was the size of your company at the time of the license agreement? (Very Small, 1-9 employees; Small, 10-99; Medium-sized, 100-499; Large, 500 or more). If very small, were you a start-up company specifically created to commercialize the subject technology?

Response Rate

The company response rate was very high: **95 percent** of the companies with DoD license agreements provided sales and other requested information on the economic outcomes of their agreements. Only 26 of the 915 companies declined to participate in the study, either explicitly or by ignoring repeated telephone calls and email messages. An additional 13 companies could not be contacted, despite extensive efforts by the research team.

Because some of the participating companies had multiple agreements, the survey provided the research team with comprehensive information on the outcomes of 1,090 of the 1,137 license agreements—96 percent of the total. Full or partial economic information on an additional 13 licenses was gathered through non-survey methods described below. In total, the research team obtained information on the economic outcomes of slightly over 97 percent of the DoD license agreements. These 1,103 licenses were used to

⁶ Contracts for further development of a licensed technology were treated as sales of R&D services and were included in the total sales.

National Economic Impacts from DoD License Agreements with U.S. Industry, 2000-2017



estimate the economic impact of the DoD licensing program.

The **primary reasons for the study's high response rates** are believed to be the following:

- *Clear communication about the purpose and legitimacy of the study.* Companies were informed that the study's purpose was to quantify the extent to which DoD-developed inventions licensed to industry were having a positive impact on the national economy and U.S. defense mission. Companies that questioned the legitimacy of the study were sent a letter from the Director of the Defense Laboratories Office in the Office of the Assistant Secretary of Defense for Research & Engineering that explained its purpose, confidential nature, and importance as well as TechLink's role in undertaking it.
- *Strong assurance that company-specific information would be kept confidential.* Companies were assured that the DoD was only interested in the overall economic impacts from its licensing agreements with industry—not in company-specific results. Most companies consider their sales figures to be confidential, proprietary, or business-sensitive. Without the assurance that all responses would be treated as business confidential information, few companies would have been willing to divulge their sales information.
- *Conciseness of the survey.* The survey questions were few in number and relatively easy to answer. In many cases, the research team was able to secure the necessary information over the telephone on the first contact. More commonly, extensive follow-up by phone and email was required, often involving several

different company personnel. However, the conciseness of the survey encouraged participation.

- *Persistence by the TechLink economic research specialists.* Some companies were contacted more than a dozen times by email or telephone in attempts to reach the right person and obtain the necessary information. Dogged persistence was a final key factor behind the high response rate.

In several cases involving non-responding companies, the TechLink team was able to obtain at least partial sales information through secondary research. Internet searches sometimes led to press releases and other announcements of contracts awarded to these companies—contracts typically for sales to the U.S. military. When these announcements were discovered, the research team undertook further research to confirm that the contracts involved products based on the technology licensed from DoD.

In addition, websites that document U.S. government contracts were useful when the licensed technologies were primarily commercialized for sales to the U.S. military or other U.S. government agencies. Sites consulted included: (1) USAspending.gov, the website of the Office of Management and Budget (OMB), which provides searchable information on all federal contracts awarded (<https://www.usaspending.gov>); (2) DIBBS, the Defense Logistics Agency (DLA) Internet Bid Board System, which provides information on all DLA awards to industry (<https://www.dibbs.bsm.dla.mil>); and (3) the Federal Procurement Data System, a central repository of information on government-wide contracts maintained by the General Services Administration (<https://www.fpds.gov>).



National Economic Impacts from DoD License Agreements with U.S. Industry, 2000-2017

In a few cases involving large publicly traded companies that declined to participate, the research team was able to obtain highly accurate sales information on major products derived from DoD inventions by reviewing these companies' annual reports. These cases comprised some of the largest sales in the study and were focused primarily on the civilian marketplace. In several cases involving non-responding defense contractors, a search of the annual DoD budgets was productive. These budgets, available online, provided often-detailed information on major acquisition contracts for defense-related products that were based on the licensed DoD inventions.⁷ Similarly, in several cases in which defense contractors had large contracts from foreign governments for defense-related products embodying the DoD inventions, the research team was able to find records of these sales in DoD reports to Congress.⁸

NAICS Code Assignments

During the survey process, TechLink researchers worked with company-provided information and conducted independent research to identify the appropriate North American Industry Classification System (NAICS) code for the product or service resulting from its license agreement. This was an essential step for analysis of the overall economic impacts. NAICS codes are one of the most important inputs to the economic impact model, IMPLAN (described below), because they are used to accurately determine the economic multipliers specific to the particular industrial activity. NAICS is the U.S. federal government's standard industry classification system. It is a comprehensive

production-oriented system that groups companies into industries based on the activities in which they are primarily engaged. NAICS recognizes 1,065 different industries in the United States and assigns a unique code to each industry. Some of the companies in this study with multiple license agreements were assigned to more than one NAICS code, depending on the associated product or service.

In addition to information provided by the companies, NAICS code data was sought from multiple online sources, including Hoovers (www.hoovers.com), the LexisNexis Academic website (www.lexisnexis.com), a commercial NAICS-related website (www.naics.com) that provides a convenient system for looking up NAICS codes by industry sectors and subsectors, and the federal System for Award Management (www.sam.gov), which contains NAICS codes self-identified by the companies. However, many of the new technologies identified in this study do not fit cleanly within a company's primary industry classification. In these cases, researchers used the classification tree at the official U.S. government NAICS code website (<http://www.census.gov/eos/www/naics/>) to identify an appropriate code.

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 by the economic research specialists. Once the data were aggregated and carefully validated by the team, the database provided mechanisms for quickly querying and analyzing the data as well

⁷ For example, see the following example: https://apps.dtic.mil/procurement/Y2017/Army/stamped/U_P40_E22203_BSA-35_BA-1_APP-2034A_PB_2017.pdf.

⁸ The U.S. Congress requires annual reports on all major "foreign military sales" and "direct commercial sales" of defense-related technology. These are found at the website of the Defense Procurement and Acquisition Policy (DPAP) Contract Policy and International Contracting (CPIC) Directorate: http://www.acq.osd.mil/dpap/cpic/cp/congressional_reports.html.

National Economic Impacts from DoD License Agreements with U.S. Industry, 2000-2017

as generating a final dataset for economic impact modeling.

TechLink subsequently submitted the final dataset to the BRD at the University of Colorado Boulder. Among other information, this dataset included—for each license agreement—a code number to identify the agreement and conceal the company’s name, the 6-digit NAICS code for the corresponding product or service, and the total sales figures.

The following economic outcomes were regarded as “company sales” and, together, comprised the “total sales”: (1) all sales of new products and services directly related to the licensed DoD technologies, including both commercial and military sales; (2) follow-on R&D contracts to further develop these technologies for specific applications, representing sales of R&D services; (3) royalties from sublicensing the licensed DoD technologies; (4) sublicensee sales of the licensed technologies; and (5) sales of products or services embodying the licensed technologies by spin-out companies.

DATA ANALYSIS

The BRD employed IMPLAN, a widely used economic impact analysis software program, to estimate the economic contribution effects of the total sales resulting from the DoD license agreements. More than 1,500 entities in academia, the private sector, and government use IMPLAN to model economic impacts. It is employed to determine economic impacts on regions ranging in size from zip code area to county, state, and national levels (www.implan.com).

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 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 suppliers’ employees, and others, ultimately generating a total impact on





National Economic Impacts from DoD License Agreements with U.S. Industry, 2000-2017

the economy that significantly exceeds the initial change in demand.

For example, a small business licenses a patented laser invention from the Air Force Research Laboratory. It then develops an improved barcode scanner using this technology, which it manufactures and sells nationwide. This requires the business to hire factory workers, who spend their payroll checks on groceries and other goods. In addition, it has to purchase components and raw materials from other companies, which also employ workers who purchase groceries and other goods, and so on.

In this example, *direct effects* are the result of the sales of the new barcode scanner based on the Air Force technology. *Indirect effects* are the result of the inter-industry purchases of components and raw materials needed to manufacture the barcode scanner. *Induced effects* are the result of the household expenditures as workers spend their earnings on goods and services across a wide spectrum of the economy. *Total economic impacts* are the sum of direct effects, indirect effects, and induced effects.

Multipliers are the ratio of the overall economic impact to the initial change and are typically derived from the following equation: $(\text{direct effect} + \text{indirect effect} + \text{induced effect}) / \text{direct effect}$. Multipliers are very specific to industry sectors and regions. IMPLAN uses NAICS codes to distinguish between 536 industry sectors recognized by the U.S.

Department of Commerce. Each sector has a unique output multiplier because it has a different pattern of purchases from firms inside and outside of the U.S. economy. Each year, IMPLAN is updated using data collected by various federal government agencies.

In this study, the BRD applied the national-level IMPLAN model to the total sales figures reported by the companies surveyed. As previously indicated, these figures represented all sales of products and services related to the DoD license agreements active during the 2000-2017 period. Using IMPLAN, the BRD was able to estimate the sum of the direct, indirect, and induced effects of these sales. The overall purpose of this modeling was to estimate the total economic impacts of the license-related sales on the nation's economy, including total economic output, value added, employment, labor income, and tax revenues.

TechLink's survey asked for cumulative sales figures, since asking companies to report sales by year would have been overly burdensome. However, the IMPLAN model requires sales to be assigned to years. Consequently, all sales were modeled as if they occurred in 2017, and economic impacts were assumed to be in 2017-value dollars. Use of 2017 as the reference year represents a conservative approach because it does not consider the relatively higher value of the earlier sales figures due to inflation. For example, \$100 in 2000 had the same purchasing power as \$147 in 2018.





National Economic Impacts from DoD License Agreements with U.S. Industry, 2000-2017



RESULTS

SALES FROM DOD LICENSE AGREEMENTS

TechLink researchers discovered that 493 of the 1,137 license agreements in the study (43 percent) had generated sales of new products or services. These agreements achieved **total cumulative sales of approximately \$27 billion.**⁹ (See Table 1) This total represents the commercial success of inventions from 58 DoD labs out of the 68 included in the study.

As previously mentioned, the “total sales” category included all of the following sources of revenue from commercialization of the licensed DoD technologies:

- Sales of new products and services, including both commercial (civilian) sales and sales to the U.S. military
- Follow-on R&D contracts to further develop the DoD technologies for specific applications, which were defined as sales of R&D services
- Royalties from sublicensees of the licensed technologies
- Sublicensee sales of the licensed technologies, when this information could be obtained
- Sales by spin-out companies, when this information was available

Table 1. Sales resulting from DoD license agreements, 2000-2017

Category	Total Companies	Total Agreements	Agreements (%)	Total Sales
Included in Study	915	1,137	100%	\$26.98 Billion
Achieving Sales	418	493	43%	\$26.98 Billion
No Sales	460	599	53%	--
Exclusively Foreign Sales	11	11	1%	--
Unknown ¹⁰	26	34	3%	--

Source: TechLink Survey, 2018

⁹ \$26,977,773,607. This number likely understates the actual sales for the reasons discussed in the report.

¹⁰ Twenty six companies refused to participate in the study and 13 companies could not be contacted, for a total of 39 companies with unknown results; however, the research team was able to find full or partial sales results for 13 of these companies that had one license agreement each, reducing the total number of companies with unknown results from 39 to 26.

National Economic Impacts from DoD License Agreements with U.S. Industry, 2000-2017

As Table 1 indicates, the research team found that 599 license agreements, 53 percent, had not generated sales or other revenues. This category included newer agreements involving DoD inventions that companies were still actively engaged in commercializing as well as agreements involving inventions that, for many reasons, had not resulted in commercialization and had been abandoned.

TechLink researchers found that another 11 license agreements, 1 percent of the total, involved small foreign companies whose primary economic activities (including research, manufacturing, and/or sales) were entirely outside the United States and not relevant to this study of economic impacts in the United States. Reasons for this small number include first, that U.S. law strongly encourages federal agencies to license their inventions to companies that agree to substantially manufacture products resulting from these inventions in the United States; and second, that federal agencies are also required by law to give first preference in licensing to U.S. small businesses.¹¹ Information was unavailable on the economic outcomes of 34 agreements, 3 percent of the total.

Table 2 shows the total cumulative sales from the DoD license agreements, broken down by sales category:

Commercial (civilian) product and service sales totaled \$20.5 billion¹² and accounted for 76 percent of the total sales (see Table 2). Remarkably, a single license agreement accounted for approximately \$16.1 billion, or nearly 60 percent of the overall sales. This was a license for a respiratory syncytial virus (RSV) antibody from the Uniformed Services

University of the Health Sciences (USUHS). The antibody is used in a top-selling drug, Synagis, to prevent serious lower respiratory tract disease in infants and young children. Without this top-selling drug, commercial sales were just under \$4.5 billion and total sales were just under \$10.9 billion.

Total sales from the single USUHS license agreement were eight times larger than those from the second most successful license agreement, which generated almost \$2 billion in sales. Twenty agreements generated more than \$100 million in sales; however, 101 agreements had sales of at least \$10 million. Notably, 233 license agreements, approximately 20 percent, generated sales of at least \$1 million.

Including all 1,103 license agreements for which sales information was obtained, the average agreement generated around \$24.5 million in sales. Excluding sales of Synagis, the average figure was



¹¹ (35 U.S. Code § 204 and § 209).

¹² \$20,547,611,309.

National Economic Impacts from DoD License Agreements with U.S. Industry, 2000-2017

Table 2. Sales from DoD license agreements, by sales category, 2000-2017

Sales Category	Total Sales	Total Sales (excluding Synagis)	Percent of Total	Percent of Total (excluding Synagis)
Commercial Product or Service Sales	\$20.55 Billion	--	76%	--
Commercial Product or Service Sales (excluding Synagis)	--	\$4.45 Billion	17%	41%
U.S. Military Product or Service Sales	\$4.55 Billion	\$4.55 Billion	--	42%
R&D Contracts	\$1.06 Billion	\$1.06 Billion	4%	10%
Royalties or Licensee Sales	\$806 Million	\$806 Million	3%	7%
Sales by Spin-out Companies	\$17 Million	\$17 Million	<1%	<1%
Total Sales	\$26.98 Billion	\$10.89 Billion	100%	100%

Source: TechLink Survey, 2018

Note: Totals may not tally due to rounding

around \$9.9 million. Among just the 493 license agreements with sales, the average figure was nearly \$22 million (not counting sales of Synagis). Among all agreements with sales, the median reported sales figure was \$1 million.

U.S. military product and service sales were slightly over \$4.5 billion¹³ (see Table 2). This was approximately 17 percent of the total. However, when the Synagis outlier is excluded, to provide a more representative picture, sales to the U.S. military accounted for 42 percent of the total—the largest single category. This high percentage is a

very positive finding from the DoD perspective. It demonstrates that, via technology transfer, the DoD R&D system is achieving its objective of developing new technology to support the U.S. defense mission. Actually, this percentage may be even higher because the other reported sales (including R&D contracts, royalties, and sales by sublicensees and spin-out companies) were not able to be differentiated by sector (U.S. military versus commercial).

A sizeable number of DoD license agreements—225 total—resulted in sales to the U.S. military. This

¹³ \$4,548,680,643.



National Economic Impacts from DoD License Agreements with U.S. Industry, 2000-2017

was 46 percent of all license agreements that had generated sales. Of this group, 78 agreements resulted *exclusively* in sales to the U.S. military and 147 license agreements had both military and commercial sales.

Companies do not need license agreements for DoD inventions if they are manufacturing and selling these inventions exclusively to the U.S. government. They typically obtain licenses because they hope to make commercial sales. It is ideal when there are both commercial and military markets for DoD inventions, because DoD benefits from production economies of scale that help reduce the cost of new defense-related products. Frequently, the commercial market is substantially larger than the military market for dual-use civilian/military products. In addition, having a commercial marketplace helps ensure the ongoing development of the new technologies and also sustains production in between the spikes of military demand.

R&D contracts to further develop the licensed technologies accounted for over \$1 billion¹⁴ (see Table 2). These contracts were considered sales of R&D services and came from both the government and private sectors. For example, a small biotech company that licensed some promising infectious disease antibodies from an Army medical lab may have received substantial funding from the National Institutes of Health to help develop a diagnostic test for the disease as well as funding from a major pharmaceutical company to develop a vaccine or therapeutic product. These R&D contracts accounted for approximately 4 percent of the total sales. The remaining 3 percent of the total sales consisted of *royalties or sales by sublicensees*¹⁵ and *sales by spin-out companies*¹⁶.

Sales by Company Size

A notable survey finding concerned company size. A common assumption is that large corporations, particularly large defense contractors, are the primary DoD technology transfer partners. However, this study determined that large corporations (with 500 or more employees) accounted for only 18 percent of all licenses achieving sales. Small businesses (per the U.S. Small Business Administration definition, those with fewer than 500 employees) accounted for 82 percent of the licenses with sales (see Table 3). Within the *small business category*, “medium-sized” companies, with between 100 and 499 employees, accounted for 9 percent of the licenses with sales; “small” companies, with 10 to 99 employees, for 26 percent; and “very small” companies, with fewer than 10 employees, for 47 percent.

However, because of the previously mentioned top-selling drug, the large corporation category accounted for 81 percent of the total sales related to the DoD license agreements. If this product is excluded, the large corporation percentage drops to 52 percent, with small businesses accounting for 48 percent of the total sales.

Large corporations accounted for 58 percent of the **U.S. military sales** resulting from DoD license agreements. This is because large defense contractors are the primary license holders of munitions technologies developed in DoD laboratories. Small companies accounted for the remaining 42 percent of the sales to the U.S. military. Within the *small business category*, “medium-sized” companies accounted for 10 percent of the military sales, “small” companies for 11 percent, and “very small” companies for the remaining 21 percent.

¹⁴ \$1,058,388,136.

¹⁵ \$806,053,519.

¹⁶ \$17,040,000.

National Economic Impacts from DoD License Agreements with U.S. Industry, 2000-2017



Table 3. Sales by company size resulting from DoD license agreements, 2000-2017

Company Size	Total Agreements with Sales	Agreements with Sales (%)	Total Sales \$ Billions	U.S. Military Sales \$ Billions
Large (500+ employees)	88	18%	\$21.79	\$2.65
Small (<500 employees)	405	82%	\$5.19	\$1.90
<i>Medium-Sized</i> (100-499 employees)	44	9%	\$1.24	\$0.48
<i>Small</i> (10-99 employees)	128	26%	\$1.29	\$0.48
<i>Very Small</i> (1-9 employees)	233	47%	\$2.66	\$0.94
TOTAL	493	100%	\$26.98	\$4.55

Source: TechLink Survey, 2018

Note: Totals may not tally due to rounding

National Economic Impacts from DoD License Agreements with U.S. Industry, 2000-2017

Sales by DoD Source of the Technology

Figures 1 and 2 present sales results by the DoD branch from which the licensed technology originated. The difference between the two charts is that Fig. 1 includes sales of Synagis related to the USUHS license agreement while Fig. 2 does not. Sales of technologies licensed from USUHS were approximately \$18.3 billion, or 68 percent of the

total; from the Army, \$6.2 billion, or 23 percent; from the Navy, \$1.8 billion, or 7 percent; from the Air Force, approximately \$600 million, or 2 percent; and from the National Security Agency (NSA), \$140 million, or less than 1 percent. (Appendix 2 shows how the economic impacts have grown since 2012 for each of these major DoD components.)

However, when Synagis sales are excluded, the percentages change significantly (Fig. 2). Sales of

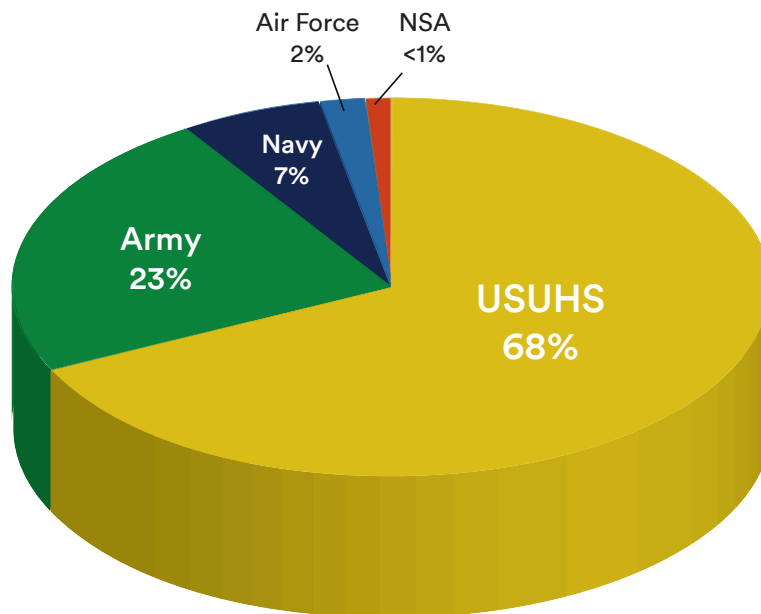


Fig. 1. Sales Results by DoD Technology Source

National Economic Impacts from DoD License Agreements with U.S. Industry, 2000-2017

technologies licensed from the Army increase to 57 percent of the total; from the Navy, to 16 percent; from the Air Force, to 6 percent; and from the NSA to over 1 percent. The USUHS segment drops from 68 percent to 20 percent.

Sales by Technology Sector

Figures 3 and 4 present the sales results from the company survey *by technology sector*. These charts

portray the economic outcomes of all 493 DoD licenses that led to sales, with each assigned to its appropriate technology sector. The difference between the two charts is that Fig. 3 includes sales of Synagis, while Fig. 4 does not.

Figures 3 and 4 demonstrate that the DoD laboratory system is generating successful patented inventions in virtually all technology fields. However, they do not accurately reflect the number

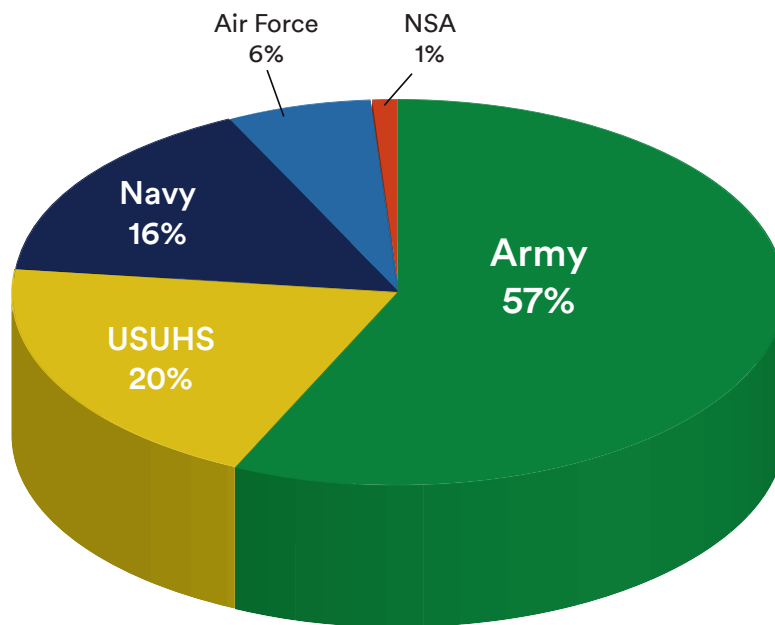


Fig. 2. Revised Sales Results by DoD Technology Source (excluding Synagis)

National Economic Impacts from DoD License Agreements with U.S. Industry, 2000-2017

of inventions in each of these technology sectors. For example, the “Materials” sector represents around 15 percent of all DoD license agreements in the study, but inventions in this sector accounted for only about 4 percent of the total sales portrayed in Fig. 4. Reasons for this difference include the fact that many DoD inventions involve specialized materials that either have limited commercial potential or that have not yet been fully developed and converted into commercial products.

Commercially successful license agreements in the **Medical & Biotechnology** sector encompassed a wide range of DoD inventions, including preventative and therapeutic vaccines and drugs; antidotes; reagents; diagnostic tests; antibodies and cell lines used in research; medical devices; wound care products; methods for activating human defense systems; and health-monitoring software. **Military Technology** consists primarily of inventions for which there are limited non-military

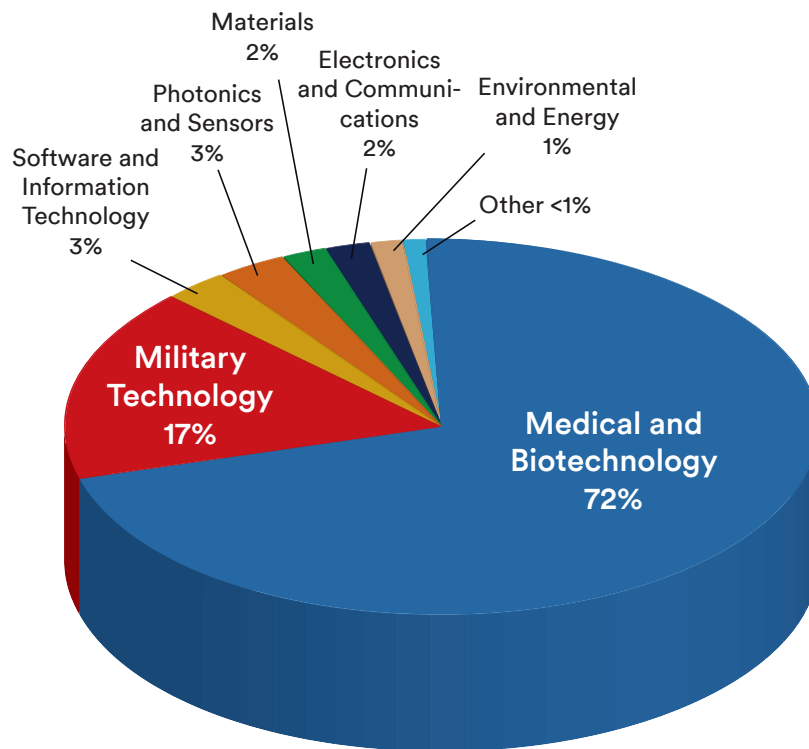


Fig. 3. Sales Results by DoD Technology Sector

National Economic Impacts from DoD License Agreements with U.S. Industry, 2000-2017

markets. These markets include both the U.S. military and allied foreign forces. Successful license agreements in this sector involved various types of armaments and ammunition, such as projectile tail cones and stabilizers, grenade launchers, improved explosives and propulsion systems, weapon sighting devices, and multiple innovations related to small arms. Other successful agreements in this sector included soft goods such as backpacks, bed nets, tents, and parachutes; armor; security devices;

individual soldier items; and missile control software.

Successful **Software & Information Technology** license agreements involved image and signal processing algorithms, cybersecurity innovations, training programs, project and incident management software, geospatial apps for smartphones, data analytic tools, automated language translation systems, data compression

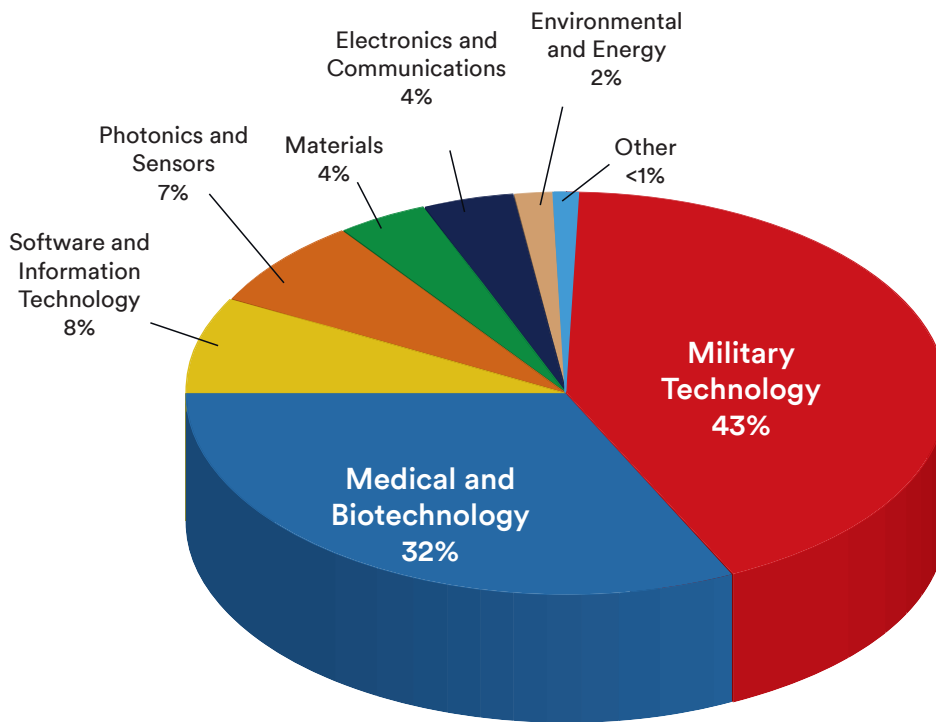


Fig. 4. Revised Sales Results by DoD Technology Sector (excluding Synagis)



National Economic Impacts from DoD License Agreements with U.S. Industry, 2000-2017

software, and design and modeling software programs.

The **Materials** sector consisted of a broad spectrum of successful DoD innovations, including improved metal coatings, metal matrix composites, specialized alloys and polymers, components for improved batteries, bullet-absorbing concrete, decontamination solutions, environmentally friendly solvents and resins, non-skid coatings, two-photon absorption materials, nanomaterials, tunable surfaces, liquid crystals, self-decontaminating fabrics, chemiluminescent materials, bio-based fuels, and protective blast-resistant materials.

The **Photonics** sector included successful DoD inventions such as laser-based imaging, detection, and navigation systems; fiber pump signal combiners; a miniature laser for range finding and target designation; helical fiber amplifiers; and interband cascade lasers. **Electronics** consisted of innovations ranging from MEMS-based accelerometers to methods for manufacturing semiconductor chips and improved computer electronics. The **Sensors** sector included various methods and devices for detecting explosives, pathogens, chemicals, and drugs; sensors for measuring radiation and pressure change; and inventions for diagnosing the health of avionics. **Communications** included innovations in wireless radio receivers, antennae, earpieces, and telecommunications; wearable electronics; and communication networks.

Successful license agreements in the **Environmental** sector included an environmentally friendly aircraft deicing system; an innovative plastic waste processor; a system for destroying shipboard waste with plasma gasification; various technologies

for treating contaminated soils, water, and air; soil stabilization systems for arctic environments; a method for dust control around helipads; a device for removing sludge from lagoons; and non-toxic fire extinguisher solutions. The **Energy** sector primarily consisted of battery technology, propulsion systems, and photoelectric cells. The **Other** category consisted of all inventions that did not fit in the above sectors and primarily included various types of mechanical devices.

Accuracy of Company Sales Information

Most companies in the study made a sincere effort to provide accurate responses to the questions posed about sales of new products and services related to their license agreements. Their responses ranged from highly detailed spreadsheets of sales figures, broken down by year, to estimates of their cumulative sales provided over the phone. The research team attempted to verify as much of the sales information as possible. However, this was possible for only a relatively small number of the license agreements. For most agreements, the companies themselves are the *only* source of information about their commercial and military sales, R&D contracts, royalties, and sublicensee and spin-out company sales.

To verify the sales of as many of the license agreements as possible, the TechLink team searched the annual reports of large pharmaceutical companies known to have products based on the licensed DoD inventions. This yielded audited sales information for several successful drugs. In addition, they used the previously mentioned U.S. government contract and budget websites to confirm a sizeable number of large sales of

National Economic Impacts from DoD License Agreements with U.S. Industry, 2000-2017

armaments and ammunition to both the U.S. military and friendly foreign allies.

Through this follow-up research, the team was able to certify the accuracy of approximately \$22.2 billion of the \$27 billion in sales reported by companies. This represents 82 percent of the total. As a result, even if the remaining unverified sales were off by 25 percent, the reported \$27 billion in total sales could be deemed at least 95 percent accurate. However, the total sales figures reported are believed to significantly understate the reality.

Sales Figures Understate the Reality


For several reasons, total sales figures obtained by this survey are probably significantly smaller than the actual cumulative sales resulting from DoD license agreements. Reasons include the following:

- *Non-responding companies.* As previously noted, 39 companies with DoD license agreements active during the 2000-2017 period did not participate in the study—26 refused and another 13 could not be contacted. Some companies in the first group are believed to be making sizeable commercial or military sales of products based on the licensed technologies.
- *Sublicensee sales.* The total sales figures also underreport the reality because they do not include most of the sublicensee sales. The TechLink team asked all companies if they had sublicensed the technologies licensed from DoD. Many companies reported that they had. However, most of these companies declined to identify their sublicensees or to divulge what they knew of sublicensee sales. Frequently, companies stated they were prevented from

identifying sublicensees by the terms of their sublicensing agreements. Sublicensee sales of DoD-licensed technologies are probably substantial. For example, in the 16 cases where licensees did report their sublicensee sales, the combined value was \$797 million.

- *Licensee underreporting of sales.* Another reason why the total reported sales are believed to be less than the actual sales 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, found that at least half of the licenses it audited had underreported sales. Frequently, these involved next-generation products based on the licensed technology.
- *Inflation.* Finally, inflation contributes, in effect, to an underreporting of sales. All sales data are expressed in nominal dollars—the survey made no distinction as to when the sales took place. Some of the company sales date back to the early 2000s and most occurred *prior to 2017*, the year used for the IMPLAN analysis. Use of 2017 as the reference year does not consider the higher value of the earlier sales figures. Sales counted in this study occurred between 2000 and 2018, and \$100 in 2000 had the same purchasing power as \$147 in 2018.

For all of the above reasons, the total sales figures reported in this survey are conservative and probably significantly understate the actual total sales resulting from DoD license agreements during the 2000-2017 period.



National Economic Impacts from DoD License Agreements with U.S. Industry, 2000-2017

OTHER ECONOMIC OUTCOMES

In addition to sales, the companies in the study reported other significant economic outcomes. They reported approximately \$776 million in *total outside investment funding* (including venture capital and angel funding) directly related to the licensed DoD technologies. In addition, *25 companies were acquired*

primarily because of their DoD license agreements. Companies reported that they had *sublicensed 64 technologies* to other companies. Finally, they reported that they had created a total of *144 new companies* to commercialize the licensed inventions, including 23 spin-outs of existing companies and 121 start-up companies.



National Economic Impacts from DoD License Agreements with U.S. Industry, 2000-2017



OTHER ECONOMIC OUTCOMES

Total outside investment funding:
\$776 million

Number of companies acquired:
25

Number of DoD technologies sub-licensed to other companies:
64

Number of new companies created:
144



National Economic Impacts from DoD License Agreements with U.S. Industry, 2000-2017



ECONOMIC IMPACT ANALYSIS

Upon receiving the company sales and NAICS code data from TechLink, the BRD at the University of Colorado Boulder employed IMPLAN to determine the economic contributions of the total sales figures. Results below are presented for *output, value added, employment, labor income, and tax revenues*. As previously noted, all dollar figures were assumed to be 2017 dollars for the modeling.

Total Economic Impact (Output): \$58.2 Billion

Output is the total value of purchases by intermediate and final consumers. In this study, it represents the total economic impact of the DoD license agreements on the U.S. economy. According to the national IMPLAN model, the approximately \$27 billion in direct sales of new products and services reported by companies generated an additional \$31.2 billion in sales economy-wide. Of this amount, approximately \$15 billion was generated from the indirect effect, the result of inter-industry purchases (firms purchasing from each other), and \$16.2 billion was generated from the induced effect, the result of households spending payroll on goods and services economy-wide (see Table 4). The sum of the direct, indirect, and induced sales—the output, or total economy-wide impact—was \$58.2 billion.

Dividing total economy-wide output (\$58.2 billion) by the direct output yielded an output multiplier of 2.16. That is, for every dollar in sales directly attributable to the DoD license agreements, an *additional* \$1.16 in sales was generated economy-wide.

Value Added: \$31.7 Billion

Value added is the difference between a company's output and the cost of intermediate inputs. In other words, it is the difference between a product's sale price and the cost of goods and services used to make it. 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 them. This increase in value resulting from the production process is the "value added." As estimated by IMPLAN, value added is equal to the total sales minus the cost of the goods and services purchased to produce the products sold. It is a useful measure of the net contribution of the DoD technology transfer partners to the national economy as a result of their license agreements with DoD.

The research team found that the total value added resulting from the license agreements between DoD labs and industry was \$31.7 billion. Of this total, \$14.5 billion was generated directly, \$8.1 billion was generated indirectly, and \$9.1 billion was generated from the induced effect (see Table 4).

Employment: 214,791 Jobs Total (11,933 average per year)

According to the national IMPLAN model, 214,791 jobs nationwide resulted from the direct, indirect, and induced effects of the DoD license agreements with U.S. industry during the 2000-2017 period. An estimated 54,342 jobs were directly supported economy-wide by the \$27 billion in sales. Indirect effects were responsible for 62,357 jobs, and induced



National Economic Impacts from DoD License Agreements with U.S. Industry, 2000-2017

effects for 98,092 jobs. In these estimations, each job is defined as one job supported over one year. This means that, on average, the DoD license agreements supported approximately 11,933 jobs per year.

Using the procedure outlined above to derive the multiplier, an employment multiplier of 3.95 was calculated. That is, for every job directly attributable to the DoD license agreements, 2.95 *additional* jobs were created or retained economy-wide. This substantial multiplier was mainly due to the relatively high-paying jobs associated with high-tech and technology-based industries, which accounted for the majority of the companies involved. That is, workers in these well-paying industries pumped more income back into the economy than lower-paid workers in other sectors, resulting in more job creation economy-wide.

Labor Income: \$16.1 Billion

Labor income consists of employee compensation (wage and salary payments, including benefits), and proprietor income (income received by self-employed individuals). The national IMPLAN model estimated that direct labor income associated with the \$27 billion in sales was \$6 billion, or approximately \$109,561 per job. This was more than double the 2017 average U.S. wage of \$48,252.¹⁷

The indirect labor income was estimated at \$4.9 billion, or approximately \$78,875 per job. The induced labor income was estimated to be \$5.2 billion, or \$52,870 per job. Compensation for the indirect and induced jobs was substantially lower than for the direct jobs because many of these were in lower-paid manufacturing and service sectors.

Together, the indirect and induced labor income amounted to \$10.1 billion. The total economy-wide labor income resulting from the DoD license agreements was \$16.1 billion. The average labor income tied to the approximately 214,791 jobs created or retained as a result of the DoD license agreements was \$74,762, approximately 55 percent higher than the 2017 average U.S. wage of \$48,252.

Tax Revenues: \$6 billion

Tax revenues were estimated for the \$27 billion in sales and their economy-wide indirect and induced effects. These tax revenues included taxes such as Social Security and Medicare (paid by employers, employees, and the self-employed), personal income taxes, motor vehicle licenses, property taxes, corporate profit 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 \$6 billion. This included \$3.86 billion in federal tax revenues and \$2.14 billion in state and local tax revenues.

¹⁷ Per the Social Security Administration, <https://www.ssa.gov/oact/cola/central.html>.





National Economic Impacts from DoD License Agreements with U.S. Industry, 2000-2017



SUMMARY

In summary, this study estimated the economic contribution to the U.S. economy of Department of Defense (DoD) license agreements in effect during the 2000-2017 period. Its purpose was to determine the extent to which these license agreements (1) contributed to new economic activity and job creation in the United States, and (2) resulted in the transition of new technology to U.S. military use.

The study surveyed 915 companies having license agreements with DoD during the 2000-2017 period. A total of 1,137 license agreements were involved because some companies had multiple agreements. Companies were asked to divulge the total sales of new products and services directly related to their DoD license agreements. They also were asked about license-related sales to the U.S. military, either directly or through a defense contractor. Of the 915 companies, 418 had generated sales of products or services through these licenses. In all, 493 licenses, representing 43 percent of the total, led to sales of products or services. Collectively, these sales were approximately \$27 billion, including \$4.5 billion to the U.S. military, either directly or through defense contractors.

The IMPLAN national model was used to estimate the total economic impacts related to the sales resulting from the DoD license agreements. Impacts analyzed included economic output, value added, employment, labor income, and tax revenues. The total economy-wide impact, as measured by output, was estimated at \$58.2 billion. Value added was estimated at \$31.7 billion, representing new wealth creation in the economy. Employment impacts included 214,791 jobs with an average income of \$74,762. Labor income was estimated at \$16.1 billion. The \$27 billion in sales and its economy-wide effects generated approximately \$6 billion in federal, state, and local tax revenues. Table 4 summarizes the total economic contribution of the DoD license agreements with U.S. industry.

\$27 billion

Total sales
new products & services

\$58.2 billion


Total economic output

214,791

New jobs created

\$74,762

Average salary of
jobs created



National Economic Impacts from DoD License Agreements with U.S. Industry, 2000-2017

Table 4. Nationwide Economic Impacts from DoD License Agreements, 2000-2017


Impact Type	Output \$ Billions	Value Added \$ Billions	Employment (Number of jobs created or retained)	Labor Income \$ Billions	Labor Income per Job (Average)	Tax Revenue \$ Billions
Direct Impact	\$26.98	\$14.49	54,342	\$5.95	\$109,561	--
Indirect Impact	\$15.03	\$8.07	62,357	\$4.92	\$78,875	--
Induced Impact	\$16.20	\$9.13	98,092	\$5.19	\$52,870	--
Federal Tax Revenues	--	--	--	--	--	\$3.86
State and Local Tax Revenues	--	--	--	--	--	\$2.14
Total Economy- Wide Impact	\$58.21	\$31.69	214,791	\$16.06	\$74,762	\$6.00

Source: BRD, University of Colorado Boulder; IMPLAN

Notes: "Employment" is measured in job-years; the "Labor Income per Job" figures are obtained by dividing the Labor Income by the Employment figures.



APPENDICES



National Economic Impacts from DoD License Agreements with U.S. Industry, 2000-2017

APPENDIX 1

National Economic Impacts by DoD Components

The following tables provide a more detailed look at the economic impacts resulting from DoD licenses active during the 2000-2017 period. They summarize the estimated economic impacts for select DoD components from which the licensed technologies originated. These include the three main DoD branches (Air Force, Army, and Navy), the National Security Agency (NSA), the Uniformed Services University of the Health Sciences (USUHS), and selected DoD commands and laboratories. Included are all DoD entities with at least four

license agreements that had generated economic impacts by the time of the study. Breakouts for DoD labs with fewer than four license agreements with sales results are not included because revealing their outcomes might enable inferences about the sales of specific companies—violating the pledge to keep company sales information confidential. For explanations of the economic terms used in the appendices, please refer to the main text of the report.

Tables

1. **Air Force**
2. **Air Force Research Laboratory (AFRL)**
3. **AFRL Aerospace Systems Directorate (RQ)**
4. **AFRL Information Directorate (RI)**
5. **AFRL Materials & Manufacturing Directorate (RX)**
6. **AFRL 711th Human Performance Wing**
7. **AFRL Space Vehicles Directorate (RV)**
8. **Army**
9. **Army Combat Capabilities Development Command (CCDC)**
10. **Army CCDC Armaments Center**
11. **Army CCDC Army Research Laboratory**
12. **Army CCDC Aviation and Missile Center**
13. **Army CCDC Chemical & Biological Command**
14. **Army CCDC Soldier Center**
15. **Army Corps of Engineers, Engineer Research and Development Center (ERDC)**
16. **Army, ERDC Construction Engineering Research Laboratory**
17. **Army, ERDC Geotechnical and Structures Laboratory**
18. **Army Medical Research and Development Command (MRDC)**
19. **Army MRMC, Medical Materiel Development Activity (USAMMDA)**
20. **Army MRMC, Medical Research Institute of Infectious Diseases (USAMRIID)**
21. **Army MRMC, Walter Reed Army Institute of Research (WRAIR)**

National Economic Impacts from DoD License Agreements with U.S. Industry, 2000-2017



22. Navy
23. Naval Air Systems Command (NAVAIR)
24. NAVAIR, Naval Air Warfare Center, Aircraft Division
25. NAVAIR, Naval Air Warfare Center, Weapons Division
26. Naval Medical Research Center
27. Naval Research Laboratory
28. Naval Sea Systems Command (NAVSEA)
29. NAVSEA, Naval Facilities Engineering and Expeditionary Warfare Center
30. NAVSEA, Naval Surface Warfare Center, Carderock Division
31. NAVSEA, Naval Surface Warfare Center, Crane Division
32. NAVSEA, Naval Surface Warfare Center, Panama City Division
33. NAVSEA, Naval Undersea Warfare Center, Newport Division
34. NAVWAR, Naval Information Warfare Command
35. National Security Agency (NSA)
36. Uniformed Services University of the Health Sciences (USUHS)

License Agreements, 2000-2017

Air Force Economic Impacts

Table 1. Air Force

Impact Type	Output \$ Millions	Value Added \$ Millions	Employment (Number of Jobs Supported)	Labor Income \$ Millions	Labor Income per Job
Direct Impact	603	312	1,891	207	109,323
Indirect Impact	386	211	1,876	133	70,971
Induced Impact	506	285	3,066	162	52,869
Total Economy- Wide Impact	1,495	808	6,833	502	73,461

Note: Totals may not tally due to rounding

Table 2. Air Force Research Laboratory (AFRL)

Impact Type	Output \$ Millions	Value Added \$ Millions	Employment (Number of Jobs Supported)	Labor Income \$ Millions	Labor Income per Job
Direct Impact	523	266	1,614	175	108,438
Indirect Impact	337	182	1,599	114	71,479
Induced Impact	431	243	2,611	138	52,868
Total Economy- Wide Impact	1,292	691	5,824	427	73,377

Note: Totals may not tally due to rounding

Table 3. AFRL Aerospace Systems Directorate (RQ)

Impact Type	Output \$ Millions	Value Added \$ Millions	Employment (Number of Jobs Supported)	Labor Income \$ Millions	Labor Income per Job
Direct Impact	151	62	408	37	90,218
Indirect Impact	132	65	527	40	76,134
Induced Impact	115	65	695	37	52,866
Total Economy- Wide Impact	398	191	1,631	114	69,743

Note: Totals may not tally due to rounding

Table 4. AFRL Information Directorate (RI)

Impact Type	Output \$ Millions	Value Added \$ Millions	Employment (Number of Jobs Supported)	Labor Income \$ Millions	Labor Income per Job
Direct Impact	154	93	642	74	115,159
Indirect Impact	74	46	481	30	62,340
Induced Impact	155	87	936	49	52,868
Total Economy- Wide Impact	383	226	2,058	153	74,497

Note: Totals may not tally due to rounding

Table 5. AFRL Materials & Manufacturing Directorate (RX)

Impact Type	Output \$ Millions	Value Added \$ Millions	Employment (Number of Jobs Supported)	Labor Income \$ Millions	Labor Income per Job
Direct Impact	14	8	55	6	110,721
Indirect Impact	9	5	53	3	64,314
Induced Impact	14	8	86	5	52,828
Total Economy- Wide Impact	37	21	194	14	72,476

Note: Totals may not tally due to rounding

Table 6. AFRL 711th Human Performance Wing

Impact Type	Output \$ Millions	Value Added \$ Millions	Employment (Number of Jobs Supported)	Labor Income \$ Millions	Labor Income per Job
Direct Impact	121	49	270	27	99,824
Indirect Impact	81	41	323	25	78,753
Induced Impact	78	44	474	25	52,888
Total Economy-Wide Impact	280	134	1,067	77	72,603

Note: Totals may not tally due to rounding

Table 7. AFRL Space Vehicles Directorate (RV)

Impact Type	Output \$ Millions	Value Added \$ Millions	Employment (Number of Jobs Supported)	Labor Income \$ Millions	Labor Income per Job
Direct Impact	74	51	215	29	132,551
Indirect Impact	34	21	187	13	70,632
Induced Impact	62	35	377	20	52,864
Total Economy-Wide Impact	171	107	779	62	79,170

Note: Totals may not tally due to rounding

Army Economic Impacts

Table 8. Army

Impact Type	Output \$ Millions	Value Added \$ Millions	Employment (Number of Jobs Supported)	Labor Income \$ Millions	Labor Income per Job
Direct Impact	6,188	2,969	22,152	1,572	70,971
Indirect Impact	4,793	2,351	19,796	1,461	73,784
Induced Impact	4,527	2,552	27,407	1,449	52,869
Total Economy- Wide Impact	15,508	7,873	69,355	4,482	64,621

Note: Totals may not tally due to rounding

Table 9. Army Combat Capabilities Development Command (CCDC)

Impact Type	Output \$ Millions	Value Added \$ Millions	Employment (Number of Jobs Supported)	Labor Income \$ Millions	Labor Income per Job
Direct Impact	4,944	2,337	18,162	1,169	64,351
Indirect Impact	3,906	1,847	15,330	1,136	74,081
Induced Impact	3,440	1,939	20,829	1,101	52,870
Total Economy- Wide Impact	12,290	6,124	54,320	3,406	62,695

Note: Totals may not tally due to rounding

Table 10. Army CCDC Armaments Center

Impact Type	Output \$ Millions	Value Added \$ Millions	Employment (Number of Jobs Supported)	Labor Income \$ Millions	Labor Income per Job
Direct Impact	2,928	1,511	7,632	563	73,708
Indirect Impact	2,104	1,024	8,151	609	74,708
Induced Impact	1,753	988	10,611	561	52,873
Total Economy- Wide Impact	6,785	3,523	26,394	1,733	65,641

Note: Totals may not tally due to rounding

Table 11. Army CCDC Army Research Laboratory

Impact Type	Output \$ Millions	Value Added \$ Millions	Employment (Number of Jobs Supported)	Labor Income \$ Millions	Labor Income per Job
Direct Impact	245	117	661	77	116,380
Indirect Impact	178	97	831	62	74,237
Induced Impact	207	117	1,252	66	52,875
Total Economy- Wide Impact	630	331	2,744	205	74,648

Note: Totals may not tally due to rounding

Table 12. Army CCDC Aviation and Missile Center

Impact Type	Output \$ Millions	Value Added \$ Millions	Employment (Number of Jobs Supported)	Labor Income \$ Millions	Labor Income per Job
Direct Impact	127	55	385	37	95,244
Indirect Impact	102	49	421	32	77,213
Induced Impact	103	58	625	33	52,882
Total Economy- Wide Impact	332	162	1,430	102	71,431

Note: Totals may not tally due to rounding

Table 13. Army CCDC Chemical and Biological Command

Impact Type	Output \$ Millions	Value Added \$ Millions	Employment (Number of Jobs Supported)	Labor Income \$ Millions	Labor Income per Job
Direct Impact	198	93	508	58	114,361
Indirect Impact	147	76	643	48	74,984
Induced Impact	159	89	960	51	52,878
Total Economy- Wide Impact	504	258	2,111	157	74,400

Note: Totals may not tally due to rounding

Table 14. Army CCDC Soldier Center

Impact Type	Output \$ Millions	Value Added \$ Millions	Employment (Number of Jobs Supported)	Labor Income \$ Millions	Labor Income per Job
Direct Impact	1,414	547	8,918	427	47,877
Indirect Impact	1,350	590	5,190	377	72,616
Induced Impact	1,197	675	7,247	383	52,863
Total Economy- Wide Impact	3,961	1,811	21,355	1,187	55,582

Note: Totals may not tally due to rounding

Table 15. Army Corp of Engineers, Engineer Research and Development Center (ERDC)

Impact Type	Output \$ Millions	Value Added \$ Millions	Employment (Number of Jobs Supported)	Labor Income \$ Millions	Labor Income per Job
Direct Impact	308	147	1,194	112	94,163
Indirect Impact	241	130	1,202	84	69,492
Induced Impact	294	166	1,780	94	52,868
Total Economy- Wide Impact	843	443	4,176	290	69,456

Note: Totals may not tally due to rounding

Table 16. Army, ERDC Construction Engineering Research Laboratory

Impact Type	Output \$ Millions	Value Added \$ Millions	Employment (Number of Jobs Supported)	Labor Income \$ Millions	Labor Income per Job
Direct Impact	140	83	701	73	104,558
Indirect Impact	84	51	551	35	63,135
Induced Impact	161	91	974	51	52,863
Total Economy- Wide Impact	385	224	2,227	160	71,690

Note: Totals may not tally due to rounding

Table 17. Army, ERDC Geotechnical and Structures Laboratory

Impact Type	Output \$ Millions	Value Added \$ Millions	Employment (Number of Jobs Supported)	Labor Income \$ Millions	Labor Income per Job
Direct Impact	154	59	436	35	80,394
Indirect Impact	141	72	593	44	74,855
Induced Impact	121	68	731	39	52,872
Total Economy- Wide Impact	415	199	1,760	118	67,093

Note: Totals may not tally due to rounding

Table 18. Army Medical Research and Development Command (MRDC)

Impact Type	Output \$ Millions	Value Added \$ Millions	Employment (Number of Jobs Supported)	Labor Income \$ Millions	Labor Income per Job
Direct Impact	6	2	22	2	73,982
Indirect Impact	6	3	25	2	74,170
Induced Impact	5	3	31	2	52,802
Total Economy- Wide Impact	17	8	78	5	65,554

Note: Totals may not tally due to rounding

Table 19. Army MRMC, Medical Materiel Development Activity (USAMMDA)

Impact Type	Output \$ Millions	Value Added \$ Millions	Employment (Number of Jobs Supported)	Labor Income \$ Millions	Labor Income per Job
Direct Impact	211	110	615	48	77,583
Indirect Impact	147	84	691	55	79,147
Induced Impact	152	86	922	49	52,860
Total Economy- Wide Impact	510	280	2,228	151	67,835

Note: Totals may not tally due to rounding

Table 20. Army MRMC, Medical Research Institute of Infectious Diseases (USAMRIID)

Impact Type	Output \$ Millions	Value Added \$ Millions	Employment (Number of Jobs Supported)	Labor Income \$ Millions	Labor Income per Job
Direct Impact	559	291	1,534	183	119,424
Indirect Impact	377	220	1,918	141	73,748
Induced Impact	483	272	2,924	155	52,865
Total Economy- Wide Impact	1,419	783	6,375	479	75,156

Note: Totals may not tally due to rounding

Table 21. Army MRMC, Walter Reed Army Institute of Research (WRAIR)

Impact Type	Output \$ Millions	Value Added \$ Millions	Employment (Number of Jobs Supported)	Labor Income \$ Millions	Labor Income per Job
Direct Impact	120	61	484	44	91,402
Indirect Impact	88	51	479	33	68,424
Induced Impact	115	65	694	37	52,861
Total Economy- Wide Impact	322	176	1,657	114	68,621

Note: Totals may not tally due to rounding

Navy Economic Impacts

Table 22. Navy

Impact Type	Output \$ Millions	Value Added \$ Millions	Employment (Number of Jobs Supported)	Labor Income \$ Millions	Labor Income per Job
Direct Impact	1,758	773	4,993	523	104,745
Indirect Impact	1,419	737	6,245	463	74,058
Induced Impact	1,470	829	8,898	470	52,871
Total Economy- Wide Impact	4,646	2,338	20,136	1,456	72,305

Note: Totals may not tally due to rounding

Table 23. Naval Air Systems Command (NAVAIR)

Impact Type	Output \$ Millions	Value Added \$ Millions	Employment (Number of Jobs Supported)	Labor Income \$ Millions	Labor Income per Job
Direct Impact	232	126	970	100	103,015
Indirect Impact	163	91	860	57	66,598
Induced Impact	234	132	1,416	75	52,865
Total Economy- Wide Impact	629	349	3,246	232	71,485

Note: Totals may not tally due to rounding

Table 24. NAVAIR, Naval Air Warfare Center, Aircraft Division

Impact Type	Output \$ Millions	Value Added \$ Millions	Employment (Number of Jobs Supported)	Labor Income \$ Millions	Labor Income per Job
Direct Impact	165	97	762	78	102,082
Indirect Impact	103	59	599	38	63,759
Induced Impact	173	97	1,046	55	52,868
Total Economy-Wide Impact	441	254	2,407	171	71,162

Note: Totals may not tally due to rounding

Table 25. NAVAIR, Naval Air Warfare Center, Weapons Division

Impact Type	Output \$ Millions	Value Added \$ Millions	Employment (Number of Jobs Supported)	Labor Income \$ Millions	Labor Income per Job
Direct Impact	67	29	207	22	106,446
Indirect Impact	60	32	261	19	73,127
Induced Impact	61	34	370	20	52,855
Total Economy-Wide Impact	188	96	838	61	72,412

Note: Totals may not tally due to rounding

Table 26. Naval Medical Research Center

Impact Type	Output \$ Millions	Value Added \$ Millions	Employment (Number of Jobs Supported)	Labor Income \$ Millions	Labor Income per Job
Direct Impact	121	61	152	20	129,526
Indirect Impact	87	48	377	32	83,882
Induced Impact	76	43	463	24	52,862
Total Economy-Wide Impact	285	152	992	76	76,426

Note: Totals may not tally due to rounding

Table 27. Naval Research Laboratory

Impact Type	Output \$ Millions	Value Added \$ Millions	Employment (Number of Jobs Supported)	Labor Income \$ Millions	Labor Income per Job
Direct Impact	765	333	2,163	232	107,247
Indirect Impact	615	315	2,682	198	73,772
Induced Impact	642	362	3,884	205	52,874
Total Economy- Wide Impact	2,022	1,010	8,729	635	72,767

Note: Totals may not tally due to rounding

Table 28. Naval Sea Systems Command (NAVSEA)

Impact Type	Output \$ Millions	Value Added \$ Millions	Employment (Number of Jobs Supported)	Labor Income \$ Millions	Labor Income per Job
Direct Impact	513	190	1,124	125	111,093
Indirect Impact	453	228	1,856	142	76,754
Induced Impact	399	225	2,417	128	52,876
Total Economy- Wide Impact	1,365	643	5,397	395	73,213

Note: Totals may not tally due to rounding

Table 29. NAVSEA, Naval Facilities Engineering and Expeditionary Warfare Center

Impact Type	Output \$ Millions	Value Added \$ Millions	Employment (Number of Jobs Supported)	Labor Income \$ Millions	Labor Income per Job
Direct Impact	78	36	426	29	67,237
Indirect Impact	67	34	281	20	72,547
Induced Impact	73	41	440	23	52,840
Total Economy- Wide Impact	217	111	1,146	72	63,013

Note: Totals may not tally due to rounding

Table 30. NAVSEA, Naval Surface Warfare Center, Carderock Division

Impact Type	Output \$ Millions	Value Added \$ Millions	Employment (Number of Jobs Supported)	Labor Income \$ Millions	Labor Income per Job
Direct Impact	60	23	161	15	90,895
Indirect Impact	50	24	200	15	76,062
Induced Impact	45	25	270	14	52,874
Total Economy-Wide Impact	155	73	631	44	69,932

Note: Totals may not tally due to rounding

Table 31. NAVSEA, Naval Surface Warfare Center, Crane Division

Impact Type	Output \$ Millions	Value Added \$ Millions	Employment (Number of Jobs Supported)	Labor Income \$ Millions	Labor Income per Job
Direct Impact	62	33	216	22	101,770
Indirect Impact	43	26	240	16	67,991
Induced Impact	57	32	346	18	52,862
Total Economy-Wide Impact	162	91	802	57	70,580

Note: Totals may not tally due to rounding

Table 32. NAVSEA, Naval Surface Warfare Center, Panama City Division

Impact Type	Output \$ Millions	Value Added \$ Millions	Employment (Number of Jobs Supported)	Labor Income \$ Millions	Labor Income per Job
Direct Impact	10	4	36	3	77,846
Indirect Impact	9	5	40	3	73,682
Induced Impact	8	5	51	3	52,935
Total Economy-Wide Impact	28	13	127	8	66,441

Note: Totals may not tally due to rounding

Table 33. NAVSEA, Naval Undersea Warfare Center, Newport Division

Impact Type	Output \$ Millions	Value Added \$ Millions	Employment (Number of Jobs Supported)	Labor Income \$ Millions	Labor Income per Job
Direct Impact	373	126	689	83	120,379
Indirect Impact	345	170	1,348	106	78,609
Induced Impact	282	159	1,709	90	52,876
Total Economy- Wide Impact	999	455	3,745	279	74,550

Note: Totals may not tally due to rounding

Table 34. NAVWAR, Naval Information Warfare Command

Impact Type	Output \$ Millions	Value Added \$ Millions	Employment (Number of Jobs Supported)	Labor Income \$ Millions	Labor Income per Job
Direct Impact	48	26	152	17	113,391
Indirect Impact	32	19	183	12	68,345
Induced Impact	44	25	268	14	52,880
Total Economy- Wide Impact	124	70	603	44	72,857

Note: Totals may not tally due to rounding

NSA and USUHS Economic Impacts

Table 35. National Security Agency (NSA)

Impact Type	Output \$ Millions	Value Added \$ Millions	Employment (Number of Jobs Supported)	Labor Income \$ Millions	Labor Income per Job
Direct Impact	141	94	672	77	114,828
Indirect Impact	67	44	496	29	58,134
Induced Impact	158	89	955	50	52,867
Total Economy- Wide Impact	366	226	2,123	156	73,715

Note: Totals may not tally due to rounding

Table 36. Uniformed Services University of the Health Sciences (USUHS)

Impact Type	Output \$ Millions	Value Added \$ Millions	Employment (Number of Jobs Supported)	Labor Income \$ Millions	Labor Income per Job
Direct Impact	18,273	10,334	24,579	3,569	145,200
Indirect Impact	8,359	4,721	33,882	2,829	83,501
Induced Impact	9,526	5,370	57,676	3,049	52,870
Total Economy- Wide Impact	36,158	20,425	116,137	9,447	81,347

Note: Totals may not tally due to rounding

APPENDIX 2

Growth in National Economic Impacts

The current economic impact study updates similar reviews conducted in 2012 and 2015. This appendix shows the progressive growth in national economic impacts from DoD license agreements since the original study in 2012. This growth is a function of two main factors—

the increasing number of license agreements included in the study, and the longer period of time provided to previous license agreements to achieve commercial results or to further accumulate sales.

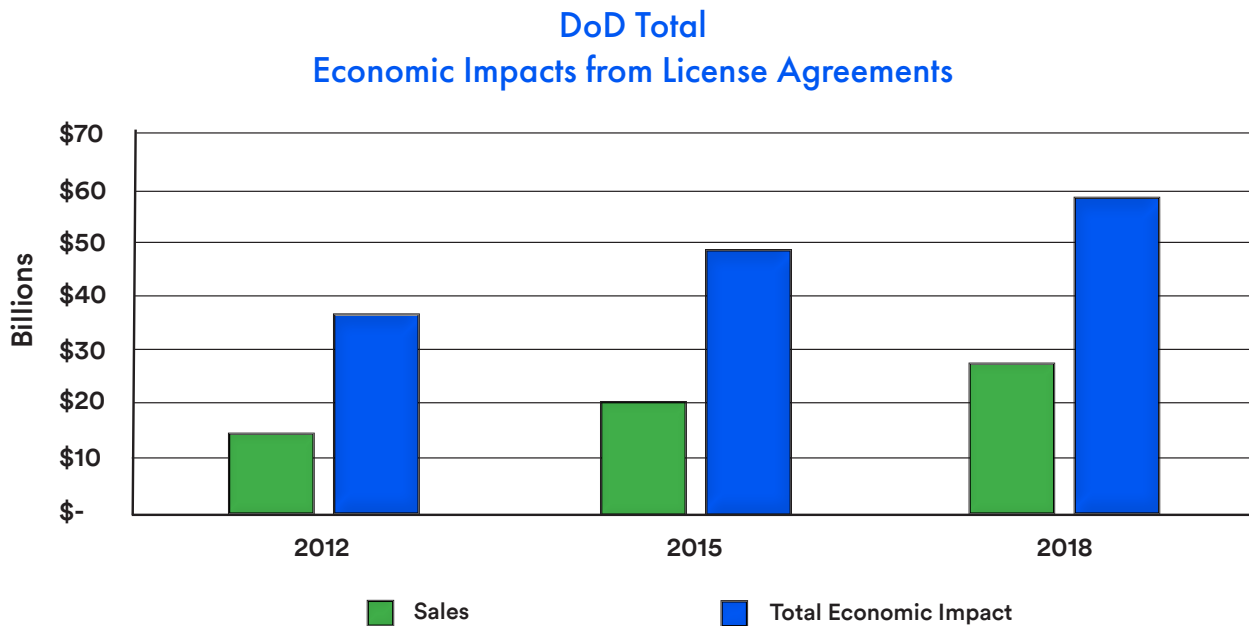


Fig. 1. Growth in Economic Impacts from DoD License Agreements

Air Force Economic Impacts from License Agreements

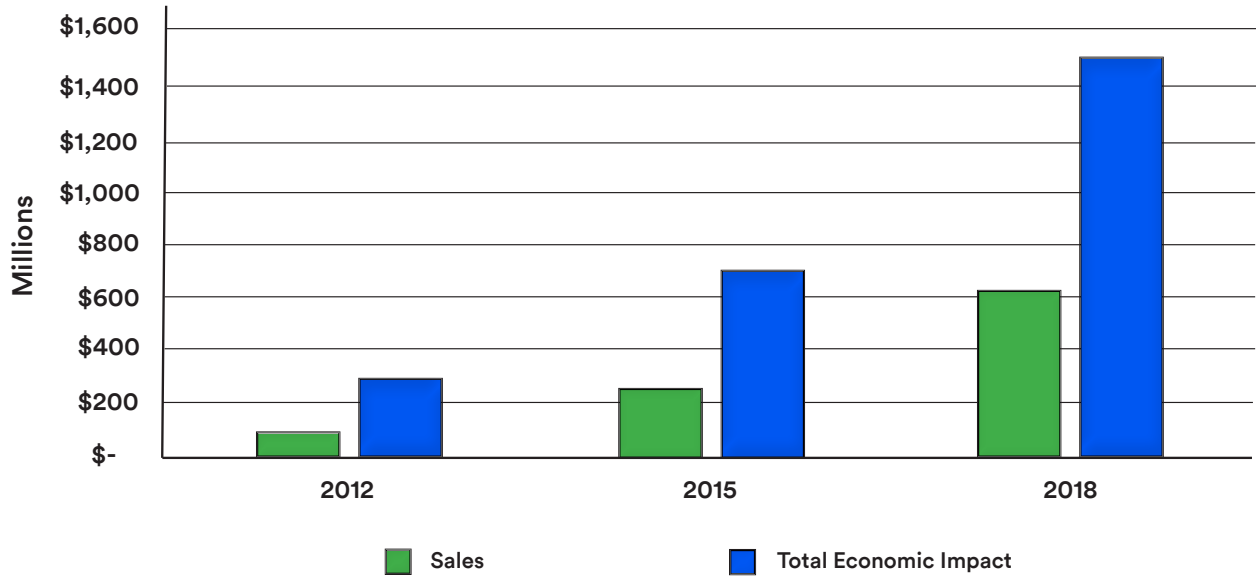


Fig. 2. Growth in Economic Impacts from Air Force License Agreements

Army Economic Impacts from License Agreements

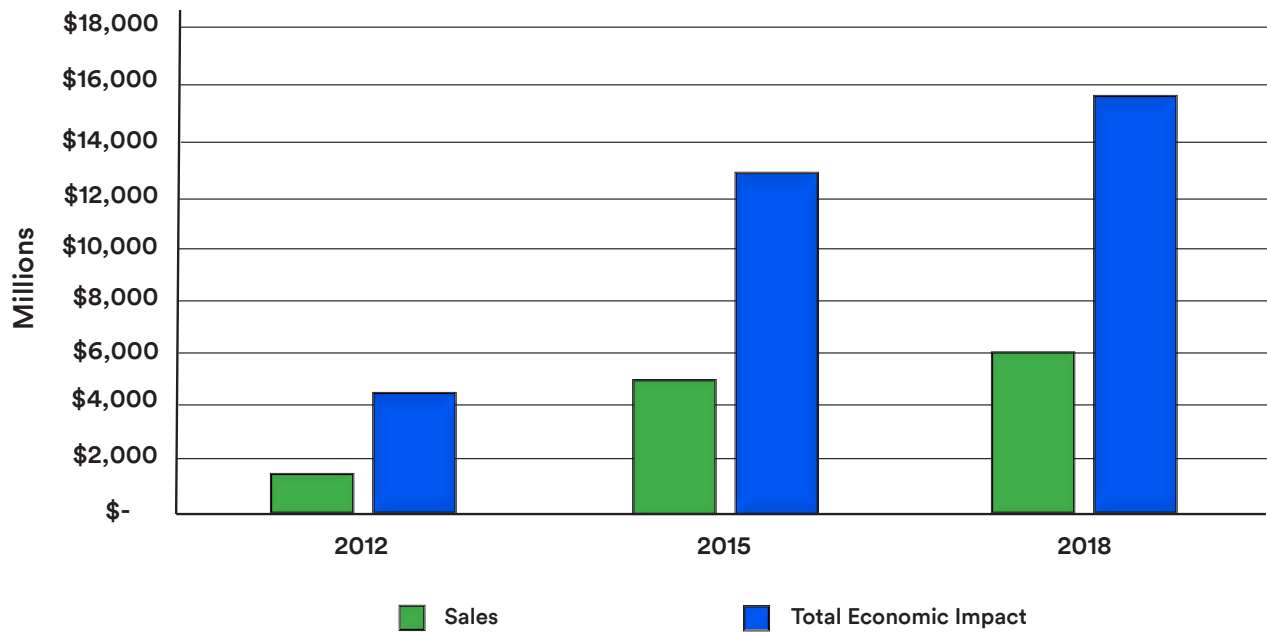


Fig. 3. Growth in Economic Impacts from Army License Agreements

Navy Economic Impacts from License Agreements

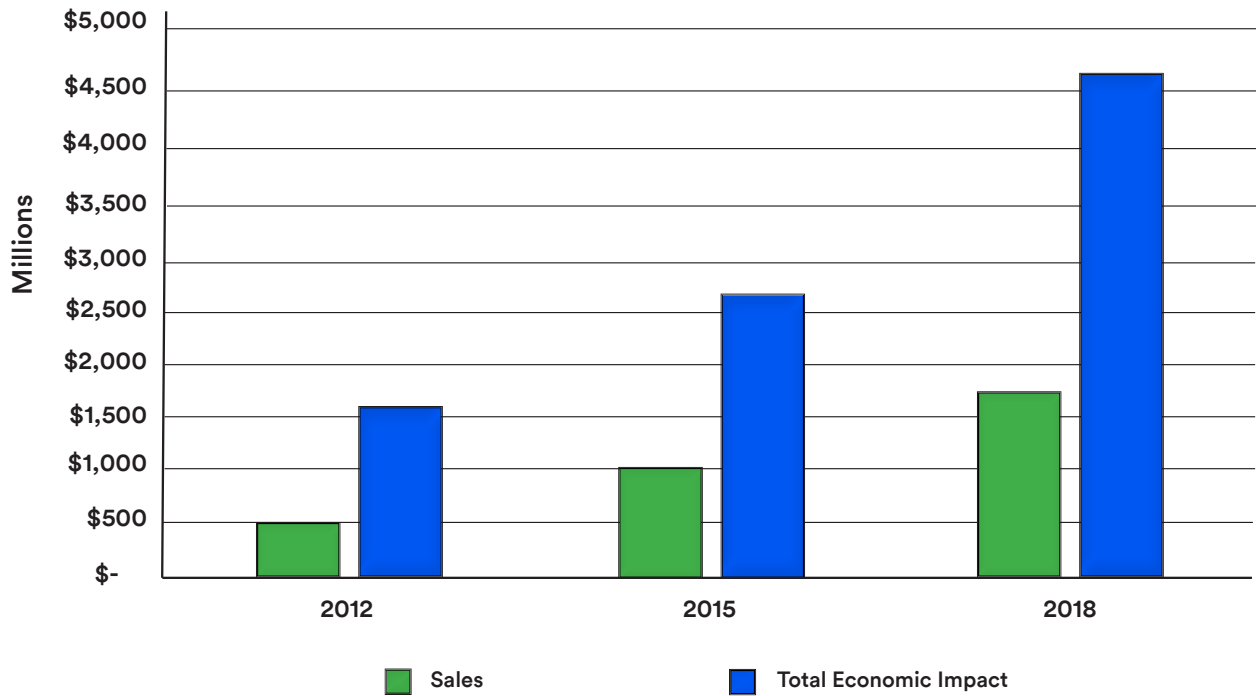


Fig. 4. Growth in Economic Impacts from Navy License Agreements

NSA Economic Impacts from License Agreements

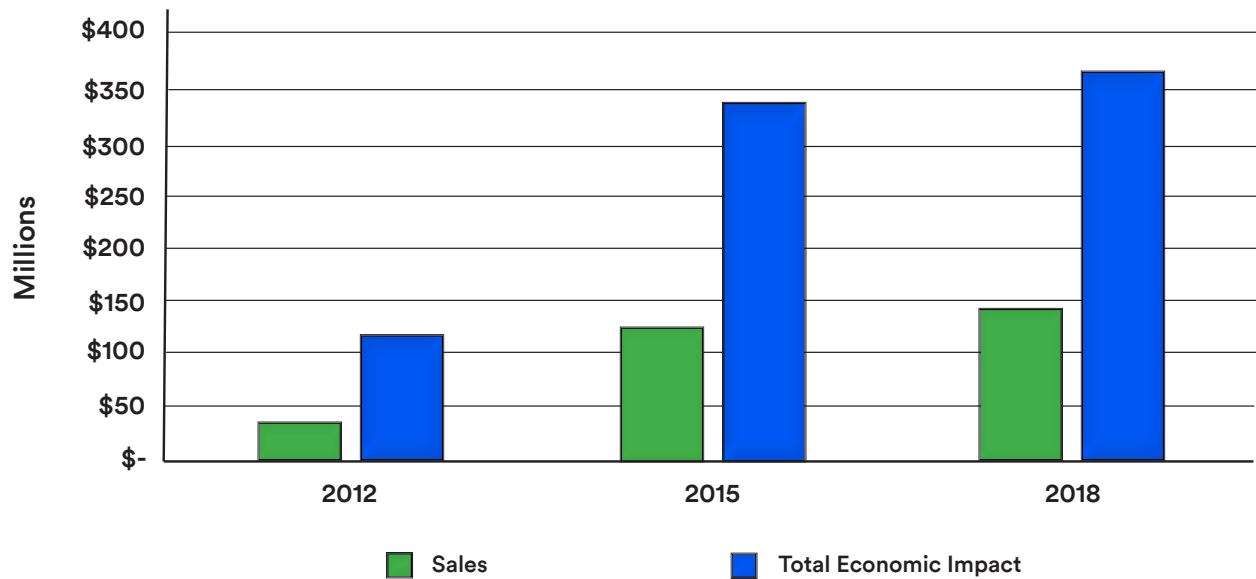


Fig. 5. Growth in Economic Impacts from NSA License Agreements

USUHS Economic Impacts from License Agreements

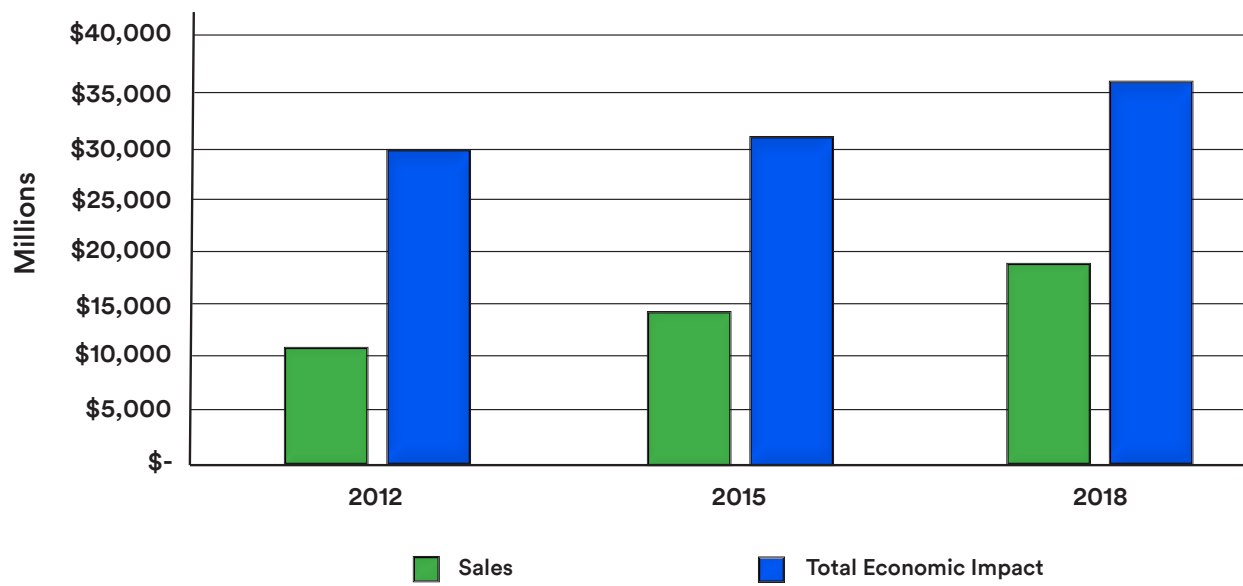


Fig. 6. Growth in Economic Impacts from USUHS License Agreements



National Economic Impacts from DoD License Agreements with U.S. Industry 2000-2017

*TechLink and
University of Colorado Business Research Division*



**National Economic Impacts
from DoD License Agreements with
U.S. Industry**

2000-2017

TechLink and University of Colorado Business Research Division