Washington State Aerospace Economic Impacts 2016 Update

October 2016

Prepared for:

WASHINGTON AEROSPACE PARTNERSHIP

Prepared by:

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EXECUTIVE SUMMARY

Aerospace has large and important impacts on the Washington state economy. The purpose of this study is to assess and quantify these impacts, both across the state and by select sub-state geographies. Analytics presented in this report represent updated estimates for 2015, leveraging the most recently published data, including on jobs, wages, revenues, exports, and tax incentive users.

Washington's aerospace cluster is anchored by the Boeing Company, with final assembly facilities for the 737, 747, 767, 777, 787, and the P-8 and KC-46 military aircraft. Boeing activities in turn support an extensive ecosystem of machine shops, composites manufacturers, avionics firms, and many other important segments of the aerospace supply chain. Washington is also home to firms engaged in unmanned aerial vehicles (UAVs) and more recently space technology. Analytics include a discussion of these broader supply chain impacts. **Exhibit E-1** below details important components of the aerospace cluster, including suppliers, original equipment manufacturers (OEMs), and supporting organizations and institutions.

Direct Impacts for Aerospace in Washington

In 2015, the aerospace industry in Washington generated $69.9 billion in business revenues. In inflation-adjusted terms, this was only slightly higher than 2014 ($69.5 billion), though since 2005 revenues have increased as a compound annual growth rate of 7.9% (inflation-adjusted).

The largest share of these was in the form of exports ($51.6 billion). As a basic industry, the aerospace industry sells nearly all its output to airlines and other purchases outside the state, thereby serving as a net importer of income into Washington.

Aerospace activities directly supported 93,800 workers in 2015. Industry employment has remained fairly stable in recent years. From 2012 to 2015, the industry employment declined by 400 jobs, or roughly 0.4% of total industry employment. Together with aerospace-related industries like carbon-fiber manufacturers, flight training, and navigational equipment manufacturers, the industry employed 136,100 workers in 2015.[1]

Boeing and many other aerospace companies pay significantly higher wages on average compared to the state overall; in 2015, aerospace employees earned an average wage of $107,000 (not including associated benefits, e.g., healthcare), compared to the state average wage of $54,000. Aerospace-related companies in the state paid $2.9 billion in wages (not

[1] For a complete list of aerospace-related industries, please see the appendix.

including benefits), representing an average wage of $69,200 (Bureau of Labor Statistics, 2015).

Exhibit E-1. Washington Aerospace Cluster Map

Aerospace Economic Impacts

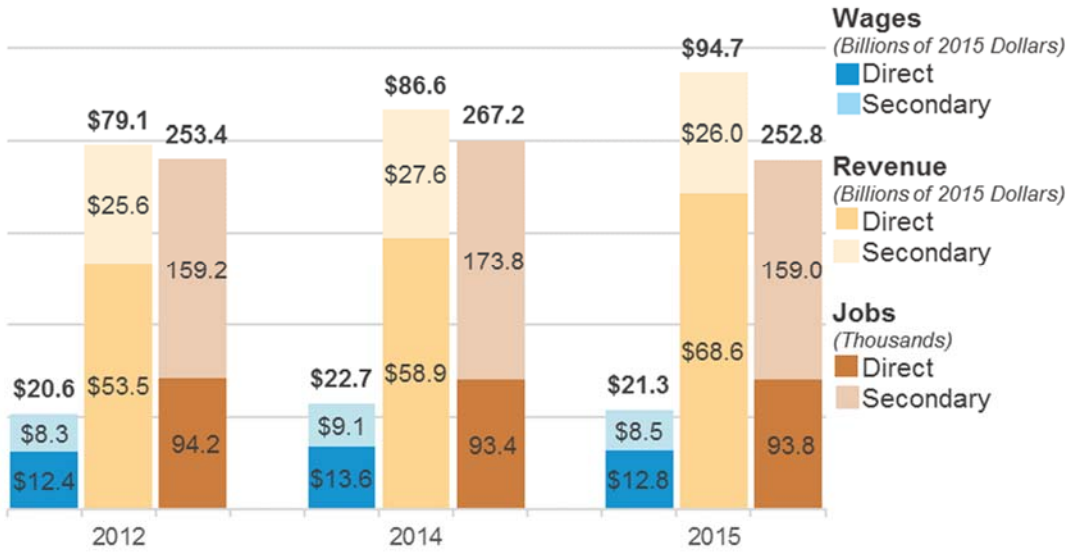
Aerospace firms purchase a share of their production inputs locally, which supports further jobs and wages across the state. At the same time, workers supported through direct aerospace activities and inter-industry purchases spend income on additional goods and services, further supporting economic activities across the state.

In 2015, the industry had a total economic impact to the Washington state economy of 252,800 jobs and $94.7 billion in business revenues. For every direct job in aerospace, an additional 1.7 jobs are supported through indirect and induced effects elsewhere in the state economy. Some of the largest industries impacted through secondary (indirect and induced) impacts include the retail sector, wholesale trade, construction, and waste management services.

A comparison with previous years' impacts is presented in **Exhibit E-2**. It is important to note the decrease in estimated direct wages between 2014 and 2015 ($13.6 billion to $12.8 billion, including benefits, 2015$) can largely be attributed a one-time lump sum $10,000 payment to IAM

workers in 2014 as part of the new collective bargaining agreement between the union and Boeing.[2]

Exhibit E-2. Economic Impacts of Aerospace in Washington—2012, 2014, and 2015



Sources: Washington State Department of Revenue, 2016; Washington State Employment Security Department, 2016; Bureau of Labor Statistics, 2016; Washington Aerospace Partnership, 2013 and 2015; Community Attributes Inc., 2016.
Note: year 2014 impact estimates (produced in 2015) were based on incomplete 2014 annual data; differences with 2015 impacts can in part be explained by estimation of complete year jobs, wages, and revenues; year 2015 estimates are based on complete annual data.

Economic Impacts of Boeing Commercial

The Boeing Company represents the vast majority of aerospace economic activity in Washington state, as measured in jobs, revenues, and wage outlays. In 2015, Boeing Commercial Airlines (BCA), the largest segment of Boeing's activities in Washington, employed an estimated 69,000 workers, including manufacturing facilities in Everett, Renton, Auburn, Frederickson, and Seattle-Tukwila, with estimated wage outlays (including benefits) of $9.4 billion. The company was the primary source for exports, including to overseas airlines in China, Japan, and the Middle East.

Factoring in indirect and induced impacts, BCA supported 192,200 jobs across the state. The majority of these impacts were through worker income expenditures; induced impacts represented 80.2% of all secondary jobs supported by BCA.

[2] http://www.seattletimes.com/business/machinists-say-yes-secure-777x-for-everett/

Fiscal Impacts of Aerospace

In 2015, aerospace firms directly paid $31.3 million in state taxes, primarily in the form of B&O taxes. Business activities supported through secondary impacts—that is, indirect and induced effects—were associated with an additional $331.8 million in estimated taxes, resulting in a total fiscal impact of $363.1 million.

Tax Incentives and Tax Incentive Users

There are several tax incentive programs available for companies involved in the aerospace industry. In 2015, 330 companies (across 346 worksite locations) in Washington participated in these programs including both aerospace companies and firms who participate in the aerospace supply chain.

Overall, companies in Washington that participated in aerospace tax incentive programs employed a combined 92,870 workers in 2015. The largest of these participants was Boeing, which took advantage of tax incentives at several of its manufacturing sites. Together, these sites had approximately 66,800 employees in 2015, the majority of which were engaged in commercial activities. (**Exhibit E-3**)

Exhibit E-3. Aerospace Manufacturer Tax Incentive Users Jobs and Wages in Washington, 2015

	Jobs	Wages (Millions)
Boeing Sites with Incentive Support	66,800	$7,376
Other Incentive Participants	26,100	$2,851
All Incentive Participants	92,900	$10,226

Sources: Washington State Department of Revenue, 2016; Washington State Employment Security Department, 2016; Community Attributes Inc., 2016.

In 2015, these tax incentive users had total economic impacts on Washington of 239,700 jobs and $20.8 billion in wages. (**Exhibit E-4**)

Exhibit E-4. Economic Impacts of Aerospace Manufacturing Tax Incentive Users in Washington, 2015

	Direct	Indirect	Induced	Total
Jobs	92,900	19,100	127,700	239,700
Labor Income (mils 2015 $)	12,997.6	1,340.9	6,426.7	20,765.2

Sources: Washington State Department of Revenue, 2016; Washington State Employment Security Department, 2016; Bureau of Labor Statistics, 2016; Community Attributes Inc., 2016.

Regional Impacts across Washington

Washington's aerospace industry is concentrated in King and Snohomish counties, with a range of support activities and aerospace manufacturers spread across the rest of the state. King County is home to several major Boeing facilities, including 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. In 2015, aerospace activities in King County accounted for 44,640 direct jobs and supported an additional 52,720 jobs in King County through secondary impacts. This number does not include jobs supported in other counties, such as jobs supported by wage expenditures in Snohomish County made by King County Aerospace workers.

Snohomish County is home to Boeing's Everett facility. It 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. The county also hosts a number of suppliers and related companies, such as Korry Electronics and UTC Aerospace Systems. In 2015, there were 43,860 direct aerospace jobs in the county. The industry supported an additional 48,590 jobs through secondary impacts.

Pierce County has a smaller aerospace sector than King and Snohomish counties, but is an important center for suppliers and related industries. Boeing has 136 production suppliers and other vendors in Pierce County.[3] Pierce County has developed over the years into a center of composites expertise, including composites manufacturers Toray Composites and General Plastics. The aerospace sector in Pierce County supported 2,610 direct aerospace jobs in 2015 and an additional 2,820 jobs in related industries through secondary economic impacts.

Spokane County has a diverse aerospace and supporting services sector. The county's aerospace and related industry companies include Belair Composites, Triumph Composite Systems, Honeywell, Altek, and Kaiser Aluminum, among many others. Fairchild Air Force Base is also located in Spokane County. As a result, the county also has an ecosystem of defense contractors that support the base. In terms of economic impacts, the county had 900 direct aerospace sector jobs in 2015, and supported an additional 780 jobs through secondary impacts.

Yakima County is home to Cubcrafters, Inc., a small craft manufacturer. The county also has a Triumph Actuation Systems site and is home to several suppliers and support services. In 2015, Yakima county had 360

[3] 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

direct aerospace jobs. Through secondary economic impacts, an additional 270 jobs were supported in 2015.

Grant County's Moses Lake is a hub for flight testing and aircraft maintenance, repair and overhaul. The Grant County International Airport is used as a flight test location for Boeing. AeroTEC has a flight test center where the company provides flight testing to both OEMs and modifiers. Aviation Technical Services (ATS) also has a location in Moses Lake. The site offers both maintenance, repair and overhaul (MRO) services as well as aircraft-on-ground services. In 2015, the county had approximately 80 direct aerospace jobs and supported an additional 50 jobs through secondary impacts.

Kitsap County has a number of aerospace-related companies, including Dugan Kinetics and Kitsap Composites. Direct aerospace related jobs are relatively low compared to other counties, with 50 estimated jobs in 2015. Through secondary economic impacts, the aerospace industry supported an additional 40 jobs throughout the county.

Contents

INTRODUCTION

Background and Purpose

Aerospace is a major industrial pillar of the Washington state economy and a key hub in the global aerospace supply chain. Commercial aircraft manufactured in Washington are sold to airlines across the globe and defense aircraft manufactured in Washington contribute to U.S. national defense. Both types of aircraft sales are supported by a broad and extensive statewide network of component suppliers, aircraft repair and maintenance operations, and research and development activities.

The Washington Aerospace Partnership has requested this update to the 2013 and 2015 reports developed by Community Attributes Inc. (CAI). Analytics presented in this report leverage the most recently available data and information, both statewide and by select counties. Findings presented in this report provide important insights and information on the importance of the aerospace sector in Washington for economic development practitioners and organizations

This study details the aerospace cluster supply chain, examines how aerospace activities impact the state economy and by region, and identifies the fiscal revenues supported by the industry.

Methodology

Throughout this report three categories of business activities tied to aerospace are used. These groupings are:

- **Aerospace**. Referring to all employers classified as belonging to the North American Classification System (NAICS) code 3364, representing the aerospace industry. Firms belonging to this group are determined to be engaged in aerospace as their primary activity.
- **Aerospace and related industries**. A broader definition, developed by the Washington State Office of Aerospace, Washington State Employment Security Department, Washington State Department of Revenue, and other stakeholders to represent both firms primarily engaged in aerospace and other firms who produce goods and services aligned with aircraft production. In addition to firms belonging to NAICS 3364, this group includes machine shops, plastics manufacturing firms, and other related businesses. A full list of industry codes used can be found in the **Appendix**.
- **Aerospace tax incentive users**. A group of firms, irrespective of industry classification, who took advantage of one or more of the Washington state aerospace tax incentives in 2015.

This analysis primarily relies on employment and wage data provided by the Washington State Employment Security Department (ESD) and U.S. Bureau of Labor Statistics and revenue and tax incentive user data provided by the Washington State Department of Revenue (DOR.

Economic impacts were calculated through use of the Washington State Input-Output (I-O) Model, though with customizations to account for local economic conditions within select counties in Washington. Three types of impacts are discussed in this report: 1) direct impacts, represented the employment and related economic activities tied to aerospace companies; 2) indirect impacts, including jobs, wages, and business revenues supported through supply chain transactions; and 3) additional economic activities supported through disposable income expenditures on goods and services by workers whose employment is supported directly or indirectly by the aerospace sector.[4]

Outline of Report

The remainder of this report is organized in three main sections:

- **Washington Aerospace.** Analysis of aerospace and related industries in Washington, including key metrics and economic impacts.
- **Aerospace Activities by County.** Discussions of the statewide economic and fiscal impacts of the aerospace industry as a whole, Boeing Commercial Aerospace, and Aerospace Tax Incentive Users. Also includes an analysis of the economic impacts of aerospace manufacturing in select counties.
- **Conclusion.** A summary of key findings and conclusions.

This report also includes an appendix that details the methodology used in this report and technical definitions of industries and tax incentive users.

[4] For more information on economic impact modeling, please see the appendix.

WASHINGTON AEROSPACE

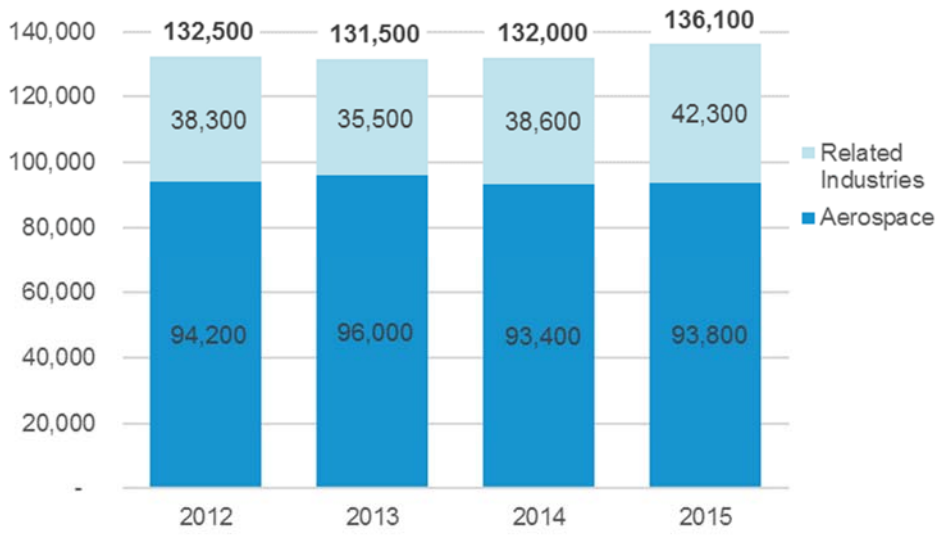
In 2015, 19.2% of total aerospace manufacturing employment in the U.S. was located in Washington. Compared to the nation as a whole, aerospace employment is 8.6 times more concentrated in Washington.[5] The industry is anchored by The Boeing Company, one of the two largest aircraft manufacturers in the world and also a major defense contractor.

Behind Boeing, a deep and extensive tiered supply chain supports various facets of aircraft production, including parts and systems manufacturers, research & development, and materials suppliers. Washington is also an important hub for aircraft maintenance, repair & overhaul (MRO) operations. Aircraft manufactured in Washington are sold across the globe, serving as an important driver of economic growth for the state economy through the net inflow of capital generated from these sales.

Overall, Washington's aerospace industry employed a total of 93,800 workers in 2015. This number has remained fairly consistent from 2012 to 2015, with slight fluctuations. From 2012 to 2015, industry employment declined by approximately 400 jobs, or 0.4% of total industry employment. Employment in aerospace-related industries has increased from 2012 to 2015, growing by a compound annual growth rate of 3.4% and increasing by 4,000 jobs. Taken together, aerospace and related industry employment has increased to **136,100 jobs** in 2015 from 132,500 in 2012. (**Exhibit 1**)

[5] This refers to Washington's aerospace manufacturing location quotient, which is defined as the Washington aerospace manufacturing employment share of Washington employment divided by the U.S. aerospace manufacturing employment share of total U.S. employment.

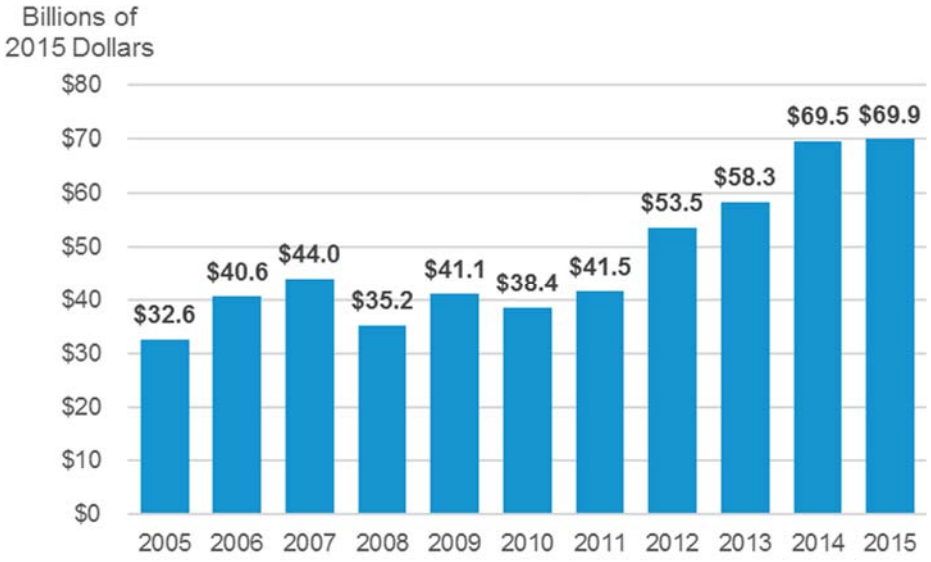
Exhibit 1. Aerospace and Related Industry Jobs, 2012-2015



Source: Washington State Employment Security Department, 2016; Washington Aerospace Partnership, 2013, 2015.

Altogether, Washington's aerospace industry generated $69.9 billion in direct revenue in 2015. Since 2005, the industry's inflation-adjusted revenues have grown at a compound annual growth rate (CAGR) of 7.9% (**Exhibit 2**). Aerospace-related firms generated an additional $10.7 billion in 2015.

Exhibit 2. Aerospace Industry Revenue, Billions of 2015 Dollars, 2005-2015

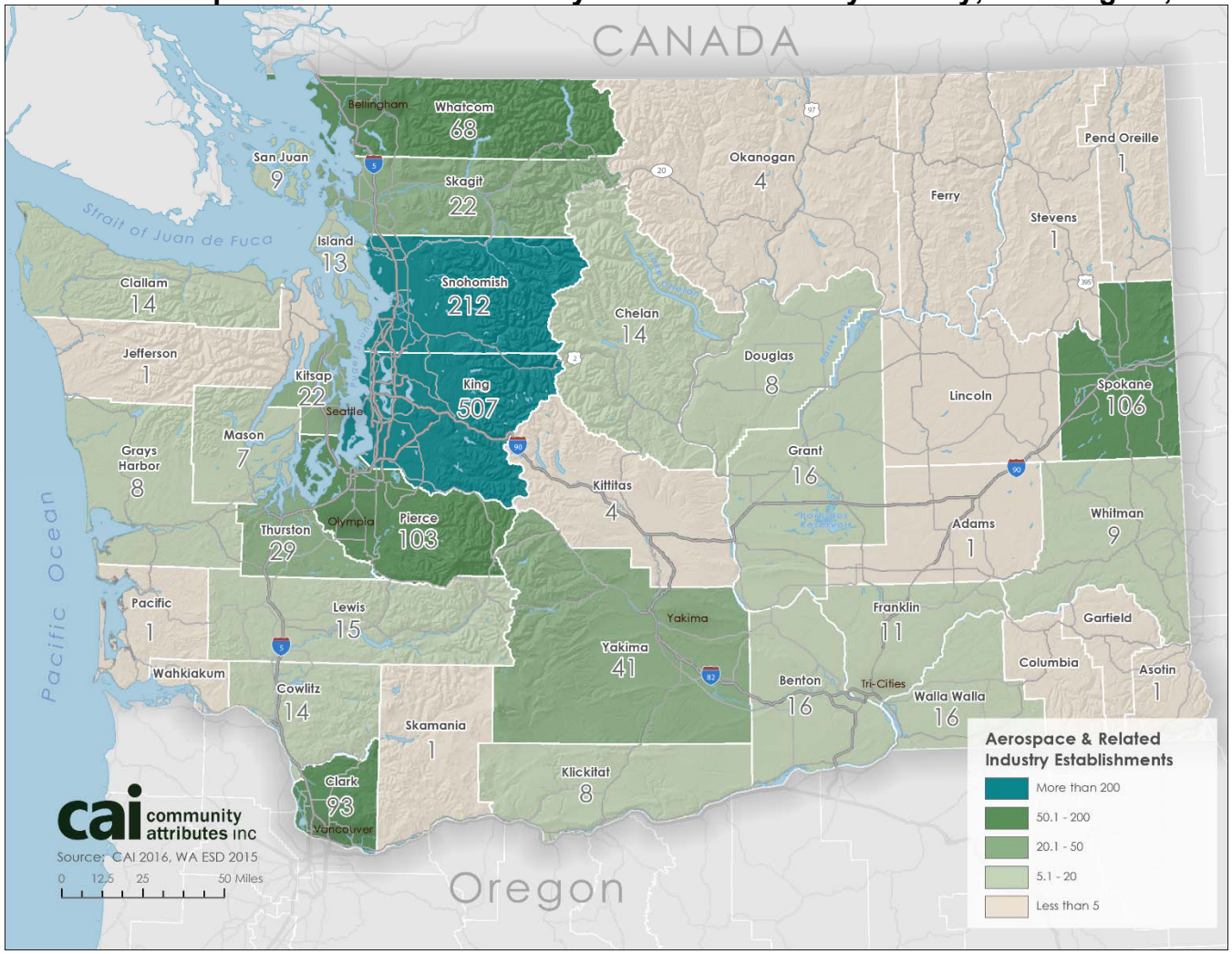


Sources: Washington State Department of Revenue, 2016; Federal Reserve Bank of St. Louis, 2016; Community Attributes Inc., 2016.

Note: the 2015 revenue value in this exhibit is higher than the direct revenue total used for economic impact analysis. This is because the value of Boeing purchases within Washington from aerospace suppliers was removed from industry revenue for economic impact modeling to avoid double-counting; these revenues are captured in indirect revenue impacts, discussed further below.

Washington's aerospace cluster is spread across the state, with major centers of employment located in the Puget Sound region. Together, aerospace companies and aerospace-related companies had more than 1,400 establishments across the state in 2015. King County had the most reported establishments with 507, followed by Snohomish County with 212. Spokane and Pierce counties each had around 100 aerospace and related industry establishments in 2015. (**Exhibit 3**).

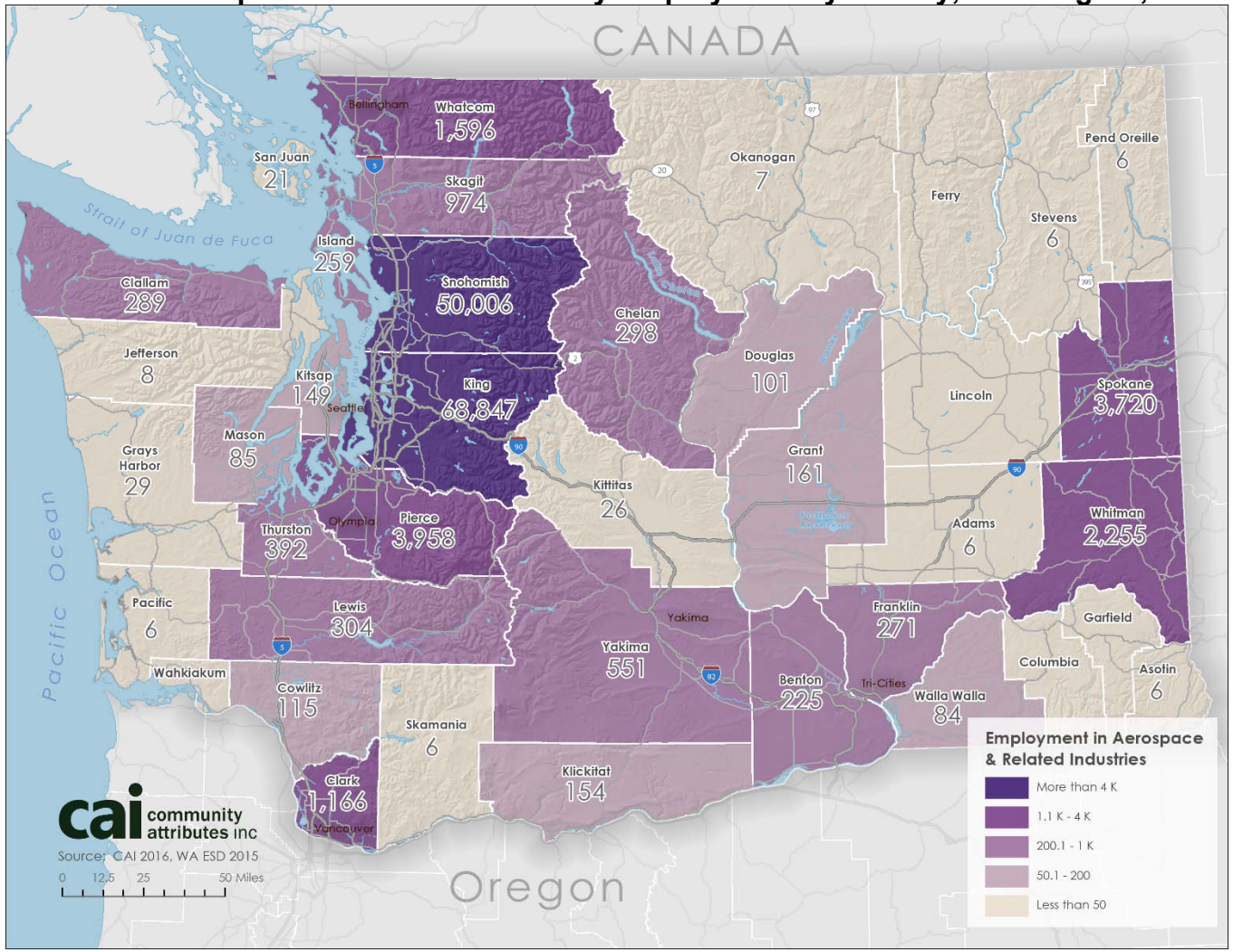
Exhibit 3. Aerospace and Related Industry Establishments by County, Washington, 2015



Sources: Washington State Department of Revenue, 2016; Community Attributes Inc., 2016.

Aerospace and related industry employment follows, to a large degree, the spread of establishments across the state. King County and Snohomish County had the highest employment, at 68,800 and 50,000 respectively, followed by Spokane County and Whitman County at 3,700 and 2,300 respectively. Whitman County has few direct aerospace firms, but a large cluster of companies in related fields, such as metal product manufacturing, machine shops, and air transportation support. (**Exhibit 4**)

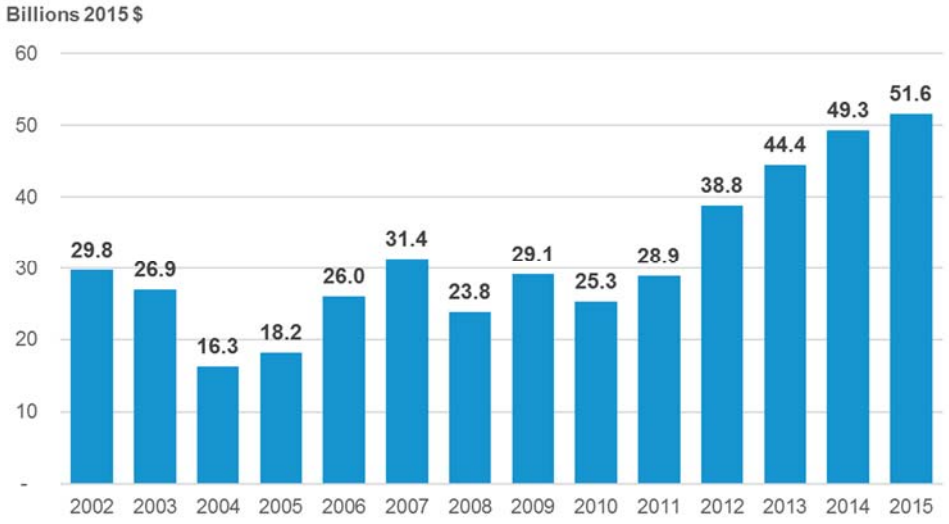
Exhibit 4. Aerospace and Related Industry Employment by County, Washington, 2015



Sources: Washington State Department of Revenue, 2016; Community Attributes Inc., 2016.

Aerospace exports are an important contributor to the state's trade. In 2015, Washington exported $51.6 billion in aerospace products around the globe, increasing consistently for the past five years. It is important to note that not all of the value of these exports are generated in Washington State. Boeing, the largest contributor to aerospace exports from Washington, relies on a global supply chain to manufacture its finished airplanes. (**Exhibit 5**)

Exhibit 5. Washington State Aerospace Exports, Billions of 2015 Dollars, 2002-2015



Sources: U.S. Census Bureau, 2016; Federal Reserve Bank of St. Louis, 2016; Community Attributes Inc., 2016.

Boeing is the world's largest aerospace company, with $96.1 billion in revenue in 2015. Airbus Group, the next-largest aerospace company, brought in $80.6 billion. Roughly 80,000 of Boeing's 160,000 employees are in Washington state, and approximately 69,000 of those employees are involved in Boeing's commercial airplane manufacturing. Boeing's other 11,500 employees are involved in the company's defense and space segments. For the purposes of this analysis, Boeing Commercial Airplanes is broken out separately from all other aerospace manufacturing in the state, which includes Boeing's defense and space work in the state in addition to a large number of other aerospace manufacturers.

Altogether, Boeing Commercial and other aerospace firms employed just under 94,000 jobs in Washington in 2015, representing 3.6% of the state's total employment, and paid wages of $10.1 billion. On average, aerospace employees were paid $107,000 per year, higher than the state average wage of $56,600. Related industries, including component manufacturers, training organizations, airlines, and maintenance and repair companies, represent an additional 42,300 jobs across the state. These related

businesses support the state's aerospace cluster, providing key local inputs and expertise. (**Exhibit 6**)

Exhibit 6. Aerospace Jobs and Wages (Billions) in Washington, 2015

	Jobs	Wages
Boeing Commercial Airplanes	69,000	$7.4
Other Aerospace Manufacturers	24,800	$2.7
Aerospace	93,800	$10.1
Related Industries	42,300	$2.9
Aerospace and Related Industries	136,100	$13.0

Sources: Washington State Department of Revenue, 2016; Boeing, 2016; Washington State Employment Security Department, 2016; Bureau of Labor Statistics, 2016; Community Attributes Inc., 2016.

Economic and Fiscal Impacts

The broader economic footprint of the aerospace sector extends across the state economy, through both supply chain purchases (indirect impacts) and worker income expenditures (induced); the latter owing to the significantly higher wages paid to aerospace workers compared with the state average.

Aerospace companies make purchases from a large number of related industries. The largest share of supply chain purchases made by aerospace companies is from other aerospace companies, illustrating the reliance of aircraft manufacturers on aircraft parts and systems manufacturers.[6] Suppliers and related businesses are represented in a number of other industries from which aerospace companies make purchases, including architecture, engineering, and computing services; construction; wholesale trade; computer and electrical part manufacturing; fabricated metal manufacturing, and educational services. Together, these inter-industry purchases support further jobs across the economy; in 2015, an estimated 27,300 jobs were supported through these indirect impacts. (**Exhibit 7**)

Induced impacts describe the impacts of wage expenditures made by employees supported through direct and indirect impacts. These employees spend their wages on everything from food and clothing to homes and cars. This portion of impacts is very high compared to other industries, due in large part to the comparatively high wages paid by the aerospace industry—an average annual wage of $107,000 including

[6] For the purposes of economic impact modeling, aerospace supplier revenues generated through sales to Boeing are treated as "indirect" revenues, explaining the difference between gross business income reported above and direct revenues as reported in this section.

benefits. In 2015, an estimated 130,900 jobs were supported through induced effects; for every direct job in aerospace, an additional 1.4 jobs were supported in other industries through induced impacts.

Exhibit 7. Economic Impacts of Aerospace in Washington, 2015

	Direct	Indirect	Induced	Total
Jobs	93,800	27,300	130,900	252,800
Labor Income (mils 2015 $)	12,776.2	1,924.9	6,589.2	21,290.4
Revenue (mils 2015 $)	68,640.5	5,702.7	20,311.0	94,654.2

Sources: Washington State Department of Revenue, 2016; Washington State Employment Security Department, 2016; Washington State Office of Financial Management, 2016; U.S. Bureau of Labor Statistics, 2016; Community Attributes Inc., 2016.
Note: Totals may not match due to rounding.

Washington's aerospace industry paid $31.3 million in state taxes in 2015. Business activities supported through secondary impacts—that is, indirect and induced effects—were associated with an additional $331.8 million in estimated state taxes, resulting in a total fiscal impact of $363.1 million in 2015. (**Exhibit 8**)

Exhibit 8. State Fiscal Impacts of Aerospace in Washington, Millions, 2015

	Direct	Secondary	Total
State Tax Payments	$31.3	$331.8	$363.1

Sources: Washington State Department of Revenue, 2016; Washington State Employment Security Department, 2016; Bureau of Labor Statistics, 2016; Community Attributes Inc., 2016.

Direct taxes paid by aerospace-related firms are also calculated. In 2015, these firms made direct tax payments to the state of $61.6 million, evenly split between B&O ($30.5 million) and Sales & Use ($29.2 million) taxes (with another $1.9 million in other taxes; **Exhibit 9**). Many of these taxes are captured in the secondary fiscal impacts of aerospace reported above, since suppliers pay taxes based on revenues generated through supply chain demand from Boeing and other aerospace companies in Washington.

Exhibit 9. Direct State Tax Payments Made by Aerospace-Related Firms in Washington, Millions, 2015

	Fiscal Impacts
B&O	$30.5
Sales & Use Taxes	$29.2
Other	$1.9
Total	$61.6

Sources: Washington State Department of Revenue, 2016; Washington State Employment Security Department, 2016; Bureau of Labor Statistics, 2016; Community Attributes Inc., 2016.

Boeing Commercial Airplanes

In 2015, Boeing employed more than 80,500 workers in Washington state. The company's commercial, defense, and space sector activities are major contributors to the nation's aerospace sector. Boeing employment in Washington is composed of Boeing Defense, Boeing Commercial, and several other smaller divisions.

Boeing Commercial Airplanes (BCA) employs an estimated 69,000 of the company's 80,500 workers, making it the largest group of Boeing's Washington activities. The company's activities across the state supported an additional estimated 24,300 workers through indirect impacts and 98,900 workers through induced effects. For every direct job at BCA, an additional 1.8 jobs were supported elsewhere in the state economy. BCA's labor income impacts include $9.4 billion in direct labor income, $1.7 billion in indirect labor income, and $5.0 billion in induced labor income. (**Exhibit 10**)

Exhibit 10. Economic Impacts of Boeing Commercial in Washington, 2015

	Direct	Indirect	Induced	Total
Jobs	69,000	24,300	98,900	192,200
Labor Income (mils 2015 $)	9,395.3	1,715.1	4,979.8	16,090.1

Sources: Washington State Department of Revenue, 2016; Boeing, 2016; Washington State Employment Security Department, 2016; Bureau of Labor Statistics, 2016; Community Attributes Inc., 2016.

Tax Incentive Users

There are seven tax incentives available to aerospace businesses, including aerospace manufacturers, businesses involved in aerospace development, component manufacturers, and certain other entities[7]. These incentives cover B&O taxes and Sales & Use taxes paid on certain items. Notably,

[7] For a complete list of tax incentives used in this analysis, please see the Appendix.

aerospace manufacturers are eligible for reduced B&O taxes and may be exempt from Sales & Use taxes that would normally apply to construction of aerospace manufacturing buildings. In 2015, tax incentive users reported $326.8 million in savings from aerospace tax incentives, according to the Washington State Department of Revenue.[8]

In 2015, **330 Washington companies (across 346 worksites) participated in aerospace tax incentive programs** in Washington. Overall, these companies employed a combined 92,900 workers in 2015. The largest aerospace tax incentive program participant in 2015 was Boeing, which had approximately 66,800 employees at sites that made use of the aerospace tax incentives. (**Exhibit 11**)

Exhibit 11. Aerospace Manufacturer Tax Incentive Users Jobs and Wages in Washington, 2015

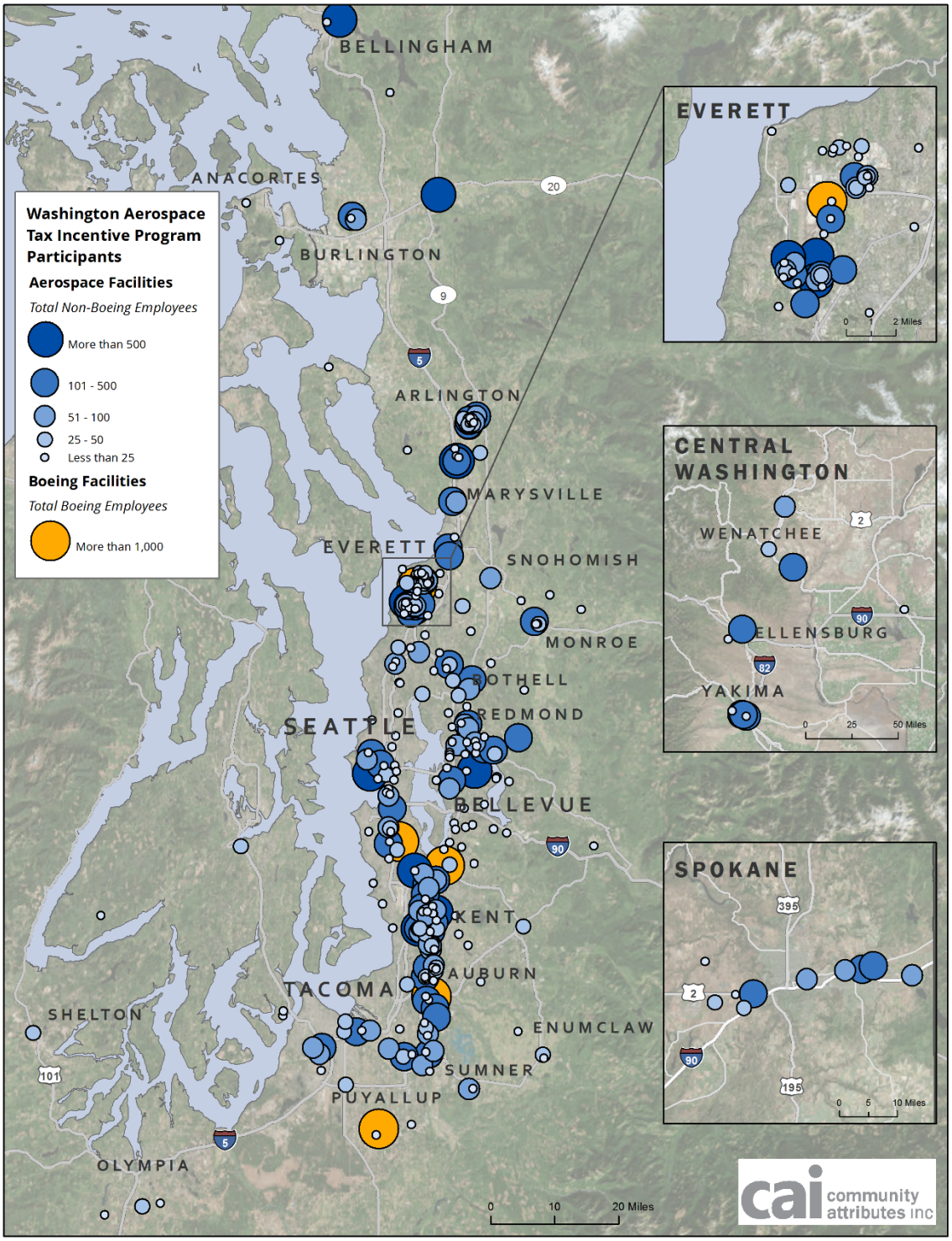
	Jobs	Wages (Millions)
Boeing Sites with Incentive Support	66,800	$7,376
Other Incentive Participants	26,100	$2,851
All Incentive Participants	92,900	$10,226

Sources: Washington State Department of Revenue, 2016; Washington State Employment Security Department, 2016; Community Attributes Inc., 2016.

The companies that participate in Washington's aerospace tax incentive users are located across the state, but are significantly concentrated in Washington's main manufacturing areas. Incentive users are highly concentrated in the Central Puget Sound region, notably around Everett, Renton, Seattle, and Tacoma. However, a large number of incentive users are also present in Spokane, as well as across many other parts of the state. A large number of these firms are aerospace component manufacturers. (**Exhibit 12**)

[8] Tax incentive users include both aerospace and non-aerospace firms in Washington.

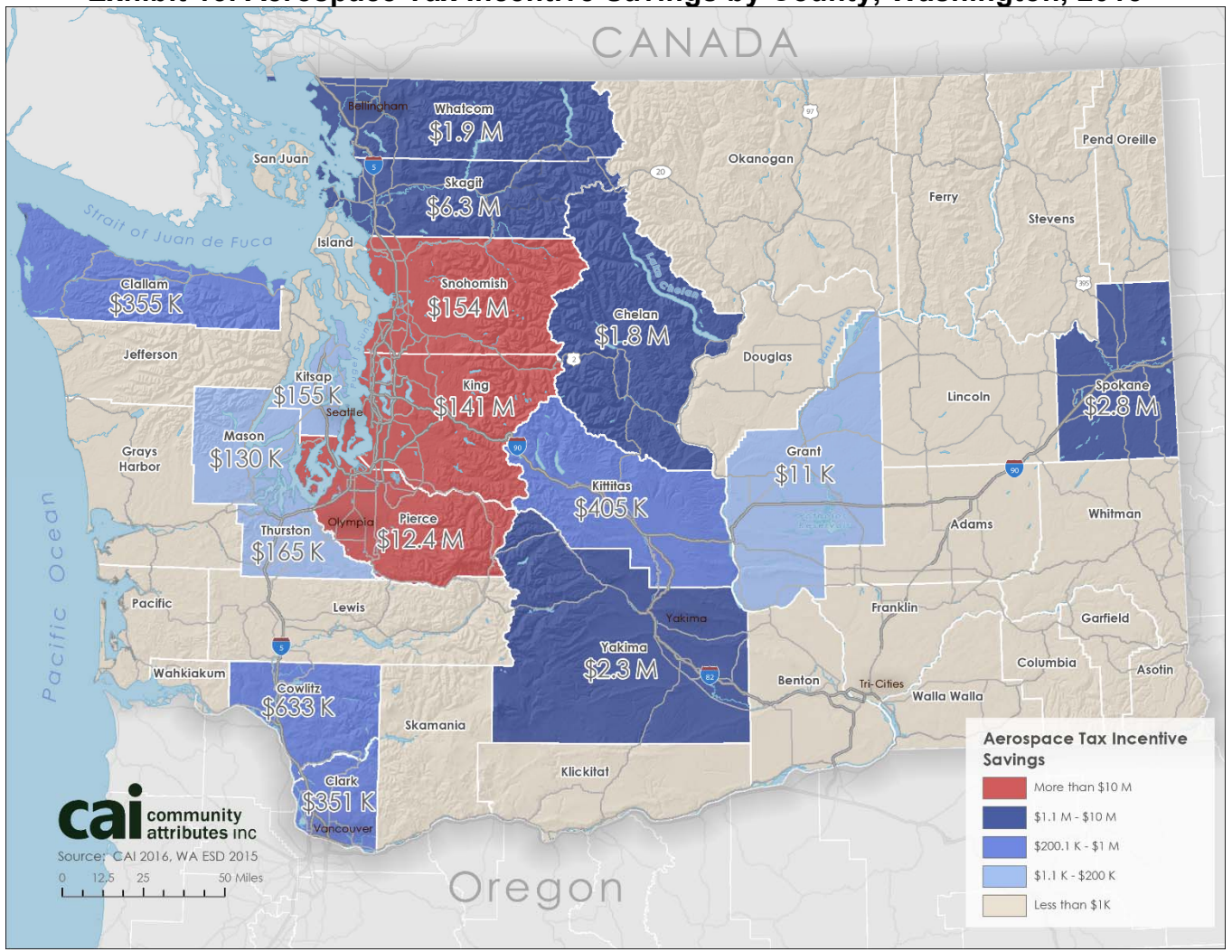
Exhibit 12. Aerospace Manufacturer Tax Incentive Users, Washington, 2015



Sources: Washington State Department of Revenue, 2016; Community Attributes Inc., 2016.

Washington's aerospace tax incentive users can be found across the state. Snohomish County and King County had the largest savings due to aerospace tax incentives in 2015, with $154 million and $142 million, respectively. (**Exhibit 13**)

Exhibit 13. Aerospace Tax Incentive Savings by County, Washington, 2015



Sources: Washington State Department of Revenue, 2016; Community Attributes Inc., 2016.

Washington's aerospace tax incentive program participants together accounted for 92,900 employees in 2015. Their economic impacts in 2015 were significant, totaling 146,800 jobs through indirect and induced impacts. For every direct job at companies that participated in aerospace tax incentive programs, an additional 1.58 jobs were supported through wage spending and inter-industry purchases.

The labor income impacts were also significant, reaching $20.8 billion in labor income through direct and secondary impacts. For every dollar paid in direct labor income by these companies, and additional $0.60 was supported through secondary impacts at other businesses. (**Exhibit 14**)

Exhibit 14. Economic Impacts of Aerospace Manufacturing Tax Incentive Users in Washington, 2015

	Direct	Indirect	Induced	Total
Jobs	92,900	19,100	127,700	239,700
Labor Income (mils 2015 $)	12,997.6	1,340.9	6,426.7	20,765.2

Sources: Washington State Department of Revenue, 2016; Washington State Employment Security Department, 2016; Bureau of Labor Statistics, 2016; Community Attributes Inc., 2016.

Of these workers, 66,800 were employed at Boeing's locations that benefitted from Washington's aerospace tax incentives. The state's non-Boeing incentive program participants had a total statewide impact of 67,000 jobs and labor income of $5.8 billion. (**Exhibit 15**)

Exhibit 15. Economic Impacts of Non-Boeing Aerospace Manufacturing Tax Incentive Users in Washington, 2015

	Direct	Indirect	Induced	Total
Jobs	26,100	5,300	35,600	67,000
Labor Income (mils 2015 $)	3,622.5	373.9	1,791.2	5,787.6

Sources: Washington State Department of Revenue, 2016; Washington State Employment Security Department, 2016; Bureau of Labor Statistics, 2016; Community Attributes Inc., 2016.

AEROSPACE ACTIVITIES BY COUNTY

King and Snohomish Counties were home to the highest levels of aerospace manufacturing employment in 2015, with 44,640 and 43,860 jobs, respectively (**Exhibit 16**). Both counties are home to major Boeing manufacturing sites and clusters of related employers. Pierce County, the next-largest county by aerospace manufacturing employment, there were

2,600 aerospace jobs in 2015, including at Boeing's Fabrication Division in Puyallup.

Exhibit 16. Aerospace Jobs, Revenue (Millions), and Wages (Millions) by County, Washington, 2015

	Jobs	Revenue	Wages
King	44,640	$32,662	$5,091
Snohomish	43,860	$32,090	$4,547
Pierce	2,610	$1,907	$214
Spokane	900	$656	$56
Yakima	360	$262	$28
Grant	80	$62	$7
Kitsap	50	$37	$4
Elsewhere in Washington	1,320	$966	$105
Total Aerospace	93,820	$68,640	$10,051

Sources: Washington State Employment Security Department, 2016; Bureau of Labor Statistics, 2016; Community Attributes Inc., 2016.

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 important contributors to Washington's aerospace sector.[9] In 2015, these industries represented a combined 42,310 jobs across the state, paid wages of $2.9 billion, and received $10.7 billion in revenue. Aerospace-related industries are most heavily concentrated in King County, with more than half of the state's aerospace-related jobs. (**Exhibit 17**)

[9] For a complete list of aerospace-related industries, please see the appendix.

Exhibit 17. Aerospace-Related Jobs, Revenues (Millions), and Wages (Millions) in Washington, 2015

	Jobs	Revenue	Wages
King	24,210	$6,126	$1,790
Snohomish	6,150	$1,555	$450
Pierce	2,820	$715	$182
Spokane	1,350	$342	$78
Yakima	190	$49	$8
Grant	100	$25	$4
Kitsap	80	$19	$4
Elsewhere in Washington	7,410	$1,876	$412
Related Industries	42,310	$10,707	$2,928

Sources: Washington State Department of Revenue, 2016; Washington State Employment Security Department, 2016; Bureau of Labor Statistics, 2016; Community Attributes Inc., 2016.

King County

King County aerospace firms encompass the entire supply chain of aerospace firms and related industries. Boeing, Washington's largest aerospace manufacture, 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 as also a major hub to numerous aerospace suppliers. Examples include:

- **Orion Industries** provides precision metal fabrication for the aerospace industry, and also has a social mission of helping individuals with barriers to achieve employment.
- **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 military's across the globe.

King County is also a hub for space travel as well, home to **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

In King County, where Washington State's aerospace industry is the most concentrated, the industry's economic impacts are the highest. With a significant Boeing presence and a concentration of supporting businesses, King County aerospace had indirect job impacts totaling 12,180 and induced job impacts totaling 40,540 in King County in 2015. Altogether, the aerospace industry in King County supported an additional 52,720 jobs across the county through secondary impacts. (**Exhibit 18**)

Exhibit 18. Economic Impacts of King County Aerospace, 2015

King County	Direct	Indirect	Induced	Total
Jobs	44,640	12,180	40,540	97,360
Labor Income (Millions)	$6,471.0	$857.6	$2,009.0	$9,337.6
Revenue (Millions)	$32,662.3	$2,434.5	$4,588.8	$39,685.6

Sources: Washington State Department of Revenue, 2016; Washington State Employment Security Department, 2016; Bureau of Labor Statistics, 2016; Longitudinal Employer-Household Dynamics, 2016; Community Attributes Inc., 2016.

Snohomish County

Snohomish County is home to more than 43,800 aerospace manufacturing jobs and more than 6,100 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.

Snohomish County is home to two of the state's largest electronic components manufacturers. 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's 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.

Economic Impacts

Snohomish County has the state's second-largest concentration of aerospace jobs, with 43,860 direct jobs in 2015. Similar to King County, Snohomish County also has a significant concentration of aerospace-related industries. As a result, a large portion of the inter-industry purchases made by Snohomish aerospace companies can be made within the county, a significant driver of secondary impacts. In 2015, Snohomish County aerospace supported a total of 48,590 jobs through secondary effects, including indirect and induced impacts. (**Exhibit 19**)

Exhibit 19. Economic Impacts of Snohomish County Aerospace, 2015

Snohomish County	Direct	Indirect	Induced	Total
Jobs	43,860	8,700	39,890	92,450
Labor Income (Millions)	$5,779.1	$603.5	$1,894.8	$8,277.4
Revenue (Millions)	$32,090.2	$1,927.3	$5,567.8	$39,585.2

Sources: Washington State Department of Revenue, 2016; Washington State Employment Security Department, 2016; Bureau of Labor Statistics, 2016; Longitudinal Employer-Household Dynamics, 2016; Community Attributes Inc., 2016.

Pierce County

Boeing's Frederickson plant in Pierce County has two specialties, machined metal wing components and composites manufacturing. Boeing counts 136 production suppliers and other vendors in Pierce County, including spinoff businesses that continue to work with Boeing[10]. 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:

[10] 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

- **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 trim fixtures, while Farwest Aircraft Inc. specializes in manufacturing maintenance tools for and electrical testing equipment for OEMs like Boeing and Mitsubishi Aircraft.

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 2,610 direct jobs. Pierce County's aerospace industry had secondary economic impacts totaling 2,820 jobs, $139.2 million in labor income, and $426.2 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 20**)

Exhibit 20. Economic Impacts of Pierce County Aerospace, 2015

Pierce County	Direct	Indirect	Induced	Total
Jobs	2,610	490	2,330	5,420
Labor Income (Millions)	$272.6	$27.9	$111.3	$411.7
Revenue (Millions)	$1,906.7	$85.6	$340.6	$2,333.0

Sources: Washington State Department of Revenue, 2016; Washington State Employment Security Department, 2016; Bureau of Labor Statistics, 2016; Longitudinal Employer-Household Dynamics, 2016; Community Attributes Inc., 2016.

Spokane County

Spokane County has a diverse aerospace and supporting services sector. The companies range in size and scope, with some companies exporting across the globe and other 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.[11] Examples of Spokane County aerospace firms include:

- **Triumph Composite System**s is on the other spectrum, a large advanced manufacturer employing 500 people in Spokane, part of the global Triumph Group. This site is Boeing's sole supplier of environmental control system ducts and composite flight deck components for all of its commercial airplanes. The site also manufactures composite floor panels for the 737, 767, and 777.[12]
- Another global company with a location in Spokane is **Honeywell**, which employs 250 people in Spokane. The Spokane location of Honeywell does metal manufacturing for parts used in semiconductor manufacturing, such as bonding wire, thermal interface materials, and plating anodes.
- Liberty Lake, East of Spokane Valley is home to large advanced manufacturers. **Altek** employs 170 people in Liberty Lake and manufactures custom components, sub-assemblies and complete assemblies. Their components are designed for both the aerospace and medical industry.[13] Another supporting aerospace industry company located in Liberty Lake, employing more than 200 people is Accra-Fab, Inc. Accra-Fab does custom metal fabrication and manufacturing, specializing in CNC turret punching, welding, shearing, forming, spot welding, laser cutting, stamping and finishing.[14]

[11] Air Spokane, 2016
[12] Air Spokane, 2016
[13] Air Spokane, 2016; Seattle Times, 2016.
[14] Air Spokane, 2016

- 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.

Economic Impacts

In Spokane County, aerospace composes a small portion of total employment: in 2015, aerospace represented 0.5% of the county's total employment, or roughly 900 jobs. While this is lower than some other counties in Washington, it is higher than the national average share of 0.4%.

Through indirect impacts—the effects of inter-industry transactions—Spokane's aerospace industry supported an additional 190 jobs. Induced impacts supported an additional 590 jobs across the county. Altogether, the county's aerospace industry had more significant induced impacts compared to indirect impacts because of the relatively low concentration of aerospace-related industries in Spokane. That is, there are less opportunities for Spokane aerospace companies to purchase from local suppliers. (**Exhibit 21**)

Exhibit 21. Economic Impacts of Spokane County Aerospace, 2015

Spokane County	Direct	Indirect	Induced	Total
Jobs	900	190	590	1,680
Labor Income (Millions)	$70.6	$11.4	$28.8	$110.8
Revenue (Millions)	$655.6	$30.5	$78.8	$764.9

Sources: Washington State Department of Revenue, 2016; Washington State Employment Security Department, 2016; Bureau of Labor Statistics, 2016; Longitudinal Employer-Household Dynamics, 2016; Community Attributes Inc., 2016.

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 manufacture the Cub Aircraft at its 40,000 square foot facility near McAllister Field Airport.[15] 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

[15] Air Spokane, 2016

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, provides maintenance services and flight instruction.

Economic Impacts

A comparatively low share of Yakima's total employment is in the aerospace industry: in 2015, 0.4% of the county's 92,000 jobs were in aerospace. While this is relatively low compared to Washington as a whole, it is very close to the share of total aerospace employment nationally, which is 0.4%. Yakima's aerospace industry is nevertheless an important contributor to the county's economy. In 2015, the industry supported 270 jobs through secondary impacts, including 50 jobs through indirect impacts—the impacts of inter-industry purchases—and 220 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 22**)

Exhibit 22. Economic Impacts of Yakima County Aerospace, 2015

Yakima County	Direct	Indirect	Induced	Total
Jobs	360	50	220	620
Labor Income (Millions)	$36.1	$2.9	$10.6	$49.6
Revenue (Millions)	$261.5	$8.5	$30.2	$300.2

Sources: Washington State Department of Revenue, 2016; Washington State Employment Security Department, 2016; Bureau of Labor Statistics, 2016; Longitudinal Employer-Household Dynamics, 2016; Community Attributes Inc., 2016.

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. 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 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

Grant County aerospace supported 80 jobs through direct impacts, 10 additional jobs through indirect effects, and a further 40 jobs through induced impacts. Grant County aerospace had economic impacts totaling 130 jobs, $10.9 million in labor income, and $69.4 million in business revenue. (**Exhibit 23**)

Exhibit 23. Economic Impacts of Grant County Aerospace, 2015

Grant County	Direct	Indirect	Induced	Total
Jobs	80	10	40	130
Labor Income (Millions)	$8.5	$0.7	$1.8	$10.9
Revenue (Millions)	$61.5	$2.5	$5.4	$69.4

Sources: Washington State Department of Revenue, 2016; Washington State Employment Security Department, 2016; Bureau of Labor Statistics, 2016; Longitudinal Employer-Household Dynamics, 2016; Community Attributes Inc., 2016.

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.

Economic Impacts

In Kitsap County, aerospace activities supported an estimated 10 jobs through indirect impacts and a further 30 jobs through induced impacts in 2015. The industry's total economic impacts in 2015 totaled 90 jobs, $7.2 million in labor income, and $42.7 million in business revenue. (**Exhibit 24**)

Exhibit 24. Economic Impacts of Kitsap County Aerospace, 2015

Kitsap County	Direct	Indirect	Induced	Total
Jobs	50	10	30	90
Labor Income (Millions)	$5.1	$0.5	$1.6	$7.2
Revenue (Millions)	$37.0	$1.3	$4.4	$42.7

Sources: Washington State Department of Revenue, 2016; Washington State Employment Security Department, 2016; Bureau of Labor Statistics, 2016; Longitudinal Employer-Household Dynamics, 2016; Community Attributes Inc., 2016.

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.[16]

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 2015, there were 93,816 aerospace manufacturing jobs in Washington, making Washington one of the nation's top aerospace clusters. In 2015, 19.2% of total aerospace manufacturing employment in the U.S. was located in Washington.

Washington's largest aerospace company is Boeing, which produces several model lines in the state. The 747, 767, 777, and 787 are all produced at Boeing Commercial Airplane's Everett site, the 737 is produced at the company's Renton location, and support activities are undertaken at the company's other major commercial sites in Auburn, Seattle-Tukwila, and Puyallup. In 2015, Boeing Commercial Airplanes employed 69,000 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 42,310 jobs in aerospace-related industries across the state. More than half of these jobs can be found in King County, which has 24,210 workers in aerospace-related industries. The next-largest county by employment in aerospace-related industries is Snohomish County, with 6,150 workers.

In 2015, the industry supported 93,800 direct jobs and an additional 158,200 through indirect and induced impacts. The industry also supported $21.3 billion in labor income through direct and secondary impacts, in addition to $94.7 billion in business revenue.

Washington's aerospace sector has impacts that ripple across 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

[16] Air Spokane, 2016.

employees. These induced impacts are high because workers spend a large portion of their wages in the county in which they are employed—especially if they also live in that county—and the average wage paid in the aerospace industry is relatively high. (**Exhibit 25**)

Exhibit 25. Economic Impacts of Aerospace, 2015, Select Counties

	Direct	Indirect	Induced	Total
King County				
Jobs	44,640	12,180	40,540	97,360
Labor Income (Millions)	$6,471.0	$857.6	$2,009.0	$9,337.6
Revenue (Millions)	$32,662.3	$2,434.5	$4,588.8	$39,685.6
Snohomish County				
Jobs	43,860	8,700	39,890	92,450
Labor Income (Millions)	$5,779.1	$603.5	$1,894.8	$8,277.4
Revenue (Millions)	$32,090.2	$1,927.3	$5,567.8	$39,585.2
Pierce County				
Jobs	2,610	490	2,330	5,420
Labor Income (Millions)	$272.6	$27.9	$111.3	$411.7
Revenue (Millions)	$1,906.7	$85.6	$340.6	$2,333.0
Spokane County				
Jobs	900	190	590	1,680
Labor Income (Millions)	$70.6	$11.4	$28.8	$110.8
Revenue (Millions)	$655.6	$30.5	$78.8	$764.9
Yakima County				
Jobs	360	50	220	620
Labor Income (Millions)	$36.1	$2.9	$10.6	$49.6
Revenue (Millions)	$261.5	$8.5	$30.2	$300.2
Grant County				
Jobs	80	10	40	130
Labor Income (Millions)	$8.5	$0.7	$1.8	$10.9
Revenue (Millions)	$61.5	$2.5	$5.4	$69.4
Kitsap County				
Jobs	50	10	30	90
Labor Income (Millions)	$5.1	$0.5	$1.6	$7.2
Revenue (Millions)	$37.0	$1.3	$4.4	$42.7

Sources: Washington State Department of Revenue, 2016; Washington State Employment Security Department, 2016; Bureau of Labor Statistics, 2016; Longitudinal Employer-Household Dynamics, 2016; Community Attributes Inc., 2016.

APPENDIX

Aerospace Industries

The following seven industry sectors compose the aerospace industry. They are organized by 6-digit North American Industry Classification System (NAICS) codes. This list was developed collaboratively between the Washington State Employment Security Department and the Governor's Office of Aerospace.

- 336411 Aircraft Manufacturing
- 336412 Aircraft Engine and Engine Parts Manufacturing
- 336413 Other Aircraft Parts and Auxiliary Equipment Manuf.
- 336414 Guided Missile and Space Vehicle Manufacturing
- 336415 Guided Missile and Space Vehicle Propulsion Manuf.
- 336419 Other Guided Missile and Space Vehicle Parts Manuf.
- 927000 Space Research and Technology

Aerospace-Related Industries

The following 32 industry sectors represent aerospace-related industries. They are organized by 6-digit NAICS codes. Like the list of aerospace industry sectors above, this list was developed collaboratively between the Washington State Employment Security Department and the Governor's Office of Aerospace.

- 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
- 334417 Electronic Connector Manufacturing
- 334418 Printed Circuit Assembly (Electronic Assembly) 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 transportation
- 611512 Flight Training

Economic Impacts

Types of Economic Impacts

Economic impact modeling considers three types of impacts, summarized below. In this report, indirect and induced impacts are collectively referred to as **secondary impacts**.

- **Direct impacts** are the revenues, wages, and jobs directly attributable to the industry or organization. This includes revenue sources like ticket sales or donations, wages paid by the aquarium, and workers employed at the aquarium.
- **Indirect impacts** refer to additional economic activity, measured in jobs, wages, and revenues, supported by inter- and intra-industry transactions associated with the direct activities being modeled. When the Seattle Aquarium buys fish feed, for example, that transaction has indirect impacts.
- **Induced impacts** are additional revenues, wages, and jobs associated by income expenditures among employees supported through direct and indirect impacts.

Statewide

Economic impacts of Washington Aerospace and related activities were calculated through use of the 2012 Washington State Input-Output Model, published by the Washington State Office of Financial Management. The I-O model is an analytic tool for assessing the intra- and inter-industry linkages and sources of final demand within a defined economy.

County

In order to provide detailed economic impacts in select counties in Washington, CAI employed location quotient adjusters. Location quotients describe an industry's concentration in an area compared to that same industry's concentration in a larger area. For example, the location quotient for aerospace in King county would be calculated as follows:

$$\text{Location Quotient} = \frac{\frac{Total\ Aerospace\ Employment\ in\ King\ County}{Total\ Employment\ in\ King\ County}}{\frac{Total\ Aerospace\ Employment\ in\ Washington}{Total\ Employment\ in\ Washington}}$$

After developing location quotients for each industry in each select county, CAI used these coefficients to adjust inter-industry transactions down for industries in which a county had less-than-average employment concentration as represented by a location quotient less than 1.[17]

CAI estimated the share of wage expenditures made by employees in a county by leveraging data from Longitudinal Employer-Household Dynamics. This data uses home and work locations of people employed in a county to estimate where spending occurs.

As a result of this analysis, impacts of aerospace activities by county represent the impacts of aerospace activities in that county only, and do not include additional impacts in other counties. For example, wage expenditures made by Snohomish County aerospace employees in King County would not be included in Snohomish County's aerospace impacts.

Fiscal Impacts

In order to arrive at estimated direct fiscal impacts for the aerospace industry, CAI leveraged data from the Washington State Department of Revenue describing taxes paid by industry. Taxes by type were summed up into industries, and then effective tax rates were estimated by dividing taxes paid by total industry revenue. These rates were then applied to the relevant industry's revenue. These impacts only include taxes paid to the state and do not include local taxes.

Additionally, CAI integrated data provided by the Washington State Department of Revenue on aerospace industry tax incentives in order to arrive at an estimate of total taxes paid for the industry.

Tax Incentives

The Washington State Department of Revenue defines seven tax incentives for aerospace businesses, including aerospace manufacturers,

[17] For more information on using location quotients for economic impact analysis, please see Bess, Rebecca and Zoe Ambargis. "Input-Output Models for Impact Analysis: Suggestions for Practitioners Using RIMS II Multipliers," Bureau of Economic Analysis, 2011.

businesses involved in aerospace development, component manufacturers, and certain other entities.

Reduced B&O Tax Rate for Aerospace Businesses. This rate applies to manufacturers and processors for hire of commercial airplanes or component parts. Non-manufacturers engaged in aerospace product development, certified repair stations, and aerospace tooling manufacturers can also make use of this program. The reduced tax rate is 0.9% for those involved in aerospace product development and 0.2904% for other activities. For more information, please see RCW 82.04.250(3), 82.04.260(11), 82.04.290(3), 82.32.534, 82.32.550, and 82.32.600.

B&O Credit for Preproduction Development Expenditures. This credit is available to manufacturers and processors for hire of commercial airplanes or components, non-manufacturers engaged in the business of aerospace product development, certificated repair stations making retail sales, and aerospace tooling manufacturers. For more detail, please see RCW 82.04.4461 and 82.32.550.

B&O Credit for Property/Leasehold Taxes Paid on Aerospace Business Facilities. This credit is available the same types of businesses as described above. For further information, please see RCW 82.04.4463, 82.32.545, and 82.32.550.

Sales & Use Tax Exemption for Aerospace Businesses for Computer Hardware, Software, and Peripherals. This exemption is available the same types of businesses as described above. The items must be used primarily in the development, design, and engineering of aerospace products or in providing aerospace services to qualify. For additional information, please see RCW 82.04.4463, 82.32.545, and 82.32.550.

Retail Sales & Use Tax Exemption for the Construction of New Facilities Used to Manufacture Commercial Airplanes, Fuselages or Wings of Commercial Airplanes. This exemption is. available to manufacturers who construct new buildings or expansions to existing buildings that will be used primarily in aerospace manufacturing. This includes the manufacturing of commercial airplanes, commercial airplane fuselages, and commercial airplane wings. This exemption is also available to port districts, political subdivisions, or municipal corporations when they construct new facilities to lease to these manufacturers. The buildings must be used primarily to manufacture commercial airplanes, commercial airplane fuselages and commercial airplane wings. For more information, please see RCW 82.08.980, 82.12.980, 82.32.534, 82.32.550, 82.32.600, 82.32.850, and 82.32.808.

List of Tax Incentive Users

The following is a list of aerospace tax incentive program participants. When a company listed more than one site that used tax incentives, organized by industry each firm is classified as in state records.

Building Equipment Contractors (2382)

- Hamilton Sundstrand Corporation

Other Specialty Trade Contractors (2389)

- JJR Engineering & Fabrication Inc.
- Rieken Jeremy D

Textile and Fabric Finishing and Fabric Coating Mills (3133)

- Mid Mountain Materials Inc.

Other Wood Product Manufacturing (3219)

- Armour Manufacturing and Construction Inc.

Converted Paper Product Manufacturing (3222)

- Color Craft LLC

Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing (3252)

- Advanced Thermoplastic Composites Inc.
- Aero-Plastics Inc.
- Angeles Composite Technologies Inc.
- General Plastics Manufacturing Co.
- Toray Composites America Inc.

Plastics Product Manufacturing (3261)

- Artisan Industries Inc.
- Multifab Inc.
- Pexco Aerospace Inc.
- Pexco LLC
- Plastic Sales & Service Inc.
- Vaupell Industrial Plastics Inc.

Steel Product Manufacturing from Purchased Steel (3312)

- FTI Manufacturing Inc.
- Western Pneumatic Tube Company LLC

Alumina and Aluminum Production and Processing (3313)

- AMI Metals Inc.
- Alcoa Inc.

Nonferrous Metal (except Aluminum) Production and Processing (3314)

- Double D Manufacturing LLC

Foundries (3315)

- Seacast Inc.
- US Castings LLC

Cutlery and Hand Tool Manufacturing (3322)

- *Aerofab NDT LLC*

Architectural and Structural Metals Manufacturing (3323)

- ABW Technologies Inc.
- Aerofab Industries Inc.
- GMS Metal Works Inc.
- Imaginetics LLC
- Proctor Products Co, Inc.
- Quality Stamping & Machining Inc.

Hardware Manufacturing (3325)

- Avia Marine Company
- Axis Manufacturing LLC

Spring and Wire Product Manufacturing (3326)

- Renton Coil Spring Company

Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing (3327)

- 3V Precision Machining Inc.
- Alpha Precision Machining Inc.
- American Manufacturing & Engineering LLC
- Automatic Products Co Inc.
- BM Programming & Machining Service Inc.
- Bolster Clay Edward
- Component Products Corporation
- Curtis Machining Inc.
- Cutting Technology Inc.
- Diamond Machine Works Inc.
- Global Machine Works Inc.

- Hirschler Manufacturing Inc.
- Hobart Machined Products Inc.
- IDL Precision Machining LLC
- JD Ott Co. Inc.
- KGR Corporation
- Kuka Systems North America LLC
- La Croix Industries LLC
- Locke Precision LLC
- Neumeier Engineering Inc.
- Northwest Precision Inc.
- P&J Machine Inc.
- Peregrine Manufacturing Inc.
- Royell Manufacturing Inc.
- Sakco Precision Inc.
- Universal Aerospace Co. Inc.
- Valley Machine Shop Inc.
- Vanwerven Inc.
- Zaldivar Adolfo

Coating, Engraving, Heat Treating, and Allied Activities (3328)

- ASKO Processing Inc.
- Blue Streak Finishers LLC
- Hytek Finishes Co
- Pacific Metallurgical Inc.
- Protective Coatings Inc.

Other Fabricated Metal Product Manufacturing (3329)

- Brown Joseph James
- CR Enterprises NW LLC
- DC Machine LLC
- Hardy Engineering & Manufacturing Inc.
- Hempstead George D
- Infinity Fabrication Inc.
- IPC - Industrial Plating Corporation
- L&E Tubing LLC
- LWDN LLC
- Northwest Metalcraft Inc.
- Precision Machine Works Inc.
- Primus International Inc.
- Three Sigma Manufacturing Inc.
- Valley Aero Manufacturing LLC

Commercial and Service Industry Machinery Manufacturing (3333)

- ECS Machining Inc.
- Quality Manufacturing Inc.
- Ryan's Precision Machining LLC

Metalworking Machinery Manufacturing (3335)

- Altek Inc.
- Art Brass Aerospace Finishing Inc.
- Delta Tooling Inc.
- Dylan Manufacturing
- Globe Machine Manufacturing Company
- Grassroots Industries LLC
- Janicki Industries Inc.
- Laz Tool & Manufacturing Co
- New Tech Industries Inc.
- Okeefe, Jack S & Mary J
- Pacific Tool Inc.
- Tool-Gauge & Machine Works Inc.
- Wilken David W

Other General Purpose Machinery Manufacturing (3339)

- GBC Enterprises Inc.
- Industrial Automation Inc.
- Triumph Actuation Systems - Yakima LLC

Computer and Peripheral Equipment Manufacturing (3341)

- Servatron Inc.

Semiconductor and Other Electronic Component Manufacturing (3344)

- Carlisle Interconnect Technologies Inc.
- Prototron Inc.

Navigational, Measuring, Electromedical, and Control Instruments Manufacturing (3345)

- Aeroacoustics Aircraft Systems Inc.
- Avtechtyee Inc.
- Control Technology Inc.
- Honeywell International Inc.
- Precision Fuel Components LLC
- Velocity CNC Machining Inc.

Other Electrical Equipment and Component Manufacturing (3359)

- Trufab LLC

Aerospace Product and Parts Manufacturing (3364)

- A&G Machine Inc.
- AECO Technologies LLC
- Aerostar Engineering Inc.
- Aim Aerospace Auburn Inc.
- AIM Aerospace Sumner Inc.
- Astronics Advanced Electronic Systems Corp
- Baker Manufacturing Inc.
- Brauer R Klaus
- Bucher Aerospace Corporation
- C&D Zodiac Inc.
- CFI Blue Sky II LLC
- Cobalt Enterprises LLC
- Compass Aerospace Northwest Inc.
- Composite Solutions Corporation
- Cub Crafters Inc.
- The Danner Corp
- ELDEC Corporation
- Exact Aerospace Inc.
- Exotic Metals Forming Co. LLC
- Gemini Management Ltd.
- Giddens Industries Inc.
- Givon USA Inc.
- Goodrich Aerostructures Integration Services
- Harper Engineering Company
- Heath Tecna Inc.
- Hexcel Corporation
- Hill Aerosystems Inc.
- IDD Aerospace Corp
- Integrated Polaris Machining LLC
- JC Manufacturing Inc.
- Jamco America Inc.
- Jetseal Inc.
- King Machine LLC
- Koch Dwight W
- Korry Electronics Co
- Leonard's Metal Inc.
- Lifeport Inc.

- Luma Technologies LLC
- M&L Machine Inc.
- Magnetic & Penetrant Services Co. Inc.
- Mark Airmotive Inc.
- Menasco Aerosystems Inc.
- Micro Aero Dynamics Group Ltd
- Northwest Aerospace Technologies Inc.
- Olympic Aero ETS LLC
- Omohundro Company Kitsap Composites Inc.
- Onamac Industries Inc.
- Pacific Propeller International LLC
- Pegasus Northwest Inc.
- Precision Engines LLC
- Precision Spring And Stamping Corporation
- Quick Precision Inc.
- Raad Industries LLC
- Rohr Inc.
- RTC Aerospace - Fife Division Inc.
- Senior Operations LLC
- Spectralux Corporation
- Stoddard International LLC
- Technic Machine Inc.
- Technofan LLC
- TECT Aerospace Inc.
- The Boeing Company
- Timco Aerosystems LLC
- Triumph Composite Systems Inc.
- Triumph Structures Everett Inc.
- Umbra Cuscinetti Inc.
- University Swaging Corporation
- Vector Industries LLC
- Westwood Manufacturing Inc.

Household and Institutional Furniture and Kitchen Cabinet Manufacturing (3371)

- Kaasco Inc.
- Pioneer Aerofab Company Inc.

Other Miscellaneous Manufacturing (3399)

- 4M Company Inc.
- Advanced Consolidated Manufacturing Inc.
- Cablecraft Motion Controls LLC
- Cascade Gasket & Manufacturing Co Inc.

- Custom Control Concepts LLC
- Developmental Machine Inc.
- Elmach LLC
- GM Nameplate Inc.
- Integrated Technologies Inc.
- Kaiser Aluminum Washington LLC
- Norfil LLC
- Saint Gobain Performance Plastics Corp
- Talon Manufacturing Inc.
- Westwood Precision Inc.
- Zodiac Cabin & Structures Support LLC
- Professional and Commercial Equipment and Supplies Merchant Wholesalers (4234)
- Nextgen Aerosciences Inc.

Metal and Mineral (except Petroleum) Merchant Wholesalers (4235)

- L&M Precision Fabrication Inc.
- LB Associates Inc.
- TW Metals Inc.

Household Appliances and Electrical and Electronic Goods Merchant Wholesalers (4236)

- Qualitel Corporation

Hardware, and Plumbing and Heating Equipment and Supplies Merchant Wholesalers (4237)

- LKD Aerospace Inc.

Machinery, Equipment, and Supplies Merchant Wholesalers (4238)

- AIM Aerospace Inc.
- B & C Manufacturing Inc.
- B/E Aerospace Inc.
- Centerline Machine Inc.
- Commercial Aircraft Interiors LLC
- Electroimpact Inc.
- Hill Industries Inc.
- Hydro Aire Inc.
- Intl Belt & Rubber Supply Inc.
- JBW Enterprises LLC
- Lite Air Aviation Products Inc.
- Marketing Masters Inc.
- Rockwell Collins Inc.

- Soundair Repair Group LLC
- Triumph Insulation Systems LLC
- VT Volant Aerospace LLC
- Xtreme Machining Inc.

Miscellaneous Durable Goods Merchant Wholesalers (4239)

- Tencate Advanced Composites USA

Chemical and Allied Products Merchant Wholesalers (4246)

- PRC Desoto International Inc.

Miscellaneous Nondurable Goods Merchant Wholesalers (4249)

- Centrix Inc.
- Evergreen Assembly LLC
- New Star Technology Incorporated

Other Motor Vehicle Dealers (4412)

- Cascade Aviation Services Inc.

Electronics and Appliance Stores (4431)

- Phil Kirk & Associates Inc.

Other Miscellaneous Store Retailers (4539)

- Mobile Tool Management Inc.

Nonscheduled Air Transportation (4812)

- Aircraft Propulsion Services LLC

Support Activities for Air Transportation (4881)

- A&R Aviation Services Inc.
- Absolute Aviation Services LLC DBA Absolute A
- Aero Controls Inc.
- Aerospace Testing Engineering & Certification
- Air Cargo Equipment Inc.
- Allflight Corp.
- Associated Painters Inc.
- Aviation Technical Services Inc.
- CHEP Aerospace US Inc.
- Kenmore Air Harbor Inc.
- Pacific Aero Tech LLC
- Pacific Northwest Inflatables Inc.

- Soniq Aerospace LP
- Team Aero Services Inc.
- Thales Avionics Inc.

Architectural, Engineering, and Related Services (5413)

- Aegis Technologies Group Inc.
- Aircraft Engineering Specialists Inc.
- Andersson Per AA
- Andrews Jimmie B & Beth A
- Ascent Engineering LLC
- BAE Systems Controls Inc.
- Bailey David P
- Cayley Aerospace Inc.
- D3 Technologies Inc.
- Endeavor Analysis LLC
- Fives Lund LLC
- Fokker Aerostructures Inc.
- G2 Engineers PLLC
- Glover John H & Robin W
- Hammerquist Kenneth
- Hoffman Joyce E
- Innovative Design Engineering & Analysis Inc.
- JBR Technologies LLC
- Kaman Engineering Services Inc.
- Kanen Inc.
- Krueger Consulting LLC
- Magnolia Aviation Services LLC
- NSE LLC
- Novacomp Engineering Inc.
- Olympic Aero Services Inc.
- Pacific Rim Aerospace Corporation
- Pacifica Engineering Inc.
- PDS Engineering Services Inc.
- PDS Tech Inc.
- Pekker Nison
- Pete Ross Aviation LLC
- Planetary Resources Development Corporation
- PM Testing Laboratory Inc.
- RMCC Consulting LLC
- Safran Landing Systems Everett LLC
- Scheiner Edward A
- Stinson William D

- Stresswave Inc.
- TFE Solutions Inc.
- TLG Aerospace LLC
- Triumph Actuation Systems Connecticut LLC

Specialized Design Services (5414)

- Aircraft Certification Service ACS LLC
- Walter Dorwin Teague Associates Inc.

Computer Systems Design and Related Services (5415)

- Archimedes Engineering LLC
- Collinear Group LLC
- Comet Design Inc.
- Diehl Aerospace Inc.
- Independent NC Programming Inc.
- Kleingartner Charles A
- Leitner Steve C & Cheryl A
- Loose Leaf Consulting Inc.
- Opcomm Inc.
- PFW Engineering Inc.
- San Juan Software LLC

Management, Scientific, and Technical Consulting Services (5416)

- Aero Xpertise LLC
- Aeromechanical Solutions LLC
- Air Informatics LLC
- Briski Consulting LLC
- Bush Point Partners LLC
- Cloudbreeze LLC
- DTA Technologies Inc.
- Fokker Elmo Inc.
- Helitrak Inc.
- Lund Carl H
- Mack Global Solutions LLC
- MJ Aerospace Consulting LLC
- Quicksilver Aerospace Consulting LLC
- Stewart Aviation MRO Consulting Group LLC
- Versogenics Inc.

Scientific Research and Development Services (5417)

- Kellegrew Kevin W

Other Professional, Scientific, and Technical Services (5419)

- Andre Consulting Inc.
- Draco Aerosystems Limited Liability Company
- Mitsubishi Aircraft Corporation America Inc.
- Sacore LLC
- TES Staffing Inc.
- Toolcraft Inc.

Employment Services (5613)

- Planetechs LLC
- Protingent Inc.
- Volt Management Corp

Other Support Services (5619)

- Windspeed Technologies LLC

Technical and Trade Schools (6115)

- TASS Inc.

Electronic and Precision Equipment Repair and Maintenance (8112)

- Avionics Shop Inc.
- Olympia Propeller Governor LLC

Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance (8113)

- Exotic Tool Welding Inc.
- Steel Fab Inc.

National Security and International Affairs (9281)

- Element Materials Technology Warren Inc.