

The Growing \$1 Trillion Economic Impact of Software

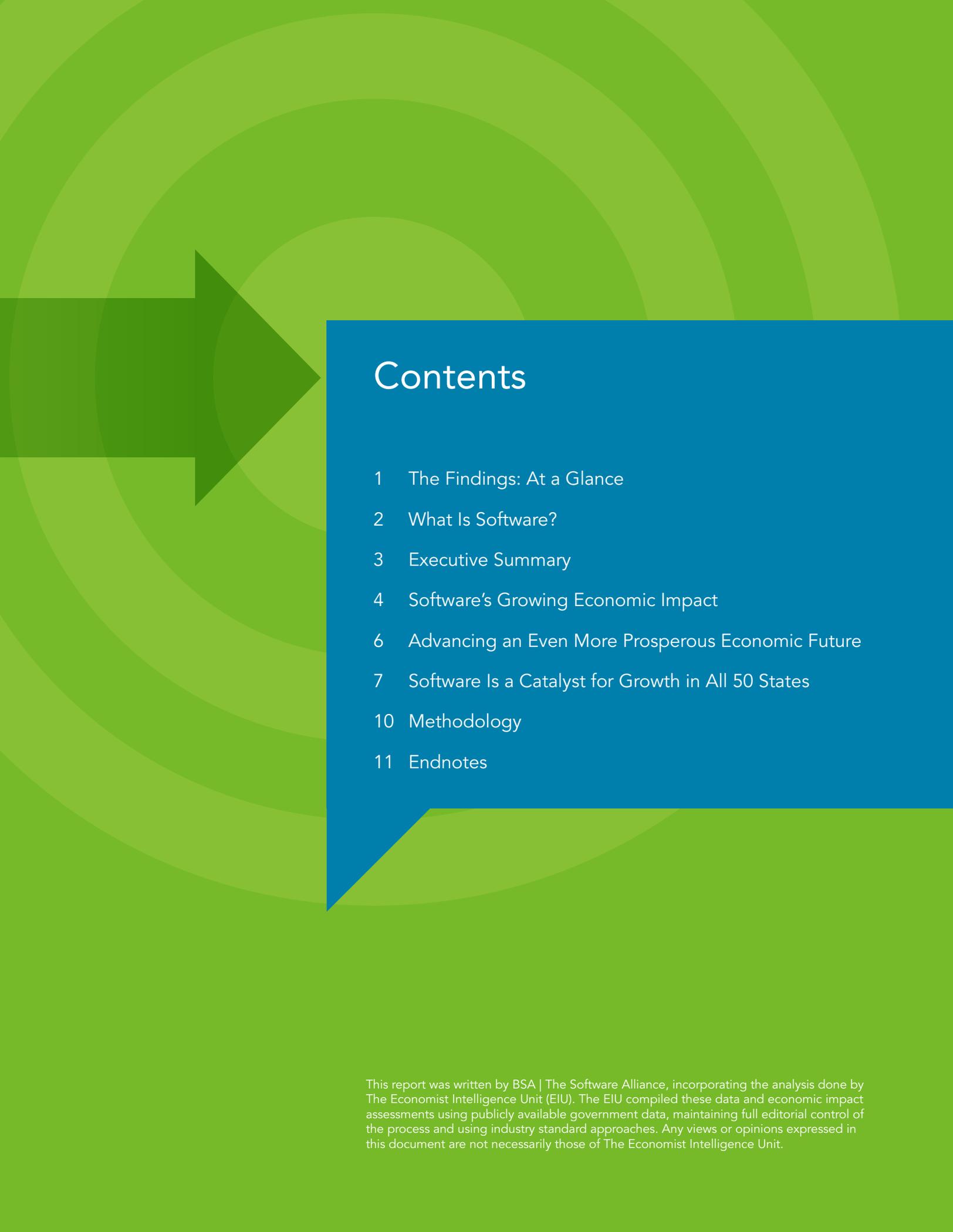
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This report was written by BSA | The Software Alliance, incorporating the analysis done by The Economist Intelligence Unit (EIU). The EIU compiled these data and economic impact assessments using publicly available government data, maintaining full editorial control of the process and using industry standard approaches. Any views or opinions expressed in this document are not necessarily those of The Economist Intelligence Unit.

The Findings: At a Glance

UNITED STATES^a

Software is so much more than your desktop at work. Software is apps. Software is data. Software is cloud computing. It creates breakthroughs and drives growth in nearly every industry. Software empowers countless people and American businesses, and improves our lives each day in ways big and small. Along with all this progress comes the dramatic, positive impact software has on our national economy each year. *The Economic Impact of Software*, a study from Software.org: the BSA Foundation conducted in 2017 by The Economist Intelligence Unit (EIU), captures the growth of the software industry in the US and the sweeping economic impact it is making at state and national levels.

Total Value-Added GDP:
\$1.14 trillion

(includes indirect and induced impacts)^b

Direct Value-Added GDP:
\$564.4 billion



EMPLOYMENT

Direct:
2.9 million jobs

Total:
10.5 million jobs
 (includes indirect and induced impacts)

Software creates jobs for a wide variety of professionals in today's workplaces — everything from software developers and web designers to project coordinators, administrative assistants, and accountants. The number of jobs created directly by the software industry has increased 14.6 percent since 2014.



WAGES

Average Annual Wage for Software Developers:
\$104,360^c

A software developer's wage is more than twice the average annual wage for all US occupations, which was \$49,630 in 2016.^d



RESEARCH & DEVELOPMENT

R&D Investment by Software Companies:
\$63.1 billion^e
19.6% of All Domestic Business R&D in the US^f

The software industry's commitment to R&D continues to spur innovation at unprecedented rates.

^a All data is from 2016 unless otherwise indicated.

^b For definitions of "indirect" and "induced," see Methodology section on page 10.

^c US Department of Labor, Bureau of Labor Statistics, Occupational Employment Statistics. Data from May 2016.

^d Ibid.

^e National Science Foundation/National Center for Science and Engineering Statistics and US Census Bureau, Business R&D and Innovation Survey. 2013 Industry breakdown. Where data is not available for 2013, the most recent year is used.

^f National Science Foundation/National Center for Science and Engineering Statistics.

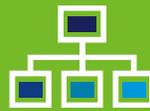
What Is Software?

Software is no longer just the code that brings our electronics to life, or the tool that puts the “smart” in our smartphone. Today software has been thrust into the very heart of the innovation ecosystem as a primary driver of new opportunities and economic growth.



Software powers our personal technology.

Software puts the apps on our tablets and smartphones — filling them with tools that create vital new ways to connect, bank, learn, shop, and travel at the touch of a fingertip. They help us share our feelings with friends, find faster routes, be more efficient, and get the best deals. These software apps have become indispensable smart assistants that help us every day.



Software delivers data-driven insights.

Software drives the data that transforms our world — enabling everything from better weather predictions, to new scientific discoveries, better economic modeling, more personalized information, and life-saving breakthroughs. It helps us use data to make more informed decisions across a range of disciplines — discovering unexpected insights from within seemingly unrelated data.



Software extends opportunity everywhere.

Software drives cloud computing and its ability to fundamentally revolutionize the way companies do business, and our own ability to collaborate — from any device, at any time, from anywhere around the globe. The cloud, for the first time, is putting the power of advanced technologies, which was once only available to the biggest players, into small businesses’ hands. At the same time, companies are avoiding expensive in-house IT costs by using the cloud to provide better, more reliable, scalable, affordable, and flexible use of applications and data.



Software enables improvements in every sector.

Software-driven advances are rippling through every major sector of the economy, in high-tech and low-tech industries alike to dramatically reduce health costs, cut crime, unclog traffic jams, reduce energy, lower carbon emissions, cut traffic fatalities, and improve quality of life. For example, in manufacturing, software is fundamentally transforming the way new products are designed, produced, and delivered to create what some now call a new era of smart manufacturing. In transportation, software is improving how we navigate our roadways, railways, and runways to save fuel, save time, and save lives.

Although software may sometimes seem like something hidden on hard drives, in apps, or on the cloud, its impact can now be readily seen in the growing ways it is used throughout our economy — boosting economic growth, creating jobs, lifting wages, and creating opportunity for the future.

Executive Summary

With each passing day, the incredible power of software innovation produces more life-improving breakthroughs. This dynamic era of accelerating possibility is being powered by massive investments in technology. These instruments in turn propel near-exponential gains in game-changing advances like cloud computing, artificial intelligence, and connected devices.

As quickly as these benefits emerge, though, the economic impact of these innovations has been difficult to measure...until now. To better quantify the software industry's role as an engine for economic growth and to measure how quickly these benefits are expanding, Software.org: the BSA Foundation commissioned The Economist Intelligence Unit to conduct a comprehensive analysis of software's impact on the US economy. This analysis, based on 2016 data, is the first to track the actual growth of software's economic impact throughout the United States.

The critical results show that the increasing ubiquity of software opportunities is growing more widespread by the day. Not only did this year's study find that the software industry's direct impact on the economy has grown 18.7 percent over the last two years, but it now leads to more than \$1.14 trillion in annual economic impact, and supports more than 10 million US jobs — while also helping businesses grow faster, paychecks grow bigger, and every state grow stronger.

In fact, software innovation is now poised to magnify, multiply, and exponentially increase opportunities far beyond the IT sector alone because it produces a powerful ripple effect that magnifies opportunities throughout the entire economy.

And the best is still ahead. The software industry's greatest emerging potential isn't just rooted in its ability to improve what individuals can achieve today, but in its innate ability to fundamentally transform what our economy can achieve tomorrow. With \$63 billion worth of investments in R&D a year, the software industry is investing in America's future and laying the ground work for even greater prosperity.

Taken together, this study will help policymakers and thought leaders better understand the magnitude of the widespread benefits that a thriving software industry can deliver. At the state level, the data can help leaders better understand the impact of their technology initiatives and more precisely focus on the pragmatic policy choices that advance greater software-driven gains.

Key Findings

Software contributed more than **\$1.14 trillion to total US value-added GDP in 2016** — a 6.4 percent increase in two years.

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The software industry contributed **\$564.4 billion** to the US economy in 2016 — an 18.7 percent increase in the last two years.

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Software is a powerful job creator — accounting for more than **10 million US jobs** — up more than 6.5 percent in the last two years. Overall, by comparison, US employment grew 3.9 percent.

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Software drives growth in all 50 states. In 35 states, direct value-added GDP from the software industry grew more than 20 percent — with Idaho and North Carolina up more than 40 percent.

.....

The software industry invested more than **\$63 billion in R&D in 2013** (the latest year for which data was available), compared to \$52 billion in 2012, a sizeable 21 percent increase that promises to pay off in future advances that will continue to **drive economic and employment growth.**



Helping design smarter cities and infrastructure. San Diego International Airport harnessed Autodesk's advanced design software to save an estimated \$800 million in the largest improvement project in the airport's history.¹ The project served as an economic stimulus for the region, created 1,000 jobs at peak construction, and was designed using green design principles, leading to decreased water usage and reduced energy consumption.²

Software's Growing Economic Impact

The growing benefits of software innovation can now be seen almost everywhere — particularly in the way software contributes to the economy, grows jobs, boosts wages, and helps propel the United States toward a more prosperous future. To quantify the size and rate of growth of software's impacts, Software.org launched an economic analysis to explore the link between software innovation and economic growth; how advances may be helping broader sectors of the economy; whether these advances can be seen in all 50 states; and how these benefits extend to local economies, workers, consumers, businesses, and the government itself.

This is the second year that we have worked with researchers at The Economist Intelligence Unit (EIU) to quantify software's economic impact on the US economy. In the first analysis, the EIU explored the state of the industry as of 2014, and demonstrated the enormous impact the software industry was generating throughout the country in both scale and scope. In this first update, the EIU builds upon its earlier work with an analysis of the most recent 2016 data to quantify the breadth and depth of software's

impact, and, for the first time, the rate at which these software opportunities are growing over time.

Researchers from the EIU sought to quantify this economic impact of software by measuring:

- 1. Direct contributions:** The breadth of the software industry's impact as a direct driver of economic gains.
- 2. Indirect impacts:** The impact the software industry indirectly produces throughout other industries in the economy.
- 3. Induced impacts:** Identifying the additional economic activity that comes from the increased general demand due to higher total wages paid to people in the software industry and to people in industries that supply to the software industry.

The research demonstrates how the software industry is having a profound impact that is rippling throughout the economy, creating valuable new jobs, boosting wages, improving productivity, increasing exports, and expanding our economic potential across numerous sectors benefitting all 50 states.

SOFTWARE IS...



Reducing medical conflicts so Americans can live longer, healthier lives. Care coordination reduces redundant care costs and improves health care quality. The Michigan Health Information Network used Salesforce's cloud to maintain information on more than 275,000 providers and to understand the connections among doctors, hospitals, and health care facilities, and between providers and patients.³ The ability to share information throughout a care team reduces redundancies, making it easier to assign and handle referrals and improve overall care.

The results are astounding:

➤ **Software's growing impact is adding more than \$1.14 trillion a year to the US economy.**

The software industry directly contributed \$564.4 billion to the US economy in 2016, representing a 18.7 percent increase over 2014. When looking at its full impact, the software industry is responsible for \$1.14 trillion of total US value-added GDP in 2016 (\$564.4 billion in direct value-added + \$575.5 billion in indirect and induced effects) — a 6.4 percent increase in just the last two years.

➤ **Software is a powerful job creator — accounting for more than 10 million US jobs.**

The software industry is also a job creating dynamo. In 2016, the software industry directly employed 2.9 million people in the US, compared to 2.5 million in 2014 — an increase of more than 350,000 US jobs during the last two years alone. Moreover, for each direct job generated by the software industry, another 2.6 jobs are supported throughout the rest of the economy. In total, software supported an additional 7.6 million jobs in other industries through indirect and induced effects — or nearly 10.5 million jobs overall.

➤ **Software drives growth in all 50 states.** Every state is benefitting from the new jobs, economic growth, and opportunities being created by software advances. In almost every state, direct value-added GDP from the software industry grew more than 10 percent. In some states, the growth was tremendous — with Idaho and North Carolina up more than 40 percent and nine other states up more than 30 percent. In all, direct value-added GDP from the software industry grew more than 20 percent in 35 states.

➤ **Growing software investments in the future will continue to drive economic benefits.**

As the software industry drives outsized investments in game-changing R&D today, it increases the size of economic gains tomorrow. More than half of all US economic growth since World War II is attributable to innovation.⁴ To continue to drive the breakthrough advances that can spur an even more prosperous future, the software industry invested more than \$63 billion in R&D in 2013 (the latest year for which data was available), compared to \$52 billion in 2012, representing a sizeable 21 percent increase. Another way to look at this is that the software industry's \$63 billion R&D investment is larger than the annual amount invested in R&D by the National Science Foundation (\$6.2 billion), the National Institutes of Health (\$30 billion), and the National Aeronautics and Space Administration (\$12.2 billion) — combined.⁵

SOFTWARE IS...



Improving public safety and security. Many city police forces are rolling out body-worn cameras to provide more transparency when reviewing conflict. But departments are often impeded by the sheer quantity of data these cameras create and the inability to easily share information with others in the criminal justice system. To solve this problem, the Charleston South Carolina Police Department migrated its system to a cloud service built on Microsoft's cloud platform.⁶

Advancing an Even More Prosperous Economic Future

Filling our lives with opportunity, our businesses with potential, our governments with solutions, and our economy with high-paying jobs, software helps grow our economy in ways big and small. The continued growth, vitality, and innovation of the software industry — and the benefits it delivers — however, depend on policies that encourage continued innovation and investment. A thriving innovation ecosystem can, in turn, provide policymakers with smarter opportunities to grow our economy, protect the environment, boost education, improve public safety, save lives, and raise standards of living.

With enormous possibilities just over the horizon, how quickly we can take advantage of these benefits will largely depend on decisions being made by policymakers today. Smart policy choices that foster a climate where software innovation can thrive advances a well-trained workforce, harnesses innovation and investment, enables data to flow freely across borders, and prevents technology specific mandates. Never before have software opportunities been so profound, the economic benefits so widespread, and a pragmatic policy environment so essential.

SOFTWARE IS...



Personalizing education to improve teaching. Educators have long understood that every student's learning style is unique. Now, using the same artificial intelligence platform it used to compete on *Jeopardy*, the IBM Foundation is working with teachers to provide high-quality, customized math lessons and strategies to strengthen teachers' abilities. The cognitive technology helps educators build personalized lesson plans that tailor the instruction, content, pace, and testing to individual students' strengths and interests, using software, data, and continuous feedback.

Software Is a Catalyst for Growth in All 50 States

In every state throughout the country, software innovation drives significant economic impact. Software contributes to a state's economy, boosting employment broadly, lifting wages, and driving investments in local R&D to help ensure long-term economic gains are realized too.

California's software industry alone directly contributes \$124.7 billion to the GDP, with New York contributing \$49.1 billion and Texas following closely behind with \$37.2 billion. The strongest concentrations of R&D spending were made in California (\$24.4 billion), Washington (\$9.6 billion), and Massachusetts (\$3.4 billion).

But software is dramatically boosting the GDP in other states as well. In 35 states, direct value-added GDP from the software industry grew more than 20 percent — with Idaho and North Carolina up more than 40 percent. Nine other states, including Kansas, Nevada and Utah, were up more than 30 percent. In reviewing the state data one thing is clear: regardless of how big or small, rural or urban, every state benefits from the tangible economic impacts that software innovation delivers.



STATE ECONOMIC IMPACT

State	GDP	EMPLOYMENT		SOFTWARE R&D	
	Direct Contribution (\$million)	Direct (Jobs)	Total (Jobs)	Investments (\$million)	Percentage of Total Business R&D
United States	\$564,383	2,906,390	10,463,152	\$63,093	19.6%
Alabama	\$3,635	26,964	51,582	\$226	14.5%
Alaska	\$263	1,414	2,640	\$2	4.3%
Arizona	\$6,686	49,092	99,625	\$235	4.5%
Arkansas	\$1,717	12,323	14,940	\$17	5.9%
California	\$124,688	494,856	1,160,457	\$24,403	27.3%
Colorado	\$13,952	82,407	140,271	\$1,071	23.7%
Connecticut	\$6,840	35,139	107,895	\$332	4.1%
Delaware	\$1,076	6,457	15,596	\$110	4.8%
District of Columbia	\$5,199	27,169	45,937	\$121	24.8%
Florida	\$19,210	119,719	213,614	\$1,121	19.3%
Georgia	\$15,577	97,123	161,524	\$939	23.3%
Hawaii	\$904	5,882	16,044	\$24	11.2%
Idaho	\$962	6,090	16,250	\$120	9.7%
Illinois	\$21,005	111,609	309,611	\$575	4.4%
Indiana	\$4,717	36,080	58,274	\$222	3.4%
Iowa	\$2,980	18,072	30,434	\$89	4.3%
Kansas	\$3,003	22,493	38,382	\$99	5.1%

STATE ECONOMIC IMPACT					
State	GDP	EMPLOYMENT		SOFTWARE R&D	
	Direct Contribution (\$million)	Direct (Jobs)	Total (Jobs)	Investments (\$million)	Percentage of Total Business R&D
Kentucky	\$2,573	22,854	26,570	\$57	4.5%
Louisiana	\$1,521	11,694	20,533	\$22	6.2%
Maine	\$933	5,588	13,199	\$68	18.6%
Maryland	\$13,397	82,952	151,594	\$425	8.9%
Massachusetts	\$28,815	129,101	385,158	\$3,418	19.6%
Michigan	\$10,551	66,275	143,650	\$383	2.4%
Minnesota	\$10,344	53,033	80,987	\$590	8.9%
Mississippi	\$816	7,076	7,554	\$16	7.6%
Missouri	\$8,274	50,453	115,921	\$756	10.5%
Montana	\$613	4,817	8,035	\$20	21.7%
Nebraska	\$2,685	19,373	21,821	\$285	45.5%
Nevada	\$1,866	10,690	25,773	\$49	9.3%
New Hampshire	\$2,736	15,055	32,316	\$351	17.2%
New Jersey	\$19,717	93,066	251,602	\$832	5.9%
New Mexico	\$874	6,092	9,993	\$24	4.6%
New York	\$49,071	173,033	577,734	\$3,322	27.6%
North Carolina	\$13,159	81,811	154,838	\$1,363	16.9%
North Dakota	\$714	4,656	5,355	\$89	38.9%
Ohio	\$13,146	78,836	188,892	\$373	4.6%
Oklahoma	\$1,757	11,695	24,706	\$35	6.9%
Oregon	\$5,624	31,778	78,489	\$633	11.2%
Pennsylvania	\$16,169	91,399	251,239	\$1,268	11.8%
Rhode Island	\$1,573	10,844	21,365	\$66	11.6%
South Carolina	\$2,886	19,953	33,577	\$132	13.0%
South Dakota	\$366	2,530	3,342	\$19	11.6%
Tennessee	\$4,612	27,566	53,500	\$139	9.8%
Texas	\$37,185	232,457	385,386	\$2,489	16.0%
Utah	\$5,854	42,008	98,282	\$548	18.6%
Vermont	\$805	5,221	10,728	\$222	54.7%
Virginia	\$29,570	183,209	457,926	\$681	15.3%
Washington	\$35,267	130,698	331,046	\$9,639	64.9%
West Virginia	\$811	4,904	8,724	\$9	2.9%
Wisconsin	\$7,483	45,014	66,506	\$643	15.2%
Wyoming	\$199	1,027	2,362	\$3	10.7%

METHODOLOGY

In 2017, Software.org: the BSA Foundation commissioned The Economist Intelligence Unit (EIU) to assess the economic impact of the software industry. The EIU collected and analyzed the most recent data available from several recognized and reputable sources. These sources included the EIU itself, IMPLAN, the National Science Foundation, the US Bureau of Economic Analysis, the US Bureau of Labor Statistics, and the US Census Bureau.

To estimate the total contributions of the software industry to the US economy, the EIU analyzed the direct contributions and estimated indirect and induced impacts using various economic multipliers. The economic contribution analysis presented in this paper uses input-output models, which describe the full inter-industry transactions between producers and intermediate and final consumers, to compute multipliers. Multipliers allow for the estimation and isolation of the direct, indirect, and induced contributions of an industry to economic outcomes (e.g., value-added GDP, employment, and wages). Direct and indirect contributions are estimated using different multipliers:

- 1. Direct contributions:** The levels of output or employment from the software industry directly.
- 2. Indirect impacts:** The indirect impacts estimate the inter-industry economic activity resulting from the direct contributions (e.g., purchases of inputs). These indirect effects look backward at the linkages of the software industry in the economy, and the demands inputs from other sectors, like real estate and other professional services. This demand generates additional output (and jobs) from those sectors that wouldn't exist if it weren't for that software industry demand. As a result, the indirect multipliers estimate this additional output from other industries that is attributable to the software industry.

- 3. Induced impacts:** Induced impacts take the next step — identifying the additional economic activity supported by spending on goods and services by households whose income was affected by the direct contributions and indirect impacts. The software industry pays its employees but also supports incomes in other sectors, like real estate. These jobs come with additional wage payments, which increase total earnings to people working in these upstream sectors. These people then buy more goods and services, which generate additional demand (and output) across the broader economy. Induced multipliers estimate this additional output from increased general demand due to higher total wages paid to people in the software industry and people in industries that supply to the software industry.

The modern definition of the software industry used in the study reflects recent technological advancements in the software industry — from one that focused on tangible and packaged software products to one that includes software-related services like the cloud-based software as a service (SaaS), cloud storage and computing, mobile app development, and hosting. As a result, the EIU analysis has defined the US software industry to include the following software sub-industries:

NAICS 5112:	Software Publishers
NAICS 5415:	Computer Systems Design and Related Services
NAICS 518:	Data Processing, Hosting and Related Services
NAICS 519130:	Internet Publishing and Broadcasting and Web Services

The EIU compiled these data and economic impact assessments using publicly available government data, maintaining full editorial control of the process and using industry standard approaches. Any views or opinions expressed in this document are not necessarily those of The Economist Intelligence Unit.

ENDNOTES

- ¹ *The Business Value of BIM for Infrastructure. Addressing America's Infrastructure Challenges with Collaboration and Technology* (Bedford, MA: McGraw-Hill Construction, 2012), available at http://images.autodesk.com/adsk/files/business_value_of_bim_for_infrastructure_smartmarket_report_2012.pdf.
- ² San Diego International Airport, *The Green Build Fact Sheet*, available at <http://www.san.org/airport-projects/the-green-build#134085-fact-sheet>.
- ³ *Michigan Health Information Network Puts the Care Back into Healthcare with Salesforce*, available at <https://www.salesforce.com/customer-success-stories/michigan-health-network/>.
- ⁴ Science and technology have been responsible for more than half of all US economic growth since World War II, according to research based on work by Nobel Prize-winning economist Robert M. Solow. See *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future* (Washington, DC: National Academies Press, 2007), available at <https://www.nap.edu/read/11463/chapter/2> and National Institute of Standards and Technology, *Innovation as a Key Driver of Economic Growth & Competitiveness*, available at <https://www.nist.gov/speech-testimony/innovation-key-driver-economic-growth-competitiveness>.
- ⁵ American Association for the Advancement of Science, *Guide to the President's R&D Budget FY2017*, available at <https://www.aaas.org/sites/default/files/AAAS%20R&D%20Report%20FY17%20web.pdf>.
- ⁶ *Charleston Police Department*, available at <https://enterprise.microsoft.com/en-us/customer-story/industries/government/charleston-police-department/>.



ABOUT SOFTWARE.ORG

Software.org: the BSA Foundation is an independent and nonpartisan international research organization that works to help policymakers and the broader public better understand the impact that software has on our lives, our economy, and our society. We believe that by working together to examine these issues we can better prepare for the future and help inform government policies and industry culture that will promote both technological advancement and widespread growth. At the same time, Software.org works to empower the workforce of the future and to help policymakers, stakeholders, and the technology industry itself look forward and prepare for the world of tomorrow.



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**Think
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**Give
Back**

**Look
Forward**



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