

Washington Aerospace Economic Impacts 2018 Update



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Prepared for:



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*Community Attributes Inc. tells data-rich stories about communities
that are important to decision makers.*

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INTRODUCTION

The aerospace sector is a major driver of economic activity in Washington state. Anchored by The Boeing Company and supported by an extensive supply chain, the aerospace sector is a key source of innovation, economic growth, and wealth. In 2013, 2015, and 2016, Community Attributes Inc. (CAI) produced a data-rich assessment of the aerospace industry's impact on the state economy, including both direct activities and the secondary impacts of the industry through upstream business-to-business transactions (indirect impacts) and worker income expenditures on goods and services in other parts of the economy (induced impacts).

This technical memorandum presents an analysis of the aerospace industry, including its statewide impacts and county-level industry presence.

SUMMARY OF FINDINGS

The aerospace industry, anchored by The Boeing Company, continues to be a significant source of employment and wealth creation across the state. Key findings from this study are as follows:

- Aerospace revenues in Washington in 2017 remained much higher relevant to prior years since 2000. In 2017, aerospace companies in Washington reported \$66.8 billion in gross revenues, down slightly from 2015. This compares against a ten-year average from 2000 to 2010 of \$44.0 billion (inflation adjusted, 2017 dollars).
- The Boeing Company generated an estimated \$54.8 billion in revenues from operations in Washington state in 2017, down from a historic high of \$62.0 billion (estimated, 2017 \$) in 2014.
- Revenues from related industries—defined as other industries engaged in or with close linkages to the aerospace supply chain—increased from \$7.0 billion in 2009 to \$11.6 billion in 2017 (inflation-adjusted, 2017 \$).
- In 2017, Washington state's aerospace workforce is estimated to be 84,000, an 11% increase in aerospace workers over the past fifteen years. Since 2002, when the number of aerospace workers were at 75,700, there have been numerous ups and downs in the aerospace industry globally, which were reflected over the years in the ups and downs of the aerospace workforce in Washington. In 2017, Boeing's workforce in Washington is estimated to be 68,900. Other aerospace firms in Washington saw employment increase by more than 31% from 2012 to 2017.
- Total aerospace industry wages (before benefits) in 2017 totaled \$9.2 billion, slightly down from the peak of \$10.6 billion in 2014 (in inflation-adjusted terms). In 2017, the average annual wage paid per

worker was \$109,400, nearly the same as the annual wage since 2014 (adjusted for inflation).

- The total economic impact of the aerospace industry in Washington state in 2017 included 226,130 jobs, \$19.7 billion in labor income, and \$89.6 billion in business revenues. However, employment impacts in 2017 were lower than in 2015 (from a prior aerospace impact analysis), when the industry supported—through direct and multiplier effects—252,800 jobs statewide.
- Factoring in multiplier effects, the aerospace industry was associated with \$420.1 million Washington state fiscal tax revenues in 2017.

METHODS AND DATA

This report uses data published by state and federal agencies, as well as company-wide employment and revenue data made available by The Boeing Company. Employment, wage, and establishment count data for aerospace and related industries were procured from the Washington State Employment Security Department, while the Washington State Department of Revenue was the source for gross business income for aerospace and related industries. Implicit price deflators were sources from the St. Louis Federal Reserve Bank.

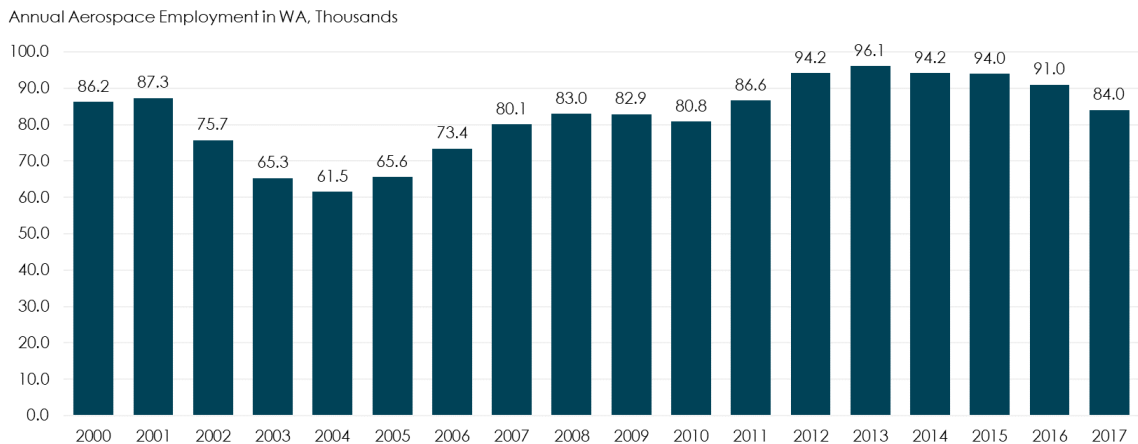
The Washington State Input-Output Model was used to evaluate the statewide and county-level economic impacts of the aerospace industry, including indirect and induced impacts. The model was customized for county-level impacts to reflect local level supply chain and household spending dynamics.

DIRECT ACTIVITIES IN WASHINGTON STATE

Employment, Occupations, and Establishments

In 2017, the aerospace industry directly employed 84,000 workers in Washington state, based on a 12-month annual average. This was down from a recent peak of 96,100 in 2013, a 13% decline (**Exhibit 1**). Reflecting a decline in the global aerospace market, this decline was in part the result of voluntary layoffs at Boeing. The cyclical nature of aerospace around the world resulted in a decline that saw Boeing Washington state employment down from 84,800 employees in 2012 to 68,900 in 2017 (**Exhibit 2**). However, since 2003, Boeing’s Washington state employment has increased 15% relative to its total global employment. In 2017, Boeing’s workforce in Washington state was roughly 48 percent of their global companywide employment, up from 33% in 2003. Recent news reports indicate layoffs at Boeing, the majority of which were voluntary, are at or near conclusion, and employment is expected to either stabilize or increase in Washington in 2018.¹

Exhibit 1. Aerospace Employment in Washington State, 2000-2017

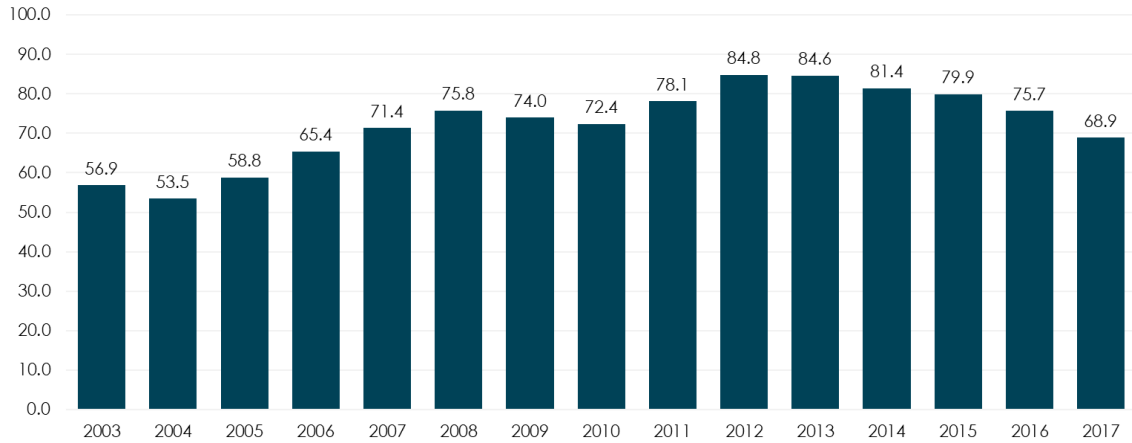


Source: Washington State Employment Security Department, 2018; Community Attributes Inc., 2018.

¹ See, for instance, King 5 News, “Boeing hiring again after years of job reductions,” December 5, 2017, accessed at: <http://www.king5.com/article/tech/science/aerospace/boeing-hiring-again-after-years-of-job-reductions/281-496841059>.

Exhibit 2. Boeing Employment in Washington State, 2003-2017

Annual Boeing Employment in WA, Thousands



Source: *The Boeing Company, 2017; Community Attributes Inc., 2018.*

Aerospace is a major employer of high-skilled occupations, ranging from engineers and assembly line workers to administrative staff. In 2017, estimated leading occupations included aircraft and structural assembly jobs, aerospace engineers, and industrial engineers. Many of these positions paid compensation well in excess of \$100,000 per year, before benefits (**Exhibit 3**).

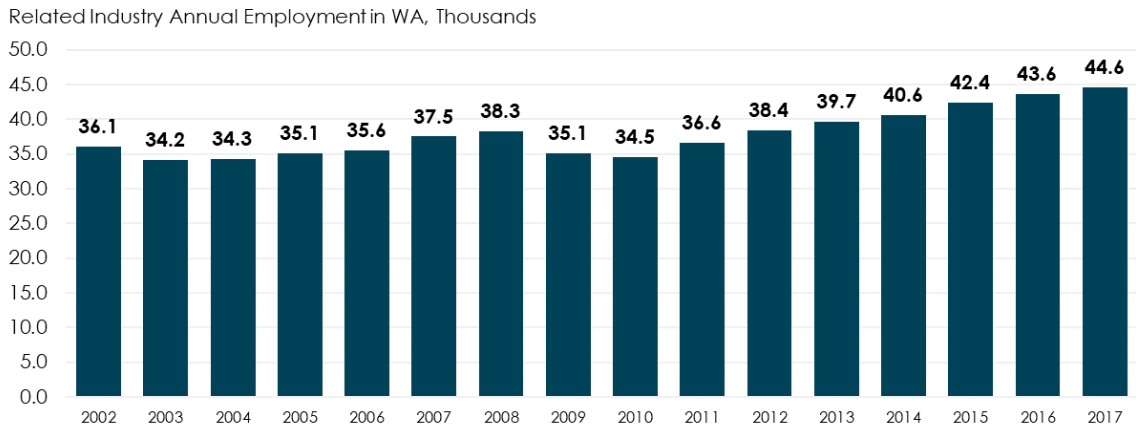
Exhibit 3. Aerospace Occupations in Washington State, 2017

SOC	Description	Number of Jobs	Median Annual Wage
51-2011	Aircraft structure, surfaces, rigging, and systems assemblers	6,740	N/A
17-2011	Aerospace engineers	4,640	N/A
51-9061	Inspectors, testers, sorters, samplers, and weighers	3,920	\$51,600
17-2112	Industrial engineers	3,780	\$103,000
49-3011	Aircraft mechanics and service technicians	3,460	\$73,700
51-4041	Machinists	3,110	\$49,500
15-1133	Software developers, systems software	2,720	\$115,500
17-2141	Mechanical engineers	2,400	\$89,700
51-2092	Team assemblers	2,010	\$33,500
13-1023	Purchasing agents, except wholesale, retail, and farm products	1,990	\$69,400
13-1199	Business operations specialists, all other	1,820	\$73,400
43-5061	Production, planning, and expediting clerks	1,820	\$48,700
51-1011	First-line supervisors of production and operating workers	1,800	\$68,400
51-4011	Computer-controlled machine tool operators, metal and plastic	1,800	\$57,600
13-1081	Logisticians	1,710	N/A
15-1132	Software developers, applications	1,640	\$127,700
17-2071	Electrical engineers	1,340	\$104,600
11-9041	Architectural and engineering managers	1,200	\$148,700
17-2199	Engineers, all other	1,010	\$96,900
15-1121	Computer systems analysts	950	\$91,600
49-2091	Avionics technicians	920	\$74,400
17-3026	Industrial engineering technicians	880	N/A
11-3051	Industrial production managers	860	\$112,500
11-1021	General and operations managers	850	\$103,200
17-2072	Electronics engineers, except computer	790	\$114,500
<i>Subtotal</i>		54,160	
<i>All other occupations</i>		29,840	
Total		84,000	

Source: U.S. Bureau of Labor Statistics, 2018; Community Attributes Inc., 2018.

Related industries include additional businesses and operations with strong overlapping services and linkages with aerospace. In this analysis, “related industries” represent a list of North American Industry Classification System (NAICS) codes developed by the Washington State Employment Security Department (ESD) and Washington Aerospace Partnership in 2013, and has been used in the 2013, 2015, and 2016 aerospace reports to approximate the broader aerospace supply chain eco-system (see **Appendix A** for list of industry codes). In 2017, this group of industries employed 44,630 workers in Washington state, a 29% increase over a recent low in 2010 of 34,500 workers (**Exhibit 4**).

Exhibit 4. Related Industry Employment, 2002-2017

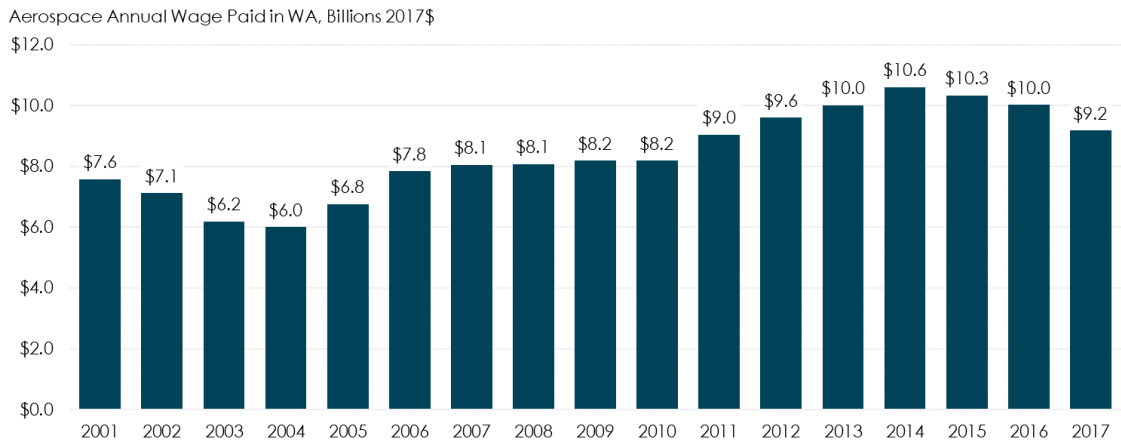


Source: Washington State Employment Security Department, 2018; Community Attributes Inc., 2018.

Wages

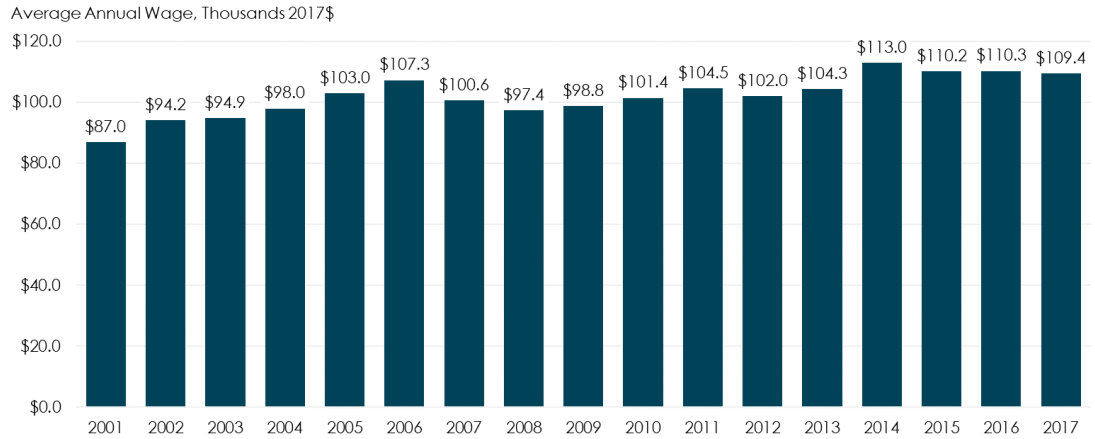
In 2017, the aerospace industry generated a total of \$9.2 billion in annual wages (**Exhibit 5**), not including benefits such as employer-provided health insurance. Adjusted for inflation, total annual wages, in aggregate across all aerospace workers, declined slightly from a peak of \$10.6 billion in 2014. At the state level, aerospace workers averaged an annual wage of \$109,400 (**Exhibit 6**) in 2017. The average wage also declined from \$113,000 in 2014, which may in part reflect an increase in retirements since 2014 due to an aging workforce.

Exhibit 5. Aerospace Total Wages in Washington State, 2001-2017 (2017\$)



Source: U.S. Bureau of Labor Statistics, 2018; Community Attributes Inc., 2018.

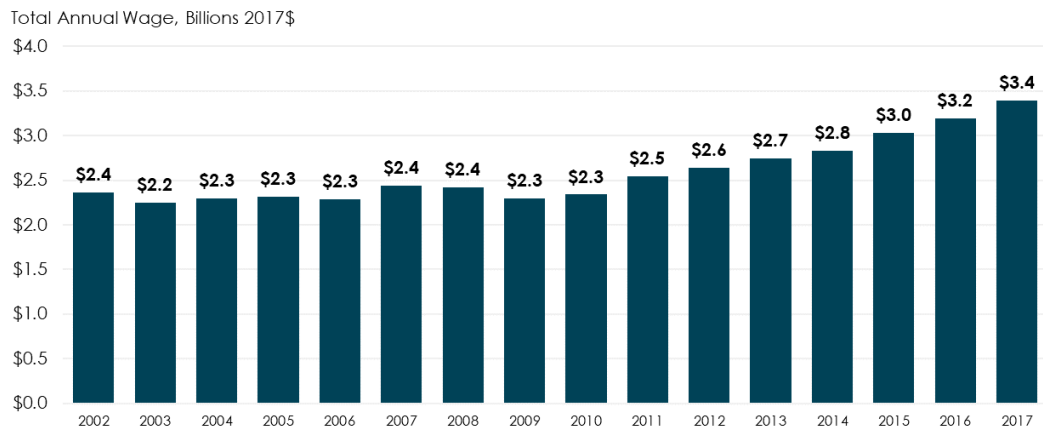
Exhibit 6. Aerospace Average Annual Wages in Washington State, 2001-2017 (2017 \$)



Source: U.S. Bureau of Labor Statistics, 2018; Community Attributes Inc., 2018.

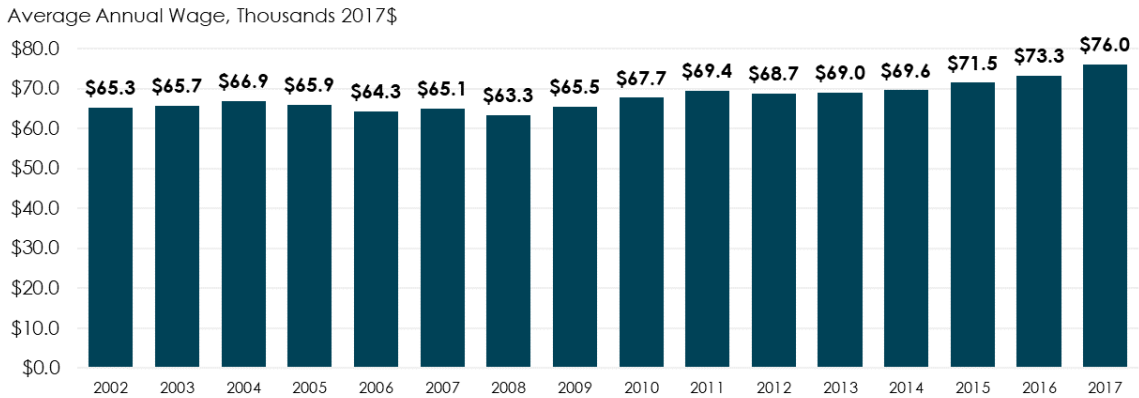
Related industries experienced a steady increase in annual total wages. In 2017, total wages (less benefits) reached \$3.4 billion (Exhibit 7). This represents a 5.0% average annual increase since 2009, in real inflation-adjusted 2017 dollars. The average wage in related industries was \$76,000 in 2017 (Exhibit 8).

Exhibit 7. Related Industry Total Wages in Washington State, 2002-2017 (2017 \$)



Source: U.S. Bureau of Labor Statistics, 2018; Community Attributes Inc., 2018.

Exhibit 8. Related Industry Average Annual Wages in Washington State, 2001-2017 (2017 \$)



Source: U.S. Bureau of Labor Statistics, 2018; Community Attributes Inc., 2018.

Business Revenues

Revenues from the aerospace industry in 2017 remained high by historic standards—gross business income in 2017 was more than double that of 2004 (\$30.9 billion, in 2017 dollars). In 2017, the aerospace industry directly generated \$66.8 billion in gross business income (**Exhibit 9**).

Exhibit 9. Aerospace Business Revenues in Washington State, 2000-2017 (2017\$)²



Source: Washington State Department of Revenue, 2018; Community Attributes Inc., 2018.

² Aerospace business revenue generated in Washington state in 2017 is estimated based on the average of first three quarters business revenue reported by Washington State Department of Revenue.

In 2017, The Boeing Company generated an estimated \$54.8 billion in revenues from operations in Washington state (**Exhibit 10**), including final production facilities for the 737 and 737 MAX, 747-8, 767, 777 (and soon 777X, including the manufacture of the composite wing), and 787, as well the KC-46A air refueling tanker (based on the 767) and P-8 anti-submarine aircraft (based on the 737).

The Boeing Company’s revenues in Washington in 2017 represented approximately 82% of all aerospace revenues in the state. Between 2003 and 2017, Boeing revenues averaged 88.2% of all aerospace revenues in Washington state.

Exhibit 10. Boeing Business Revenues in Washington State, 2003-2017 (2017 \$)³

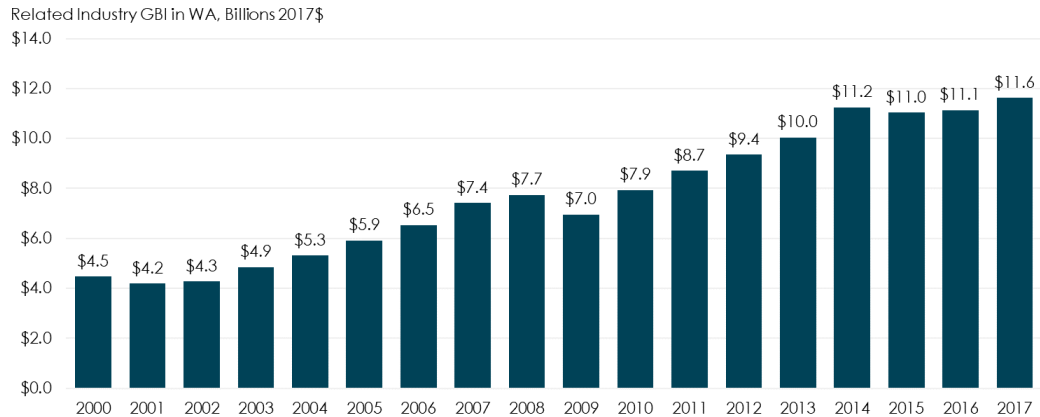


Source: Washington State Department of Revenue, 2018; The Boeing Company, 2017; Community Attributes Inc., 2018.

Related industries in Washington state generated an estimated \$11.4 in gross business income in 2017; this represents a 5.8% annual growth rate since 2000 in 2017 dollars; **Exhibit 11**). Among all related activities, the top three industries, which generated the largest revenues in 2017, were “Search, Detection, Navigation, Guidance, and Nautical System Manufacturing” (\$1.6 billion), “Instrument Manufacturing for Measuring and Testing Electricity and Electrical Signals” (\$1.6 billion), and “Plastics Material and Resin Manufacturing” (\$1.3 billion).

³ The business revenue generated by the Boeing Company is estimated by the share of the Boeing Company employment out of the total aerospace employment in Washington State and the estimated total business revenue generated aerospace industry in Washington state.

Exhibit 11. Related Industry Business Revenues in Washington State, 2000-2017 (2017\$)⁴



Source: Washington State Department Revenue, 2018; Community Attributes Inc., 2018.

Economic and Fiscal Impacts

Due to its large employment footprint and high wages, aerospace has a significant widespread economic impact across the state. Total economic impacts represent both the direct footprint of the aerospace sector as well as additional jobs, labor income, and business revenues supported through upstream business-to-business transactions (indirect impacts) and worker household income expenditures (induced impacts). In this report, economic impacts were computed using the Washington State Input-Output (I-O) Model published by the Washington State Office of Financial Management.

In 2017, the aerospace sector directly employed 84,000 workers, paid \$11.4 billion in labor income (including benefits) and generated an estimated \$66.8 billion in business revenues. These activities, in turn, supported a total of 226,130 jobs across the state economy, \$19.7 billion in labor income, and \$89.6 billion in business revenues through multiplier effects (**Exhibit 12**).

Exhibit 12. Economic Impacts of Aerospace in Washington, 2017

	Direct	Indirect	Induced	Total
Jobs	84,000	27,230	114,900	226,130
Labor Income (mils 2017 \$)	\$11,446.2	\$2,133.9	\$6,086.8	\$19,666.9
Business Revenue (mils 2017 \$)	\$66,786.3	\$4,895.5	\$17,962.3	\$89,644.1

Source: Office of Financial Management, 2018; Washington State Employment Security Department, 2018; Community Attributes Inc., 2018.

⁴ Related industry business revenue generated in Washington state in 2017 is estimated based on the average of first three quarters business revenue reported by Washington State Department of Revenue.

These impacts can be translated into economic multipliers. For example, each dollar of direct revenue in aerospace supports \$1.34 in total economic activity across the state economy. Likewise, every job in aerospace is associated with a total of 2.7 jobs across the state (**Exhibit 13**).

Exhibit 13. Economic Multipliers, 2017

Total jobs per direct job	2.69
Total labor income per \$1 direct income	\$1.72
Total business revenues per \$1 direct revenues	\$1.34
Total business revenues per direct job	\$1.07

Source: Office of Financial Management, 2018; Community Attributes Inc., 2018.

The Boeing Company constitutes the vast majority of these statewide impacts. In 2017, The Boeing Company supported, through multiplier effects, a total of 189,200 jobs and \$75.0 billion in business revenues statewide, factoring in direct, indirect, and induced impacts (**Exhibit 14**).

Exhibit 14. Economic Impacts of Boeing in Washington, 2017

	Direct	Indirect	Induced	Total
Jobs	68,860	24,190	96,140	189,190
Labor Income (mils 2017 \$)	\$9,577	\$1,785	\$5,093	\$16,456
Business Revenue (mils 2017 \$)	\$54,764	\$5,214	\$15,029	\$75,008

Source: Office of Financial Management, 2018; The Boeing Company, 2017; Community Attributes Inc., 2018.

Note: totals may not exactly sum due to rounding.

As a major employer and operator in the state, the aerospace industry and Boeing make sizable direct and secondary impacts to the state in the form of taxes. In 2017, the aerospace sector made direct tax payments—including B&O, sales & use, and other tax categories—of \$30.1 million. The total fiscal impact of the aerospace sector, including taxes paid by businesses associated with aerospace through indirect and induced impacts, summed to an estimated \$420.1 million in 2017 (**Exhibit 15**).

Exhibit 15. Estimated Direct and Total Fiscal Impacts of Aerospace, Washington State, 2017

	Direct	Secondary	Total
State Fiscal Impacts	\$30.1	\$390.0	\$420.1

Source: Office of Financial Management, 2018; Washington State Department of Revenue, 2018; Community Attributes Inc., 2018.

AEROSPACE ACROSS THE STATE

Snohomish and King Counties were home to the highest levels of aerospace manufacturing employment in 2017, with an estimated 39,820 and 38,990 jobs, respectively (**Exhibit 16**). Both counties are home to major Boeing manufacturing sites and clusters of related employers. In Pierce County, the next-largest county by aerospace employment, there were 2,500 aerospace jobs in 2017, including at Boeing’s Fabrication Division in Puyallup.

Exhibit 16. Aerospace Jobs, Revenue, and Wages by County, Washington, 2017

	Jobs	Revenues (Millions \$2017)	Wages (Millions \$2017)
Snohomish County	39,820	\$31,659.1	\$4,355.8
King County	38,990	\$30,997.2	\$4,264.7
Pierce County	2,500	\$1,991.0	\$273.9
Spokane County	750	\$598.3	\$82.3
Yakima County	460	\$361.8	\$49.8
Grant County	70	\$56.8	\$7.8
Kitsap County	40	\$35.5	\$4.9
Elsewhere in Washington	1,370	\$1,086.5	\$149.5
Total Washington	84,000	\$66,786.3	\$9,188.7

Sources: Washington State Department of Revenue, 2018; Washington State Employment Security Department, 2018; U.S. Bureau of Labor Statistics, 2018; Community Attributes Inc., 2018.

Note: totals may not exactly sum due to rounding.

The aerospace sector in Washington is surrounded by an ecosystem of supporting industries. Electronic and mechanical component manufacturers, machine shops, composites manufacturers, training organizations, airlines, and air travel-related companies are all important components of Washington’s aerospace industry cluster.⁵ In 2017, of the 44,630 related industry jobs across the state, the majority were primarily concentrated in King County, with more than half of the state’s aerospace-related jobs. (**Exhibit 17**)

⁵ For a complete list of aerospace-related industries, please see the Appendix A.

**Exhibit 17. Aerospace-Related Jobs, Revenues, and Wages by County,
Washington, 2017**

	Jobs	Revenues (Millions \$2017)	Wages (Millions \$2017)
King County	26,570	\$6,923.7	\$2,020.7
Snohomish County	5,920	\$1,542.7	\$450.2
Spokane County	2,680	\$697.3	\$203.5
Pierce County	1,290	\$336.6	\$98.2
Yakima County	190	\$48.5	\$14.1
Grant County	110	\$28.7	\$8.4
Kitsap County	80	\$20.8	\$6.1
Elsewhere in Washington	7,790	\$2,030.7	\$592.7
Total, Washington	44,630	\$11,628.9	\$3,393.9

Sources: Washington State Department of Revenue, 2018; Washington State Employment Security Department, 2018; Bureau of Labor Statistics, 2018; Community Attributes Inc., 2018.

Note: totals may not exactly sum due to rounding.

The distribution of aerospace and related establishments, in sum, across the state is presented in **Exhibit 18**, while estimated jobs for aerospace and related industries is presented in **Exhibit 19**. Both exhibits illustrate the high concentration of aerospace activities within the Puget Sound region. However, there are also notable concentrations of establishments and jobs elsewhere across the state, such as in Spokane and Whatcom counties.

Exhibit 18. Map of Aerospace and Related Establishments by County, 2017

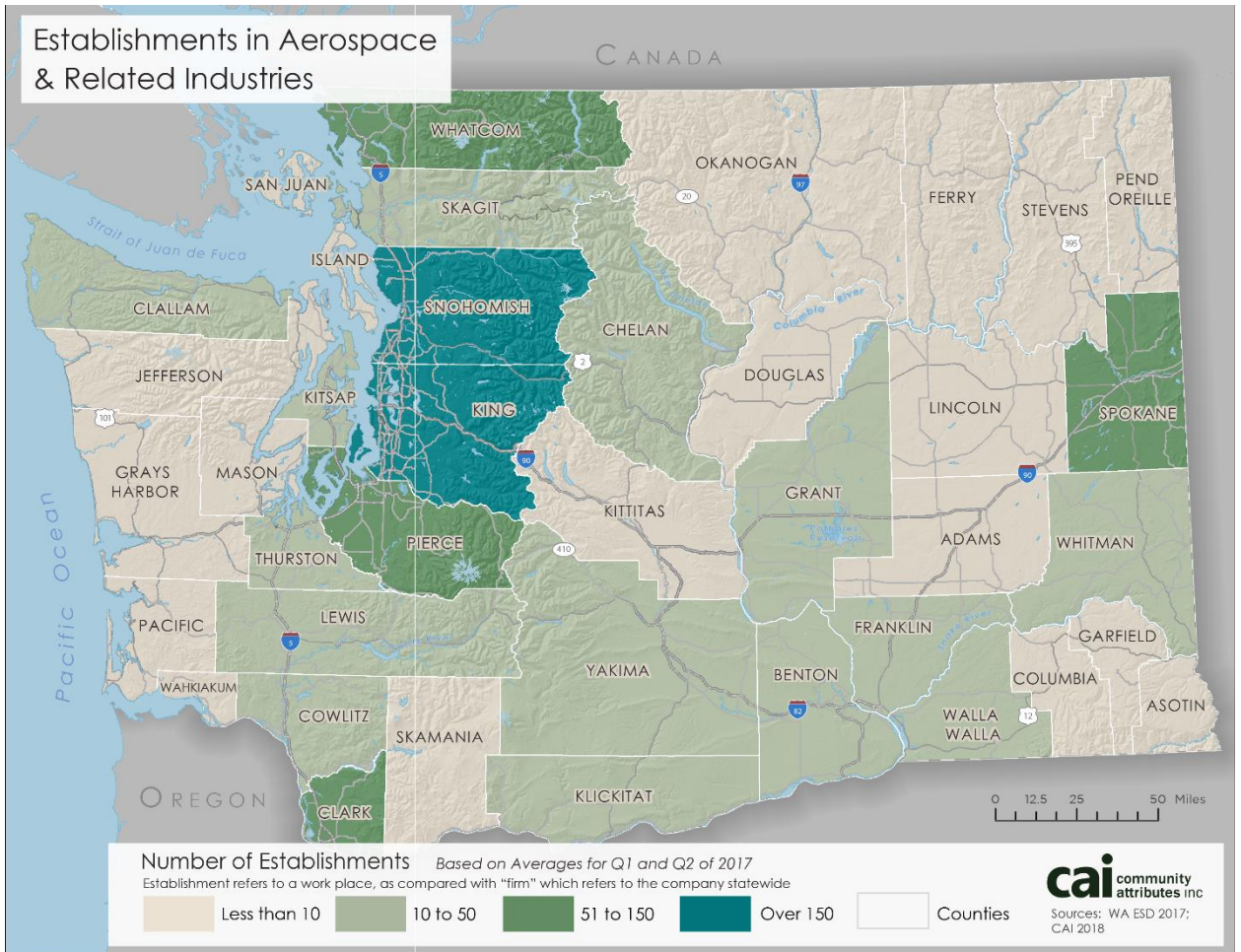
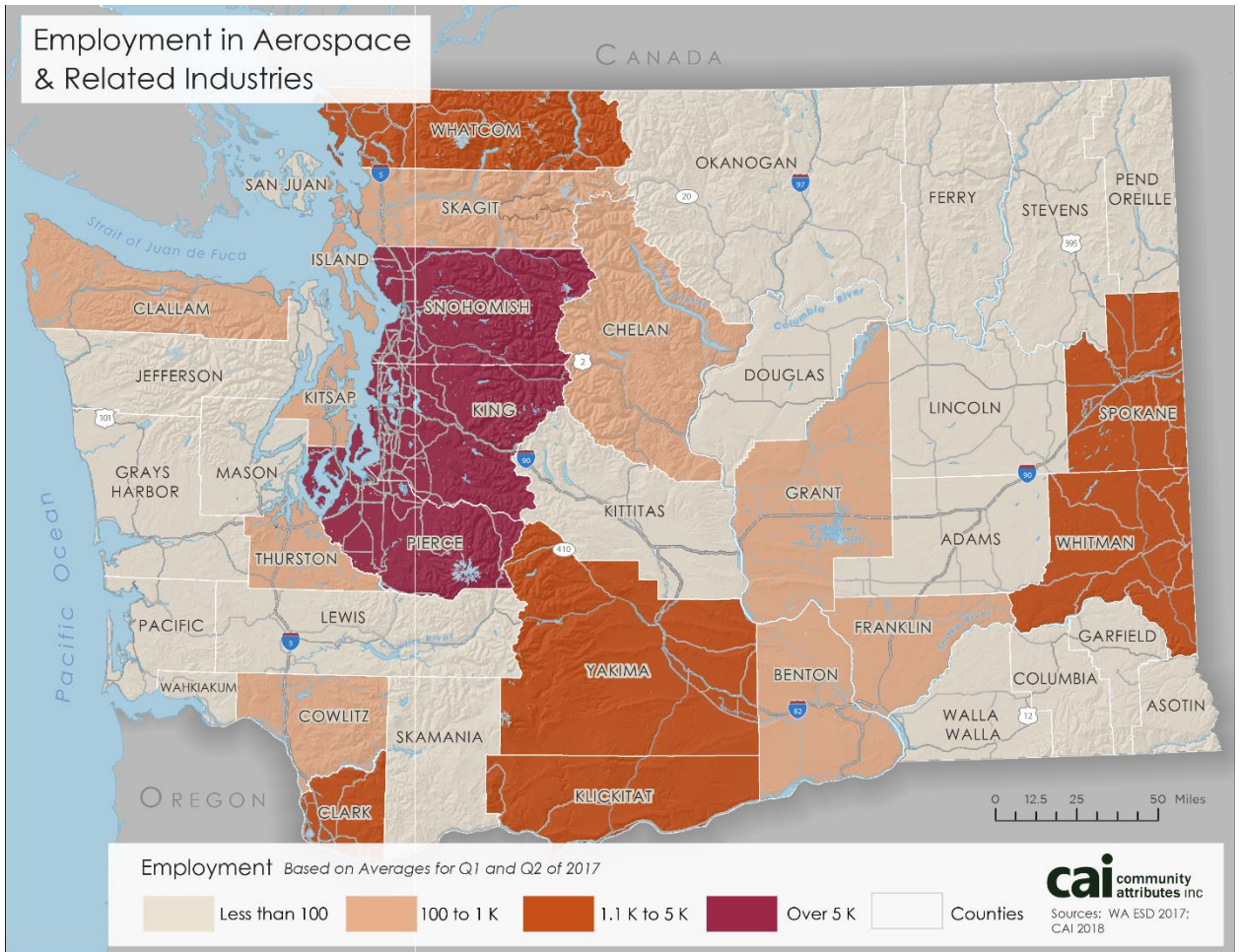


Exhibit 19. County Map of Aerospace Employment, 2017



AEROSPACE IMPACTS BY COUNTY

King County

King County aerospace firms encompass an extensive supply chain of aerospace and related businesses. Boeing, Washington's largest aerospace manufacturer, supports a thriving cluster in King County. Boeing facilities in King County include the final assembly lines for the 737 and P-8 aircraft at its Renton plant, final delivery preparations and test flights at Boeing Field in Seattle, and a parts and components fabrication facility in Auburn.

King County is also a major hub to numerous aerospace suppliers. Examples include:

- **Orion Industries** provides precision metal fabrication, hydraulic assembly, finishing, and more for the aerospace industry and also has a social mission of helping individuals with barriers to achieve employment. The company has been named a Boeing Supplier of the Year three times, and consistently receives Boeing Performance Excellence Awards. In 2017, they merged with Diversified Industries, a move that increased their social mission and aerospace work, and increased their geographic footprint to include Mukilteo in Snohomish County.
- **Exotic Metals Forming Company LLC** is an aerospace-related business in King County. The company manufactures metal sheets and specializes in aerospace applications. Exotic Metals Forming Company is a supplier for Boeing, Airbus, Pratt & Whitney, UTC and more, and has been awarded supplier excellence awards from Boeing and Pratt & Whitney. The company was selected to supply parts to Boeing for the 737 MAX. In 2015 they expanded, opening a facility in Airway Heights.
- **Pacific Propeller** is a parts manufacturer located in Kent. The firm specializes in maintenance and repair of propeller technology, used in both helicopters and airplanes. Their services are used by air transportation providers and militaries across the globe.
- **Aero-Plastics**, based in Renton, is a parts manufacturer specialized in precision metallic and plastic components and assemblies. Aero-Plastics markets to aerospace, medical, biotech, and other commercial industries and provides CNC machining, CNC turning, and injection molding and integration. Aero-Plastics has been a recipient of multiple Boeing Performance Awards, as well as Supplier of the Year.
- **Greenpoint Technologies** is a subsidiary of Zodiac Aerospace located in Kirkland. Greenpoint is a Boeing Business Jet-recognized completion center providing interior aircraft products, VIP cabinetry fabrication facility, precision manufacturing, and large aircraft hangar facilities.

- **Machinists, Inc.** is a precision machining shop based in Seattle. The company specializes in machining, welding, and engineering of components and systems targeting aerospace, space, energy, marine, research laboratories, and transportation industries.
- **Zunum Aerospace**, based in Kirkland, is an aircraft manufacturer startup. Founded in 2013 and backed by Boeing HorizonX and JetBlue Technology Ventures, Zunum focuses on 10- to 50-seat hybrid-electric regional aircraft. Zunum launched its first aircraft design in 2017 with seating for 12 passengers and a delivery window starting in 2022. Zunum also plans to fly a 19-seat prototype in 2019 or 2020, a design optimized for a 1,300 km range and viable on a battery energy density of 300 watt-hours per kilogram.
- **Systima Technologies, Inc.**, is an aerospace manufacturer located in Kirkland. Systima specializes in energy systems and components, and complex integrated systems targeting the defense, space, and commercial markets. Systima has a state-of-the-art facility for engineering and analysis, prototype development, testing, qualification and production with over 110,000 square feet and an environmental testing lab for space testing services with over 5,000 square feet.

King County is also a hub for space travel with the headquarters of **Blue Origin**. This company, founded by Amazon CEO Jeff Bezos, is focused on developing technologies for space travel, reducing the costs of space travel, and making private space travel possible.

Economic Impacts

There were an estimated 38,990 aerospace jobs in King County in 2017, a large percentage of which were with The Boeing Company. Added to this total, there were an estimated 13,020 indirect jobs across the local supply chain and 54,440 induced jobs in other parts of the economy (**Exhibit 20**).

Exhibit 20. Economic Impacts of King County Aerospace, 2017

	Direct	Indirect	Induced	Total
Jobs	38,990	13,020	54,440	106,450
Labor Income (mils 2017 \$)	\$5,420.9	\$969.8	\$2,885.3	\$9,276.0
Business Revenue (mils 2017 \$)	\$30,997.2	\$2,776.0	\$6,800.7	\$40,573.9

Source: Office of Financial Management, 2018; Washington State Employment Security Department, 2018; Community Attributes Inc., 2018.

Note: totals may not exactly sum due to rounding.

Snohomish County

Snohomish County is home to an estimated 39,820 aerospace jobs and more than 5,900 jobs in aerospace-related industries. The Boeing facility in Everett is the final assembly site for the 747, 767, the new 777X (including the composite wings), composite-based 787 Dreamliner, and the Air Force's KC-46 aerial refueling aircraft, built on a 767 platform. Examples of aerospace activities in Snohomish County include the following:

- Everett-based **Korry Electronics** recently won a large contract to supply control panels to the Boeing 777X. Korry Electronics manufactures switches, control systems, cockpit controls, displays, and night-vision filters for aerospace and other mechanical applications.
- **Crane Aerospace and Electronics**, located in Lynnwood, recently completed construction of a new 12,000 square foot facility. The new facility will house enhanced research and development and testing for the company's new fuel flow transmitters. These new devices, expected to be used in the new 777X, are designed to operate at up to 350 degrees Fahrenheit. Fuel flow transmitters are a major component in aircraft fuel systems and are required to operate at extremely high temperatures. Crane Aerospace and Electronics currently employs approximately 1,200 people at its Lynnwood facility.
- **UTC Aerospace Systems**, a global firm specializing in a wide range of aircraft systems. UTC produces actuation systems, electric systems, engine components, interiors, landing gear systems, space systems and much more. With locations across Washington, this company is an important supplier for Boeing, and also works with Airbus, Bombardier, and COMAC. UTC has multiple locations in Everett, specializing in interiors, landing gear and aerostructures. An additional location in Spokane specializes in wheels and brakes.
- **Esterline** is a specialized manufacturing company focused primarily in aerospace and defense. Esterline is a global corporation with more 13,000 employees and with multiple locations in Washington state. The company focuses on avionics & controls, sensors & systems, and advanced materials, Esterline provides technology and services for commercial and military aircraft, including interface systems, cockpit displays and integration systems, high-precision temperature and pressure sensors and more. Besides the aerospace and defense industries, Esterline also serves the industrial, medical, energy and gaming clients with high-end applications.
- **Aviation Technical Services** is the largest independent maintenance, repair & overhaul (MRO) provider in North America, with hangar facilities in Everett and Moses Lake. ATS provides airframe maintenance, component repair, engineering support,

fuselage painting, and business jet services for military, commercial and regional aircraft operators. ATS is one of the largest providers of 737 airframe maintenance; ATS has worked on 450 aircraft and 15,000 components per year. In 2016, ATS was presented with the *Aviation Week 2016 MRO of the Year Award* (Leading Independent Organization).

- **TMD Technical Solutions**, founded by a group of aerospace engineers in 2015, is an engineering services company based in Everett. As a partner of TAMADIC Corporation in Japan, TMD’s services include aerospace and automotive engineering, tooling design and manufacturing, FAA Aircraft Certification Service, testing and analytical predictions, and repair development and evaluation.
- **Umbra Cuscinetti** is a subsidiary of Umbra Cuscinetti S.p.A. As a distributor of aircraft components and equipment, Umbra Cuscinetti focuses on the design and manufacture of aerospace and industrial ball screws, bearings, and other precision-movement products. UMBRA supports 18 global aircraft manufacturers, including Airbus, Boeing, Bombardier, Cessna, Dassault, and Embraer. The company also provides services for over 60 jet aircraft programs and UAV and guided weapons programs.

Economic Impacts

Snohomish County has the state’s largest concentration of aerospace jobs, as well as a significant concentration of aerospace-related industries. As a result, a large portion of the inter-industry purchases made by Snohomish aerospace companies is made within the county, a significant driver of secondary impacts. In 2017, Snohomish County aerospace supported a total of 103,720 jobs, including 63,900 through indirect and induced impacts (**Exhibit 21**).

Exhibit 21. Economic Impacts of Snohomish County Aerospace, 2017

	Direct	Indirect	Induced	Total
Jobs	39,820	9,930	53,970	103,720
Labor Income (mils 2017 \$)	\$5,536.7	\$730.4	\$2,869.3	\$9,136.4
Business Revenue (mils 2017 \$)	\$31,659.1	\$2,260.7	\$8,475.1	\$42,394.9

Source: Office of Financial Management, 2018; Washington State Employment Security Department, 2018; Community Attributes Inc., 2018.

Note: totals may not exactly sum due to rounding.

Pierce County

Boeing's Frederickson plant in Pierce County has two specialized roles: machined metal wing components and composites manufacturing. In addition to this plant, The Boeing Company counts 136 production suppliers and other vendors in Pierce County, including spinoff businesses that continue to work with the company.⁶

Pierce County has developed over the years into a center of composites expertise, with a cluster of composites manufacturers. Examples of Pierce County aerospace firms include:

- **Toray Composites**, a subsidiary of Tokyo-based Toray Industries, is located in Tacoma. Its products include carbon fiber and glass fiber fabrics and have been used in the production of the new Boeing 777X and the Boeing 787 Dreamliner as well as products for sports, recreational, and industrial manufacturers. The company's 400 employees operate its manufacturing facility 24/7.
- **General Plastics** is another composites company. The company occupies a 135,000-square foot manufacturing facility in Tacoma. General Plastics' expertise lies in the fields of plastics, composites and advanced materials, providing build-to-print, interior cabin parts, and aircraft light decks. General Plastics also provides essential testing services through flammability and physical property test and has an FAA certified burn test facility.
- **Baker Manufacturing** in Puyallup and **Farwest Aircraft Inc.** in Edgewood both provide essential support services to the aerospace industry. Baker Manufacturing specializes in tooling services for composite vacuum fixtures and trims fixtures, while Farwest Aircraft Inc. specializes in manufacturing maintenance tools and electrical testing equipment for OEMs like Boeing and Mitsubishi Aircraft.
- **Tool Gauge**, based in Tacoma, is an aerospace supplier specializing in aerospace OEMs and tier-one aircraft integrators. Tool Gauge provides metal and plastic parts manufacturing and assemblies and is one of a select number of Boeing-certified class I and II plastics shops. With the growth of components manufacturing in the aerospace industry, Tool Gauge is planning to double its factory floor by late 2019.
- **AIM Aerospace** provides composite product design, testing, and manufacturing services. AIM primarily works with Boeing and the jet maker's major suppliers on the 737, 777, and 787 programs. AIM employs 1,000 workers and has three locations in Washington

⁶ C. R. Roberts, "Norm Dicks' Powerful Finesse Brought Boeing back to Pierce County". The News Tribune, July 9, 2016, <http://www.thenewstribune.com/news/business/article88670067.html#1>.

state—Renton, Auburn, and Sumner—with two other locations outside Washington.

Beyond the composites and manufacturing-related industries, Pierce County is also home to firms specializing in aerospace software development. **Topia Technology** in Tacoma provides software development and data security for aviation systems. Their technology has been used by the Army, the FAA, the Air Force, and the TSA.

Economic Impacts

Pierce County had the third-largest concentration of aerospace jobs after King and Snohomish Counties, totaling 2,500 direct jobs in 2017. Pierce County’s aerospace industry had secondary economic impacts totaling 3,880 jobs, \$623.5 million in labor income, and \$211.6 million in revenue. Unlike King County and Snohomish County, Pierce County has a lower concentration of aerospace-related industries. For this reason, aerospace employers in Pierce County make a larger share of their inter-industry purchases from elsewhere in the state, which results in a lower indirect impact multiplier. (**Exhibit 22**)

Exhibit 22. Economic Impacts of Pierce County, Aerospace, 2017

	Direct	Indirect	Induced	Total
Jobs	2,500	590	3,290	6,380
Labor Income (mils 2017 \$)	\$348.2	\$36.8	\$174.8	\$559.8
Business Revenue (mils 2017 \$)	\$1,991.0	\$108.1	\$515.4	\$2,614.6

Source: Office of Financial Management, 2018; Washington State Employment Security Department, 2018; Community Attributes Inc., 2018.

Note: totals may not exactly sum due to rounding.

Spokane County

Spokane County has a diverse aerospace and supporting services eco-system. The companies range in size and scope, with some companies exporting across the globe and others focusing on the local market. **Belair Composites** is an example of a small aerospace-related company, employing 13 people, and is a producer and manufacturer of custom aftermarket hose products. The company’s products are used for defrosters and air vents in the aerospace market.⁷ Examples of Spokane County aerospace firms include:

- **Triumph Composite Systems** is on the other spectrum. A large advanced manufacturer employing 500 people in Spokane, it is part of the global Triumph Group. This site is Boeing’s sole supplier of environmental control system ducts and composite flight deck

⁷ Air Spokane, 2016

components for all of its commercial airplanes. The site also manufactures composite floor panels for the 737, 767, and 777.⁸

- Another global company with a location in Spokane is **Honeywell**, which employs 250 people in the County. In Spokane, Honeywell does metal manufacturing for parts used in semiconductor manufacturing, such as bonding wire, thermal interface materials, and plating anodes.
- **Altek** employs 170 people in Liberty Lake and manufactures custom components, sub-assemblies, and complete assemblies. Their components are designed for the aerospace and medical industries, among other industries.⁹
- **Accra-Fab** is another supporting aerospace industry company located in Liberty Lake, employing more than 200. Accra-Fab does custom metal fabrication and manufacturing, specializing in CNC turret punching, welding, shearing, forming, spot welding, laser cutting, stamping and finishing.¹⁰
- Spokane County is also home to one of two **Kaiser Aluminum Washington** locations. These locations provide supporting and related manufacturing services to the aerospace sector. The facility located in Trentwood is the largest flat-rolled aluminum mill in the western United States.
- **AMI Metals** is a global materials supplier. The company provides aluminum plate, sheet, bar, and extruded profiles primarily for the aerospace industry, and specifically for Boeing Integrated Defense Systems programs such as SBI-net, C-17, F/A-18E/F, F-22, F-15, V-22, CH-47, and AH-64.
- **Proto Technologies** is a machining company based in Liberty Lake. The company provides rapid prototyping and low volume production services and specializes in quick-turn 3D printing, additive manufacturing, complex silicone, urethane and metal molding.

Economic Impacts

In Spokane County in 2017, aerospace direct employment represented 5.0% of the county's total employment, or roughly 750 jobs. The industry supported an additional 190 jobs through indirect impacts and 1,000 jobs through induced impacts across the county (**Exhibit 23**).

⁸ Air Spokane, 2016

⁹ Air Spokane, 2016; Seattle Times, 2016.

¹⁰ Air Spokane, 2016

Exhibit 23. Economic Impacts of Spokane County Aerospace, 2017

	Direct	Indirect	Induced	Total
Jobs	750	190	1,000	1,940
Labor Income (mils 2017 \$)	\$104.6	\$12.5	\$53.1	\$170.2
Business Revenue (mils 2017 \$)	\$598.3	\$32.7	\$154.9	\$785.9

Source: Office of Financial Management, 2018; Washington State Employment Security Department, 2018; Community Attributes Inc., 2018.

Note: totals may not exactly sum due to rounding.

Yakima County

Washington's aerospace manufacturing industry includes commercial and large aircraft manufacturers as well as a manufacturer of small aircraft. Yakima County is home to **Cubcrafters, Inc.**, which manufactures the Cub Aircraft at its 40,000 square foot facility near McAllister Field Airport.¹¹ Examples of Yakima County aerospace firms include:

- **Triumph Actuation Systems** manufactures hydraulic actuation systems and components in its Yakima manufacturing site, such as locking actuators and hydraulic fuses. Triumph's components and systems are used in aircraft for commercial and defense applications and the company engages in activities across the supply chain. The company has more than 70 locations across the globe that manufacture everything from complex aircraft structures to individual parts.
- In addition to the global companies with locations in Yakima, the county is also home to smaller aerospace suppliers. **ASAP Metal Fabricators** and **Farwest Fabricators Inc.** both focus on precision metal fabrication, including laser cutting, CNC forming and welding. **Cascade Quality Molding** is another local company, specializing in mold-making and tooling, as well as plastic injection molding.
- Yakima is also home to the **McCormick Air Center**. This facility provides support services for air transportation as a fixed-based operator. McCormick Air Center is also an aviation fuel dealer, providing maintenance services and flight instruction.
- **Pexco Aerospace** is an aircraft interiors supplier based in Union Gap. The company has facilities specializing in the extrusion of polymer parts for aircraft interiors, with 145,000 square feet on approximately 22 acres in Yakima.

¹¹ Air Spokane, 2016

Economic Impacts

A low share of Yakima’s total employment is in the aerospace industry: in 2017, 0.4% of the county’s 108,850 jobs were in aerospace.¹²

Yakima’s aerospace industry is nevertheless an important contributor to the county’s economy. In 2017, the industry supported 650 jobs through secondary impacts, including 70 jobs through indirect impacts—the impacts of inter-industry purchases—and 580 jobs through induced impacts—the impacts of wage expenditures made by employees supported by aerospace. Yakima is similar to other counties with relatively low concentrations of aerospace-related industries: because there are less related industries from which to make local purchases, Yakima aerospace has lower indirect impact multipliers than the state aerospace industry does as a whole. (**Exhibit 24**)

**Exhibit 24. Economic Impacts of Yakima County
Aerospace, 2017**

	Direct	Indirect	Induced	Total
Jobs	460	70	580	1,100
Labor Income (mils 2017 \$)	\$63.3	\$4.0	\$30.8	\$98.0
Business Revenue (mils 2017 \$)	\$361.8	\$11.8	\$90.8	\$464.4

Source: Office of Financial Management, 2018; Washington State Employment Security Department, 2018; Community Attributes Inc., 2018.

Note: totals may not exactly sum due to rounding.

Grant County

Moses Lake is a hub for flight testing and maintenance, repair and overhaul. **The Grant County International Airport**, formerly Larson Air Force Base, is used as a flight test location for Boeing. **AeroTEC** has locations in both Moses Lake and Seattle. The Moses Lake location is a flight test center, where they provide turn-key flight testing to both OEMs and modifiers. In 2017, AeroTEC began support for flight testing of the first of four Mitsubishi Regional Jet (MRJ) airplanes in Moses Lake. Other services provided by AeroTEC include data analysis, FAA certification services, performance analysis, light manufacturing for aerospace production and more. The company provides these services to both Boeing and Airbus commercial airplanes, as well as regional and small aircraft.

Aviation Technical Services (ATS) also has a location in Moses Lake in addition to its location in Everett. ATS provides both maintenance, repair,

¹² Yakima’s total employment in 2017 is estimated based on the first two quarters of covered employment, as reported in the Quarterly Census of Employment and Wages (QCEW) data series.

and overhaul (MRO) services as well as aircraft-on-ground services. ATS in Everett is based at Paine Field, and their Moses Lake location is based at Grant County International Airport. This firm provides comprehensive maintenance services to OEMs, businesses jets and defense and government aircraft.

Economic Impacts

In 2017, estimated aerospace direct employment in Grant County represented 0.24% of the county’s total employment of 29,450 jobs. With an additional 80 jobs supported through induced impacts, a total of 150 jobs were supported by the aerospace industry across the county (**Exhibit 25**).

**Exhibit 25. Economic Impacts of Grant County
Aerospace, 2017**

	Direct	Indirect	Induced	Total
Jobs	70	0	80	150
Labor Income (mils 2017 \$)	\$9.9	\$0.0	\$4.5	\$14.4
Business Revenue (mils 2017 \$)	\$56.8	\$0.0	\$12.8	\$69.6

Source: Office of Financial Management, 2018; Washington State Employment Security Department, 2018; Community Attributes Inc., 2018.

Kitsap County

Kitsap County-based **Dugan Kinetics** is an example of an aerospace-related company. The company manufactures thrust reversers for the MD-80 Series aircraft. Its products improve fuel efficiency and increase engine life by using less fuel than other thrust reversers.

Another aerospace-related company located in Kitsap County is **Kitsap Composites** in Port Orchard. This company relocated from California to Kitsap County and specializes in designing, manufacturing, and testing composite hardware. Their products include radomes, reflectors, and polarizers used by both the aerospace and defense industries. Radomes are domes that protect radar equipment on aircraft.

Raytheon, an engineering and technology company headquartered in Massachusetts, also has a location in Keyport in Kitsap County. The company provides services in state-of-the-art electronics, mission systems integration, capabilities in C5I (command, control, communications, computing, cyber and intelligence), and more.

Economic Impacts

There were an estimated 40 jobs supported directly by the aerospace industry in Kitsap County in 2017, based on data reported by the Washington State

Employment Security Department. An additional 50 jobs were supported through induced impacts. The industry supported, through direct and multiplier effects, \$43.7 million in business revenue across the county.

**Exhibit 26. Economic Impacts of Kitsap County
Aerospace, 2017**

	Direct	Indirect	Induced	Total
Jobs	40	0	50	100
Labor Income (mils 2017 \$)	\$6.2	\$0.0	\$2.8	\$9.0
Business Revenue (mils 2017 \$)	\$35.5	\$0.0	\$8.2	\$43.7

*Source: Office of Financial Management, 2018; Washington State Employment Security Department, 2018; Community Attributes Inc., 2018.
Note: jobs totals do not exactly sum due to rounding.*

Other Washington Counties

Although the majority of aerospace and related jobs are located in seven Washington counties, there are important activities in other Washington counties. Insitu is a Boeing subsidiary that produces unmanned aerial vehicles (UAVs) in Klickitat County. Insitu’s UAVs have been used by governments around the world for drug interdiction, surveillance, reconnaissance missions in the defense sector, environmental monitoring, search and rescue, and disaster relief applications in the commercial and civil sectors.

Silicon Forest Electronics manufactures electrical components and systems for aerospace, medical, defense, industrial, mining, oil, gas, and unmanned systems applications. The company has a location in Vancouver, Washington, and combines automated assembly and holds aerospace manufacturing certifications. Silicon Forest Electronics also offers testing and inspection services, including functional tests, boundary scans, 3D solder paste inspection, automated optical inspection, and x-ray inspection.

East Wenatchee in Douglas County is home to Paine Electronics, LLC. This company provides supporting manufacturing services to the aerospace industry, producing custom high precision pressure instrumentation. Their work includes hydraulic control systems, fuel pressure monitoring, flight testing equipment, landing gear and brake monitoring systems, as well as satellite positioning systems. Paine Electronics also specializes in pressure and temperature sensors for extreme environments.¹³

¹³ Air Spokane, 2016.

Janicki Industries a Sedro-Woolley based manufacturing is part of the team with Northrop Grumman to build the new B-21 bomber for the Air Force. According to the Skagit Valley Herald, Janicki Industries will build air frame and/or mission systems components for the new aircraft. Janicki Industries specializes in advanced composite materials and metals, and their research and development lab has made advances in composite materials and methods.

CONCLUSION

Washington's aerospace industry is an important contributor to the state economy and an essential link in the global aerospace supply chain. In 2017, there were 84,000 aerospace manufacturing jobs in Washington, making Washington one the world's largest aerospace industry clusters. In 2017, 17.6% of total aerospace manufacturing employment in the U.S. was located in Washington.

The 747, 767, 777 (and soon to be 777X), and 787 are all produced at Boeing Commercial Airplane's Everett site, the 737 is produced at the company's Renton location, and supporting activities are undertaken at the company's other major manufacturing sites in Auburn, Seattle-Tukwila, and Puyallup. In 2017, Boeing Commercial Airplanes employed 68,900 workers across the Puget Sound region.

Washington's aerospace cluster is more than just aircraft manufacturers. Aerospace-related industries provide essential components and systems, such as electronic display systems, carbon fiber components, and actuation systems. There are 44,630 jobs in aerospace-related industries across the state. More than half of these jobs can be found in King County (26,570 workers in aerospace-related industries). The next-largest county employment in aerospace-related industries is Snohomish County, with 5,920 workers.

In 2017, the industry supported 84,000 direct jobs and an additional 142,130 jobs through indirect and induced impacts. The industry also supported \$19.7 billion in labor income through direct and secondary impacts and \$89.6 billion in business revenue.

Washington's aerospace sector has impacts across the state, with facilities, employees, or consumption in every county in the state. These impacts are more pronounced in counties with high aerospace industry employment, such as King and Snohomish counties. This is primarily due to the impact of wage spending from aerospace industry employees. Aerospace workers in these counties spend a large share of their wages within the county they are employed, spurring additional economic benefits.

APPENDIX A: NAICS CODES USED IN THIS REPORT

Category	NAICS	Description
Aerospace	927000	Space Research and Technology
	3364	Aircraft Manufacturing
Related	325211	Plastics material and resin manufacturing
	332710	Machine Shops
	332813	Electroplating, anodizing, and coloring
	332999	Miscellaneous fabricated metal product manufacturing
	333512	Machine Tool Manufacturing
	333514	Special Die and Tool Manufacturing
	333517	Machine tool manufacturing
	333611	Turbine and turbine generator set units
	333612	Speed changer, drive, and gear manufacturing
	333613	Mechanical power transmission equipment
	333618	Other engine equipment manufacturing
	334418	Printed Circuit Assembly (Electronic Assembly) Manufacturing
	334417	Electronic Connector Manufacturing
	334419	Other Electronic Component Manufacturing
	334511	Search, Detection, Navigation, Guidance, and Nautical System Manuf.
	334513	Instruments and Related Products Manufacturing
	334515	Instrument Manufacturing for Measuring and Testing Electricity and Electrical Signals
	334519	Other Measuring and Controlling Device Manufacturing
	335311	Power, Distribution, and Specialty Transformer Manufacturing
	335314	Relay and Industrial Control Manufacturing
	335921	Fiber Optic Cable Manufacturing
	335991	Carbon and Graphite Product Manufacturing
	335999	All Other Miscellaneous Electrical Equipment and Component Manufacturing
	481111	Scheduled passenger air transportation
	481112	Scheduled freight air transportation
	481211	Nonscheduled air passenger chartering
	481212	Nonscheduled air freight chartering
	481219	Other nonscheduled air transportation
	488111	Air traffic control
	488119	Other airport operations
	488190	Other support activities for air transpo
	611512	Flight Training

Sources: Washington State Employment Security Department, 2013; Washington Aerospace Partnership, 2013.