

Aerospace in Washington

Economic Impacts and Workforce Analysis

March 2019

Prepared by:



Prepared for:





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

President and CEO:
Chris Mefford

Analysts:
Madalina Calen
Spencer Cohen, PhD
Diana Haring
Michaela Jellicoe

Community Attributes Inc.
500 Union Street, Suite 200
Seattle, Washington 98101

www.communityattributes.com

EXECUTIVE SUMMARY

Aerospace Economic Impacts

The aerospace industry in Washington, anchored by The Boeing Company, continues to be a major pillar of the statewide economy, and a leading source of employment and wealth creation across the state. Key findings from this study are as follows:

- In 2018, the aerospace industry generated an estimated \$71 billion in gross revenues in Washington state. Revenues appear to have increased since 2017, thereby sustaining a trend of much higher revenues relative to prior years. From 2002 to 2011, statewide revenues averaged \$40 billion. From 2012 through 2018, revenues averaged \$68 billion (all inflation adjusted, 2018 dollars).
- In 2018, Washington state's aerospace workforce is estimated to have reached 83,400 workers, about the same or down slightly from the average annual employment in 2017, industry wide. These workers were employed across 199 establishments. Jobs at Boeing increased in 2018, adding 4,000 jobs, which may portend industry wide gains continuing into 2019. 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.
- Total estimated aerospace labor compensation in 2018 totaled \$12.4 billion, very slightly down from 2017. In 2018, the average annual wage paid per worker was \$116,770 (compared to roughly, and an estimated \$63,000 across all industries and all workers in Washington in 2018).
- The total economic impact of the aerospace industry in Washington state in 2018 included 223,700 jobs, \$20.5 billion in labor income, and \$94.4 billion in business revenues. Between 2012 and 2018, the total economic impact of aerospace has increased from \$80.6 billion, in 2018 dollars, to \$94.4 billion. Total labor compensation impacts decreased from \$21.1 billion (2018 \$) to \$20.5 billion. Total jobs have decreased, reflecting productivity gains in the industry in Washington.

Aerospace Workforce Supply and Demand

Across the Washington state aerospace industry, more than 62,300 employees work in 56 core aerospace industry occupations. These core occupations represent only a portion of total employment within the aerospace industry. Overall employment within the aerospace industry includes employment in other occupations that are commonly found in other industries, as well. Core aerospace industry occupation employment is projected to grow at a compound annual growth rate of 0.8% between 2021 and 2026. In total, annual openings in core aerospace industry occupations

are projected to total more than 6,000 per year between 2021 and 2026. Annual openings include new jobs created due to growth as well as job openings created by existing employees exiting employment to retire, move or change occupations.

Annual openings are those openings that are projected to be filled annually and do not account for job openings that go unfilled. In 2018, across Washington, there were an average of more than 150,500 job postings per month, according to Help Wanted Online data from The Conference Board. Key aerospace occupation groups had thousands of job postings monthly. Engineering occupations averaged nearly 3,900 job postings per month. Production occupations, including supervisors, assemblers and fabricators, and metal and plastic workers had an average of nearly 2,000 job postings per month.

The Aerospace Workforce Supply and Demand Dashboard presented below shows occupations in the aerospace industry grouped by minimum education level required for entry and ranked by average annual openings within the industry from 2021 to 2026. In some cases, the actual education required by Washington state employers may be different from the minimum education level categories defined by the Bureau of Labor Statistics.

Overall findings include the following:

- Between 2021 and 2026 Washington is forecasted to have a net shortage of 2,651 among core aerospace occupations annually.
- Among 56 core aerospace occupations, 39 are projected to experience an undersupply of qualified workers from Washington annually.
- Core aerospace occupations span a wide diversity of skills ranging from aerospace engineers to machinists to software developers and computer numerically controlled machine tool programmers.
- Aircraft structure, surfaces, rigging and systems assemblers in the aerospace industry are forecasted to have an annual shortage of 800 workers, the largest projected talent gap in the industry. Qualified candidates from Washington are projected to fill just 22% of annual openings.
- Several occupations are forecasted to experience large surpluses in local workforce supply: industrial engineering technicians; architectural and engineering managers; industrial production managers; and electro-mechanical technicians are each projected to experience surpluses greater than 100 qualified candidates annually.

Washington Aerospace Workforce Supply and Demand Dashboard

On-the-Job Training

Annual Average Demand and Supply All Occupations by Education	Occupation Ranked by Annual Openings (2021-2026)	Employment		CAGR	Annual Demand and Supply, 2021-2026			
		2016	2026	2016-2026	Scale: 0 - 1,237 annual openings in sector	Gap		
<p>2,772</p> <p>796</p> <p>415 Graduates</p> <p>381 UI Claims</p>	1 Aircraft Structure, Surfaces, Rigging, and Systems Assemblers	12,166	10,664	-1.3%	Demand 1,031	Supply 231	(800)	
	2 Inspectors, Testers, Sorters, Samplers, and Weighers	12,042	12,020	0.0%	Demand 507	Supply 100	(407)	
	3 Production, Planning, and Expediting Clerks	10,449	11,325	0.8%	Demand 255	Supply 27	(228)	
	4 Machinists	10,700	11,090	0.4%	Demand 225	Supply 40	(185)	
	5 Tool and Die Makers	2,064	1,872	-1.0%	Demand 130	Supply 61	(69)	
	6 Painters, Transportation Equipment	2,571	2,911	1.2%	Demand 102	Supply 19	(83)	
	7 Computer-Controlled Machine Tool Operators, Metal and Plastic	1,753	1,629	-0.7%	Demand 94	Supply 90	(4)	
	8 Industrial Machinery Mechanics	7,053	7,514	0.6%	Demand 92	Supply 10	(82)	
	9 Fiberglass Laminators and Fabricators	1,338	1,305	-0.2%	Demand 54	Supply 12	(42)	

Associate Degree or Postsecondary Award

Annual Average Demand and Supply		Occupation	Employment		CAGR	Annual Demand and Supply, 2021-2026			
All Occupations by Education		Ranked by Annual Openings (2016-2026)	2016	2026	2016-2026	Scale: 0 - 756 annual openings in sector			Gap
<p>Demand: 919 Supply: 1,224 Graduates: 1,003 UI Claims: 221</p>	1	Aircraft Mechanics and Service Technicians	5,561	5,343	-0.4%	Demand	257		(56)
						Supply	201		
	2	First-Line Supervisors of Production and Operating Workers	15,198	16,012	0.5%	Demand	190		(164)
						Supply	26		
	3	Avionics Technicians	2,466	2,398	-0.3%	Demand	144		(108)
					Supply	36			
	4	Industrial Engineering Technicians	2,185	2,016	-0.8%	Demand	118		
						Supply	630		512
	5	Mechanical Drafters	2,231	2,215	-0.1%	Demand	91		
						Supply	95		4

Bachelor's Degree

Annual Average Demand and Supply		Occupation	Employment		CAGR	Annual Demand and Supply, 2021-2026		
All Occupations by Education		Ranked by Annual Openings (2018-2023)	2016	2026	2016-2026	Scale: 0 - 479 annual openings in sector		Gap
<div>Demand: 2,307</div> <div>Supply: 1,323</div> <div>879 Graduates</div> <div>444 UI Claims</div>	1	Logisticians	6,498	6,587	0.1%	Demand	399	(355)
						Supply	44	
	2	Industrial Engineers	7,719	8,461	0.9%	Demand	330	(304)
						Supply	26	
	3	Aerospace Engineers	6,816	6,194	-1.0%	Demand	274	45
						Supply	319	
	4	Purchasing Agents, Except Wholesale, Retail, and Farm Prod	9,306	9,603	0.3%	Demand	245	(227)
						Supply	18	
	5	Software Developers, Systems Software	15,674	20,972	3.0%	Demand	176	(128)
						Supply	48	
	6	Electrical Engineers	6,426	6,976	0.8%	Demand	122	(88)
						Supply	34	
	7	Mechanical Engineers	7,928	8,688	0.9%	Demand	102	(64)
						Supply	38	
	8	Operations Research Analysts	3,415	4,194	2.1%	Demand	90	(81)
					Supply	9		
	9	Architectural and Engineering Managers	4,729	4,983	0.5%	Demand	87	276
					Supply	363		
	10	Financial Analysts	6,987	8,502	2.0%	Demand	81	(69)
					Supply	12		
	11	Computer Network Architects	6,627	8,052	2.0%	Demand	74	(12)
					Supply	62		
	12	Financial Specialists, All Other	3,423	3,918	1.4%	Demand	60	(46)
					Supply	14		
	13	Materials Engineers	1,056	993	-0.6%	Demand	56	(44)
					Supply	12		
	14	Industrial Production Managers	2,741	2,841	0.4%	Demand	52	155
					Supply	207		
	15	Engineers, All Other	3,440	3,647	0.6%	Demand	50	(17)
					Supply	33		

Local and Regional Impacts

The large numbers of statewide impacts sometimes overshadow an understanding of how local communities benefit from aerospace and its employees that live and shop in their communities. Aerospace workers live relatively near their workplaces. Worker residences are concentrated in Western Washington counties, up and down nearly the entirety of the I-5 corridor, including many workers living on the eastern side of I-5 counties.

Everett, Marysville, Arlington and surrounding rural areas rank highest in worker residents, working out of facilities north of Seattle. Renton area and Kent industrial valley workers are more dispersed throughout urban areas in Western Washington.

Spending patterns of Aerospace workers in their places of residence provide an understanding of local impacts from Aerospace.

Everett-Lynnwood

In the Everett and Lynnwood area, Aerospace workers and spending support a tremendous amount of business activity. These workers support the equivalent of three car dealerships, or a total of 1,800 cars each year purchased by aerospace workers. Typical dining out patterns, assuming most of their spending is local to them, support \$76 million in sales at restaurants and drinking places, which equates to nearly 1,300 restaurant workers and 89 individual restaurants. Additional retail spending by aerospace workers supports nearly 900,000 square feet of retail space, nearly \$300 million in retail sales.

North Everett to Arlington

Northward from Everett into Arlington, aerospace workers support the equivalent of one to two car dealerships, or a total of 600 cars each year purchased by aerospace workers. Dining patterns support an estimated \$24 million in sales at restaurants and drinking places, which equates to more than 400 restaurant workers and roughly 28 individual restaurants. Additional retail spending by Aerospace workers supports nearly 270,000 square feet of retail space and nearly \$87 million in retail sales. The equivalent of 27 doctors and dentist offices are supported as well, summing to 600 jobs.

Auburn-Renton

From Auburn to Renton, aerospace workers support the equivalent of two car dealerships, or a total of 800 cars per year purchased by aerospace workers. Typical dining out patterns, assuming half of their spending is local to them, supports \$37 million in sales at restaurants and drinking places, which

equates to more than 600 restaurant workers and roughly 43 individual restaurants. Additional retail spending by Aerospace workers supports more than 400,000 square feet of retail space, \$130 million in retail sales. The equivalent of 51 doctors and dentist offices are supported by aerospace workers, totaling nearly 900 jobs.

Pierce and South King County.

In Pierce County communities, and the southern portion of King County, aerospace workers support the equivalent of one to three car dealerships, or a total of 1,200 cars per year purchased by Aerospace workers. Typical dining out patterns, assuming half of their spending is local to them, supports \$54 million in sales at restaurants and drinking places, which equates to more than 900 restaurant workers and roughly 63 individual restaurants. Retail spending by aerospace workers supports nearly 600,000 square feet of retail space, nearly \$200 million in retail sales. In terms of healthcare, aerospace workers support the equivalent of 55 doctors and dentist offices, or a total of 1,300 jobs.

blank

CONTENTS

Introduction	1
Direct Aerospace Activities in Washington State	3
Economic and Fiscal Impacts	7
Aerospace Workforce Supply and Demand	9
Local and Regional Impacts.....	23
Summary and Conclusions	31
Appendix A. Workforce Supply and Demand Detailed Methodology and Analysis	33

blank

INTRODUCTION

Background and Purpose

The aerospace industry is a major driver of economic activity in Washington state. Anchored by The Boeing Company and supported by an extensive supply chain, the aerospace industry is a key source of innovation, economic growth and wealth. Aerospace Works for Washington (AWW) is a non-profit coalition of elected, business and community leaders dedicated to ensuring Washington state remains a leader in aerospace. To advance this mission, AWW commissioned analysis and metrics updating previous aerospace industry assessments in 2013, 2015 and 2016 to provide strategic decision-making support for aerospace activities statewide.

This study provides a data-rich assessment of the aerospace industry's impact on the state economy, as well as an assessment of aerospace workers impacts on the communities where they live. Analysis includes both the direct activities of the aerospace industry and the secondary impacts of the industry through upstream business-to-business transactions and worker expenditures on goods and services throughout the economy. Additionally, this study examines in detail workforce supply and demand in the aerospace industry in Washington.

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. Implicit price deflators were sourced from the St. Louis Federal Reserve Bank. Figures for 2018 were based on the latest available data (through October) and modeled estimates for revenues and wages and employment data through 2018 from The Boeing Company.

The Washington State Input-Output Model was used to evaluate the statewide economic impacts of the aerospace industry, including indirect and induced impacts.

Workforce supply and demand analysis draws from data published by the Washington State Employment Security Department, the Bureau of Labor Statistics (BLS) and the National Center for Education Statistics (NCES). Specifically, the following data sources form the foundation of the modeling:

- **Occupational estimates and forecasts from the Washington State Employment Security Department (ESD) and the Bureau of Labor Statistics.** This data provides current estimates and forecasted demand for occupations in Washington and associated educational requirements, as well as occupational wages. Occupational forecasts include openings created by retirements and separations. For this reason, average annual openings are larger than the average of net jobs created over a period of time.
- **Washington unemployment insurance claims.** This data, also published by ESD, provides monthly unemployment claims and the previous occupations of the claimant by occupation code.
- **Educational attainment data from the National Center for Education Statistics' Integrated Postsecondary Education System (IPEDS).** IPEDS provides the number of graduates by educational program, defined according to the Classification of Instructional Programs, for Washington's higher education institutions as well as a table of equivalence used to translate educational programs and occupations.

In general, this data provides measures of demand and supply by occupation across industries. The occupations are defined in accordance with the Bureau of Labor Statistics Standard Occupational Classification system and industries are delineated using definitions from the North American Industry Classification System.

Organization of Report

- **Direct Aerospace Activities in Washington State.** Describes the employment, occupations and establishments that compose Washington's aerospace industry, as well as the wages and business revenues generated by the industry.
- **Economic and Fiscal Impacts.** Analyzes the total economic and fiscal impacts supported by aerospace in Washington.
- **Aerospace Workforce Supply and Demand.** Analyzes the occupational demand and supply in Washington's aerospace industry and examines how local supply is expected to meet occupational demand in Washington.
- **Local and Regional Impacts.** Provides an assessment, leveraging data and modeling tools, of the varied impacts of aerospace to cities and communities across the state.
- **Summary and Conclusions.** Summarizes the key findings on the direct, economic and fiscal impacts of aerospace in Washington and the workforce pipeline for the industry's workforce.

DIRECT AEROSPACE ACTIVITIES IN WASHINGTON STATE

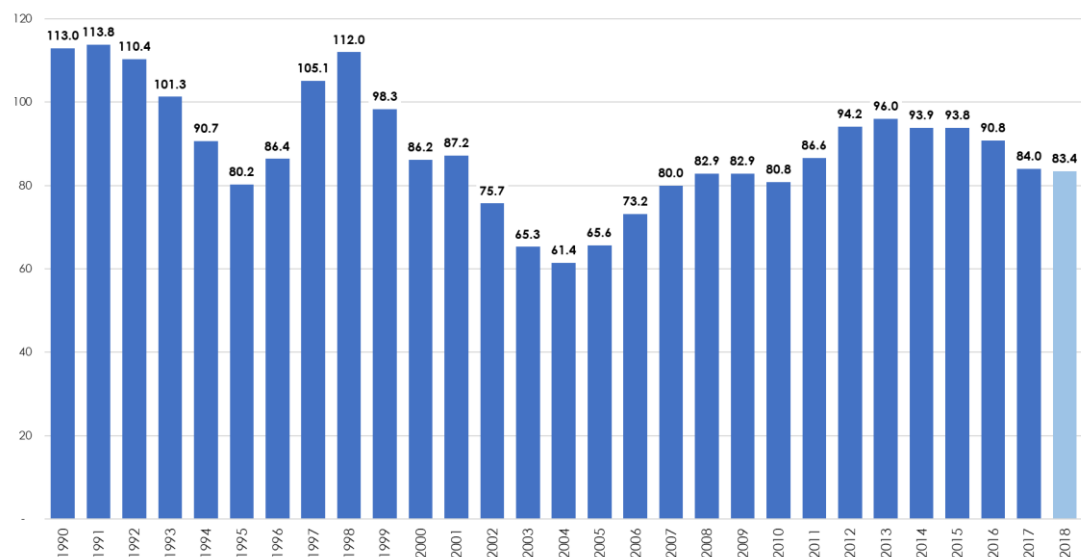
Employment and Establishments

In 2018, the aerospace industry directly employed an estimated 83,400 workers in Washington state, based on a monthly average for 2018. This represents a slight decline of 700 jobs from 2017 and is below a recent peak of 96,100 jobs in 2013 (**Exhibit 1**). The Boeing Company employed 69,800 workers in Washington state as January 1, 2019, the first increase in six years (**Exhibit 2**).¹

Since 2003, Boeing's Washington state employment has increased 14% relative to its total global employment. In 2018, Boeing's workforce in Washington state was roughly 47% of their global companywide employment, up from 33% in 2003. News reports indicate the 2017 layoffs at Boeing, the majority of which were voluntary, have concluded. According to The Boeing Company, 4,000 jobs were added at its Washington state operations in 2018.

Exhibit 1. Aerospace Employment in Washington State, 1990-2018

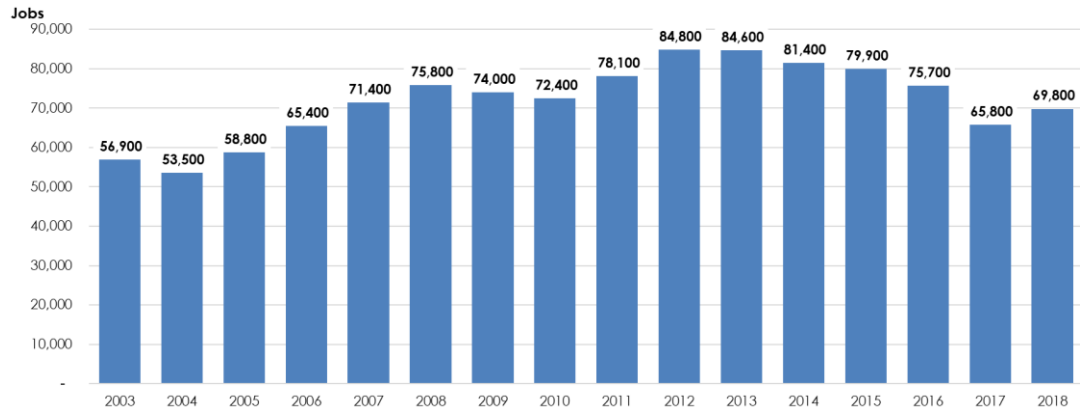
Thousands of Jobs



Sources: Washington State Employment Security Department, 2019; Community Attributes Inc., 2019.

¹ Employment for The Boeing Company in Washington state and statewide aerospace employment are not perfectly comparable, since the former represents employment as January 1, 2019, whereas Washington statewide employment represents a 12-month average from January to December of 2018. In December 2018, there were a reported 85,400 workers employed in the aerospace industry in Washington statewide, a 3,800 increase over January 2018.

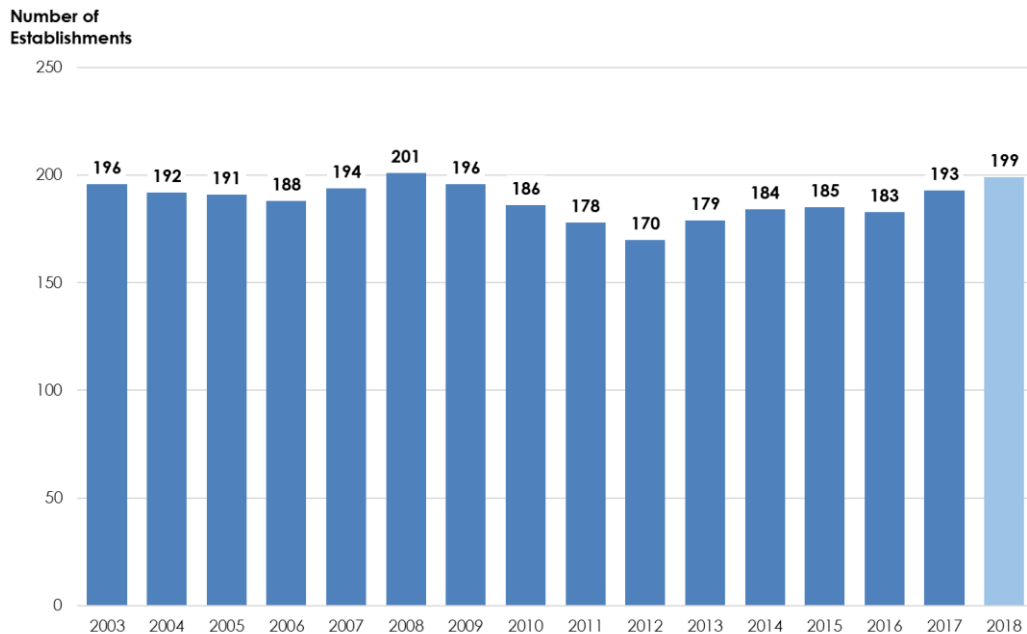
Exhibit 2. Boeing Employment in Washington State, 2003-2018



Sources: *The Boeing Company, 2019; Community Attributes Inc., 2019.*

Aerospace establishments represent places of employment for companies defined in federal employment data as “aerospace.” In some cases, a single company may have more than one establishment in Washington state, such as multiple production lines or offices. Despite the ups and downs of aerospace employment in recent years, the establishment count has increased each year since 2012 except for in 2016, dropping from 185 to 183. In 2018, based on the first two quarters of available data, aerospace establishments in Washington state averaged 199 (**Exhibit 3**).

Exhibit 3. Aerospace Establishments

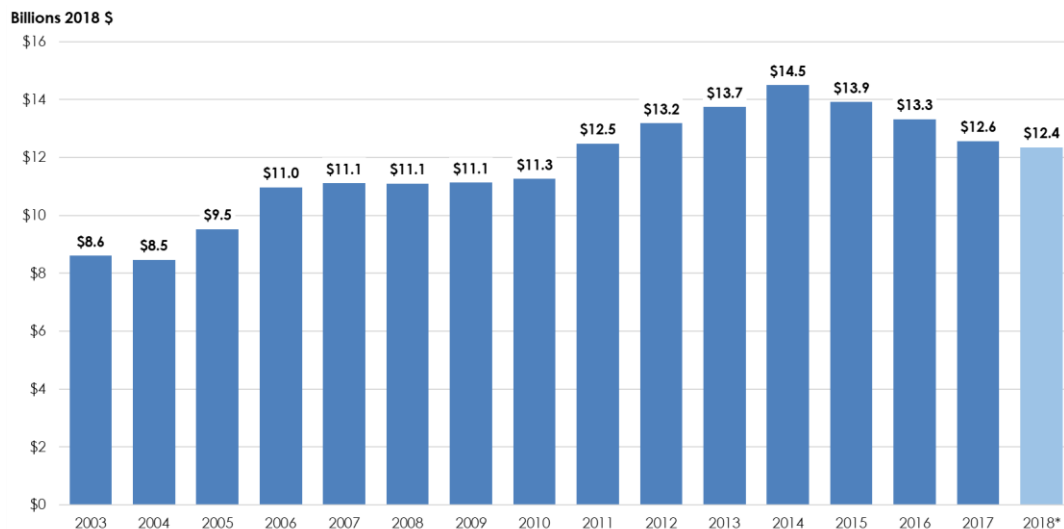


Sources: *U.S. Bureau of Labor Statistics, 2019; Community Attributes Inc., 2019.*

Wages

The aerospace industry generated a total of \$12.4 billion in annual wages (**Exhibit 4**), including benefits such as employer-provided health insurance. Adjusted for inflation, total annual compensation, in aggregate across all aerospace workers, declined slightly from a peak of \$14.5 billion in 2014. At the state level, aerospace workers averaged an annual wage (excluding benefits) of \$116,770 (**Exhibit 5**) in 2018. The statewide average annual wage for aerospace workers in 2017 was \$117,700. For comparison, the overall statewide average annual wage was \$62,100. The statewide aerospace industry average wage also declined from \$121,500 in 2014, which may in part reflect an increase in retirements and greater share of the workforce earlier in their careers since 2014 due to an aging workforce.

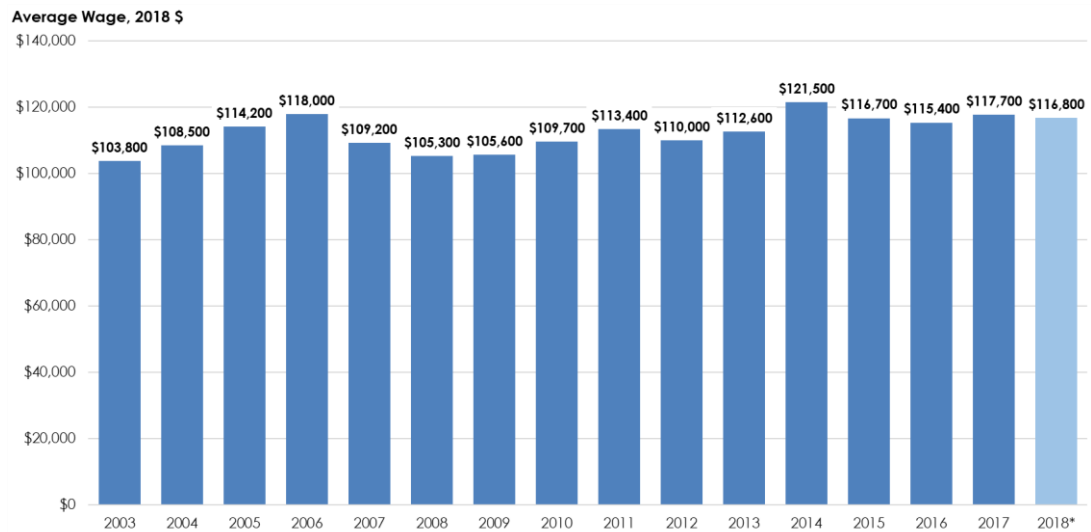
Exhibit 4. Aerospace Total Labor Compensation, Including Benefits, in Washington State, 2003-2018 (2018 \$)



**Estimate for 2018 based on available data.*

Sources: U.S. Bureau of Labor Statistics, 2019; Community Attributes Inc., 2019.

Exhibit 5. Aerospace Average Annual Wage in Washington State, 2003-2018 (2018 \$)



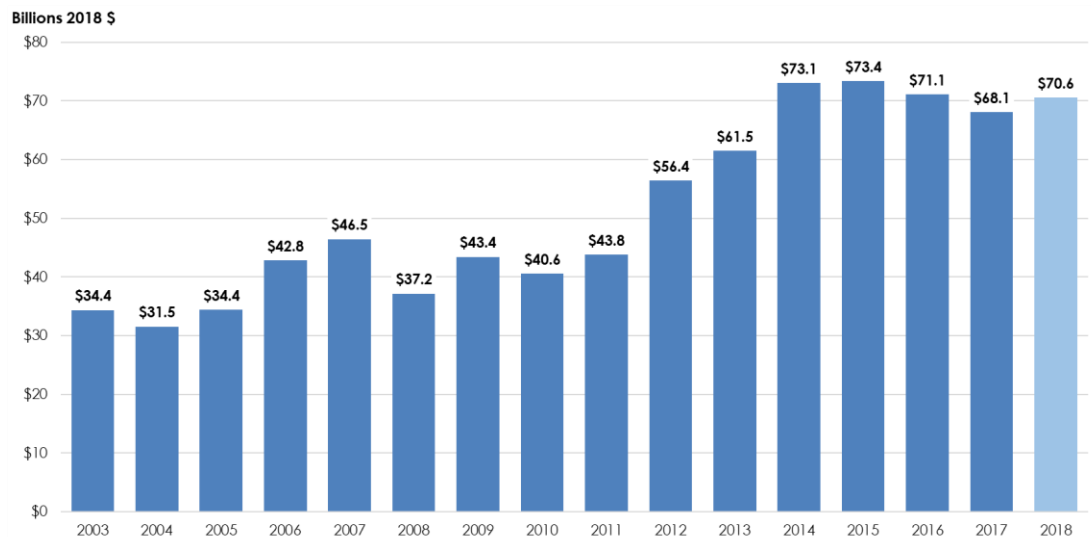
*Estimate for 2018 based on available data.

Sources: U.S. Bureau of Labor Statistics, 2019; Community Attributes Inc., 2019.

Business Revenues

Revenues from the aerospace industry in 2018 remained high by historic standards—gross business income in 2018 was more than double that of 2004 (\$31.5 billion, in 2018 dollars). In 2018, the aerospace industry directly generated \$70.6 billion in gross business income (**Exhibit 6**).

Exhibit 6. Aerospace Business Revenues in Washington State, 2003-2018 (2018 \$)



*Estimate for 2018 based on available data.

Sources: Washington State Department of Revenue, 2019; Community Attributes Inc., 2019.

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 industry 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 2018, the aerospace industry directly employed 83,400 workers, paid \$12.4 billion in labor income (including benefits) and generated an estimated \$70.6 billion in business revenues. These activities, in turn, supported a total of 223,700 jobs across the state economy, \$20.5 billion in labor income, and \$94.4 billion in business revenues through multiplier effects (**Exhibit 7**).

Exhibit 7. Economic Impacts of Aerospace in Washington, 2018

	Direct	Indirect	Induced	Total
Jobs	83,400	25,900	114,400	223,700
Total Compensation (mils 2018 \$)	\$12,381.3	\$1,948.9	\$6,133.6	\$20,463.8
Business Revenue (mils 2018 \$)	\$70,589.4	\$5,674.0	\$18,100.5	\$94,363.9

Sources: Office of Financial Management, 2019; Washington State Employment Security Department, 2019; Community Attributes Inc., 2019.

These impacts can be translated into economic multipliers. For example, each dollar of direct revenue in aerospace supports \$1.30 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 8**).

Exhibit 8. Economic Multipliers, 2018

Type	Multiplier
Total output per \$ final demand	1.3
Total jobs per direct job	2.7
Total compensation per \$ direct income	1.7
Total jobs per \$ mil final demand	3.2

Source: Office of Financial Management, 2019; Community Attributes Inc., 2019.

Between 2012 and 2018, the total economic impact of aerospace has increased from \$80.6 billion, in 2018 dollars, to \$94.4 billion. Total labor compensation impacts decreased from \$21.1 billion (2018 \$) to \$20.5 billion. The average annual wage among all jobs supported by aerospace has increased from \$83,100 in 2012 to \$91,500 (2018 \$). Between 2012 and 2018 the average annual compensation among direct aerospace jobs has increased from \$133,700 to \$148,500, including benefits. (**Exhibits 9 and 10**)

**Exhibit 9. Direct Aerospace Industry Economic Impacts, Washington,
2012 to 2018**

	2012	2014	2015	2016	2018
Jobs	94,200	93,400	93,800	90,800	83,400
Total Compensation (mils 2018 \$)	\$12,598	\$13,838	\$12,998	\$12,517	\$12,381
Business Revenue (mils 2018 \$)	\$54,509	\$60,020	\$69,835	\$67,845	\$70,589

Note: past direct revenue and employment estimates presented above do not exactly match historic data presented in earlier sections of this report due to subsequent state agency data revisions.

Sources: Washington Aerospace Partnership, 2013, 2015 and 2016; Community Attributes Inc, 2018, 2019.

**Exhibit 10. Total Aerospace Industry Economic Impacts, Washington,
2012 to 2018**

	2012	2014	2015	2016	2018
Jobs	253,400	267,200	252,800	242,800	223,700
Total Compensation (mils 2018 \$)	\$21,054	\$23,080	\$21,661	\$21,192	\$20,464
Business Revenue (mils 2018 \$)	\$80,611	\$88,161	\$96,301	\$93,955	\$94,364

Sources: Washington Aerospace Partnership, 2013, 2015 and 2016; Community Attributes Inc, 2018, 2019.

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 2018, the aerospace industry made estimated direct tax payments—including B&O, sales & use and other tax categories—of \$192.3 million. The total fiscal impact of the aerospace industry, including taxes paid by businesses associated with aerospace through indirect and induced impacts, summed to an estimated \$567.1 million in 2018 (**Exhibit 11**).

**Exhibit 11. Estimated Direct and Total Fiscal Impacts of Aerospace,
Washington State, 2018**

	Direct	Secondary	Total
B&O	\$152.1	\$103.3	\$255.5
Sales & Use Taxes	\$40.1	\$241.4	\$281.6
Other	\$0.0	\$30.1	\$30.1
Total	\$192.3	\$374.8	\$567.1

Source: Office of Financial Management, 2019; Washington State Department of Revenue, 2019; Community Attributes Inc., 2019.

AEROSPACE WORKFORCE SUPPLY AND DEMAND

The most recent forecasts produced by the Washington State Employment Security Department project declines in overall aerospace employment through 2026. The current outlook for workforce demand and supply provides an important element in helping industry and regional leaders to address future workforce challenges.

Core occupations represent the primary skills within the aerospace industry. **Exhibits 12 and 13** present these core aerospace occupations in Washington. These occupations were selected based on their relatively high concentration within the aerospace industry and the number of employees in total within the aerospace industry in Washington.

These core occupations represent only a portion of total employment within the aerospace industry. However, these occupations are highlighted because they represent the primary skills that define employment within the industry. Overall employment within the aerospace industry includes employment in other occupations that are not core to the industry. Additionally, core aerospace occupations are also present in industries other than aerospace throughout Washington.

Aerospace occupations fall within a range of SOC codes, with the highest concentrations among production and architecture and engineering, with more than 40,800 out of 62,300 employees within the aerospace industry, representing more than 65% of aerospace employment within Washington. Additionally, overall these occupations have the highest concentration within the aerospace industry of total occupational employment, 40% for production occupations and 41% for architecture and engineering. (**Exhibit 12**)

Aerospace occupations cover a diverse set of skills and experience. Across Washington, the occupation with the highest concentration in the industry are aircraft structure, surfaces, rigging and systems assemblers, this is also the occupation with the most employment within the aerospace industry. Other prominent production occupations within the Washington industry include inspectors, testers, sorters, samplers and weighers; machinists; first-line supervisors of production and operating workers; and tool and die makers, each with more than 1,000 jobs in Washington. The aerospace industry also employs a diversity of architecture and engineering occupations. The industry employs nearly 5,000 aerospace engineers, as well as more than 1,000 each of industrial engineers; electrical engineers; industrial engineering technicians; and mechanical engineers. (**Exhibit 12**)

Exhibit 12. Aerospace Architecture and Engineering Occupations and Production Occupations, Estimated Employment in Industry and Total Employment, Washington, 2018

SOC	Occupation	Employment in Industry	Employment in Other Industries	Total Employment	Share in Industry
51-2011	Aircraft Structure, Surfaces, Rigging, and Systems Assemblers	10,901	259	11,160	98%
51-9061	Inspectors, Testers, Sorters, Samplers, and Weighers	3,906	7,140	11,046	35%
51-4041	Machinists	1,943	7,873	9,815	20%
51-1011	First-Line Supervisors of Production and Operating Workers	1,671	12,270	13,941	12%
51-4111	Tool and Die Makers	1,450	444	1,893	77%
51-4011	Computer-Controlled Machine Tool Operators, Metal and Plastic	969	639	1,608	60%
51-9122	Painters, Transportation Equipment	734	1,624	2,358	31%
51-2091	Fiberglass Laminators and Fabricators	447	780	1,227	36%
51-4031	Cutting, Punching, and Press Machine Setters, Operators, and Tenders, Metal and Plastic	355	1,541	1,895	19%
51-4033	Grinding, Lapping, Polishing, and Buffing Machine Tool Setters, Operators, and Tenders, Metal and Plastic	331	672	1,004	33%
51-2031	Engine and Other Machine Assemblers	296	608	904	33%
51-9191	Adhesive Bonding Machine Operators and Tenders	286	294	580	49%
51-4012	Computer Numerically Controlled Machine Tool Programmers, Metal and Plastic	256	101	357	72%
51-9121	Coating, Painting, and Spraying Machine Setters, Operators, and Tenders	151	1,287	1,438	11%
51-4035	Milling and Planing Machine Setters, Operators, and Tenders, Metal and Plastic	113	186	298	38%
51-6093	Upholsterers	78	392	471	17%
51-4194	Tool Grinders, Filers, and Sharpeners	76	181	257	30%
51-4034	Lathe and Turning Machine Tool Setters, Operators, and Tenders, Metal and Plastic	40	108	149	27%
51-4023	Rolling Machine Setters, Operators, and Tenders, Metal and Plastic	38	310	348	11%
51-4191	Heat Treating Equipment Setters, Operators, and Tenders, Metal and Plastic	25	64	89	28%
Production Occupations Subtotal		24,066	36,772	60,838	40%
17-2011	Aerospace Engineers	4,964	1,288	6,252	79%
17-2112	Industrial Engineers	3,784	3,297	7,081	53%
17-2071	Electrical Engineers	1,465	4,430	5,895	25%
17-3026	Industrial Engineering Technicians	1,417	587	2,004	71%
17-2141	Mechanical Engineers	1,226	6,047	7,272	17%
17-3013	Mechanical Drafters	990	1,056	2,047	48%
17-2131	Materials Engineers	769	200	969	79%
17-2199	Engineers, All Other	625	2,531	3,156	20%
17-2072	Electronics Engineers, Except Computer	527	3,149	3,677	14%
17-3012	Electrical and Electronics Drafters	402	420	822	49%
17-3021	Aerospace Engineering and Operations Technicians	255	124	379	67%
17-3027	Mechanical Engineering Technicians	143	808	951	15%
17-3025	Environmental Engineering Technicians	121	312	433	28%
17-3024	Electro-Mechanical Technicians	70	63	133	53%
Architecture and Engineering Occupations Subtotal		16,758	24,311	41,070	41%

*Employment figures are estimated based on the latest available data through June 2018.
Sources: Bureau of Labor Statistics, 2019; Washington State Employment Security Department, 2019; Community Attributes Inc., 2019.*

Other SOC codes prominent within the aerospace industry include business and financial operations occupations; installation, maintenance and repair occupations; computer and mathematical occupations; management occupations; transportation and material moving occupations; life, physical, and social science occupations; healthcare practitioners and technical occupations; protective service occupations; and office and administrative support occupations. These occupations represent nearly 35% of total aerospace occupational employment, at roughly 21,500 jobs. Overall nearly 25% of total employment within these occupations is represented in the aerospace industry alone. (**Exhibit 13**)

The diversity in aerospace employment extends beyond production and architecture and engineering occupations. The industry also employs more than 3,600 logisticians and more than 3,300 aircraft mechanics and services technicians. Other occupations with more than 1,000 employees include purchasing agents; production, planning and expediting clerks; avionics technicians; software developers; and architectural and engineering managers. Occupations with high concentrations within the aerospace industry that exemplify the diversity of skills include materials engineers; computer numerically controlled machine tool programmers; aerospace engineering and operations technicians; and materials scientists. (**Exhibits 12 and 13**)

Exhibit 13. All Other Aerospace Occupations, Estimated Employment in Industry and Total Employment, Washington, 2018

SOC	Occupation	Employment in Industry	Employment in Other Industries	Total Employment	Share in Industry
13-1081	Logisticians	3,644	2,316	5,961	61%
13-1023	Purchasing Agents, Except Wholesale, Retail, and Farm Products	2,475	6,061	8,536	29%
13-2051	Financial Analysts	650	5,759	6,409	10%
13-2099	Financial Specialists, All Other	524	2,615	3,140	17%
	Business and Financial Operations Occupations Subtotal	7,294	16,752	24,046	30%
49-3011	Aircraft Mechanics and Service Technicians	3,302	1,799	5,101	65%
49-2091	Avionics Technicians	1,728	534	2,262	76%
49-9041	Industrial Machinery Mechanics	878	5,591	6,470	14%
49-2094	Electrical and Electronics Repairers, Commercial and Industrial Equipment	301	1,149	1,450	21%
	Installation, Maintenance, and Repair Occupations Subtotal	6,210	9,074	15,283	41%
15-1133	Software Developers, Systems Software	1,473	12,904	14,378	10%
15-2031	Operations Research Analysts	904	2,229	3,133	29%
15-1143	Computer Network Architects	716	5,363	6,079	12%
15-1122	Information Security Analysts	263	1,933	2,196	12%
15-2021	Mathematicians	34	110	144	24%
	Computer and Mathematical Occupations Subtotal	3,390	22,540	25,930	13%
11-9041	Architectural and Engineering Managers	1,038	3,300	4,338	24%
11-3051	Industrial Production Managers	634	1,880	2,514	25%
	Management Occupations Subtotal	1,672	5,180	6,852	24%
53-7021	Crane and Tower Operators	192	1,070	1,261	15%
53-2012	Commercial Pilots	157	826	983	16%
53-2022	Airfield Operations Specialists	43	224	267	16%
	Transportation and Material Moving Occupations Subtotal	392	2,119	2,512	16%
43-5061	Production, Planning, and Expediting Clerks	2,043	7,542	9,585	21%
29-9011	Occupational Health and Safety Specialists	257	2,278	2,535	10%
19-2032	Materials Scientists	145	124	270	54%
33-9021	Private Detectives and Investigators	92	519	611	15%
	All Occupations	62,321	127,211	189,531	33%

Employment figures are estimated based on the latest available data through June 2018.

Sources: Bureau of Labor Statistics, 2019; Washington State Employment Security Department, 2019; Community Attributes Inc., 2019.

There are more than 62,300 workers employed in aerospace core occupations in Washington state. Aerospace core occupational employment represents a third of all employment (127,200) in these occupations across the state economy. Total employment among Washington aerospace occupations is more than 189,500 employees, of which more than 127,200 work outside the aerospace industry. (**Exhibit 13**)

Aerospace occupations provide their workers with higher-than-average wages, overall the annual median wage across Washington was \$44,440 in 2017. Among all core aerospace occupations, the occupation with the highest median wage are architecture and engineering managers, followed by industrial production managers. Out of 56 core aerospace occupations nine have median wages higher than \$100,000, 24 have 90th percentile wages higher than \$100,000. Additionally, among all core aerospace occupations,

just ten have median wages less than the overall median wage in Washington. (Exhibits 14 and 15)

Exhibit 14. Aerospace Occupations Median Wage and 90th Percentile Wage, On-the-Job Training, Washington, 2017

SOC	Occupation	Employment in Industry	Median Wage ↓	90 th Percentile Wage
53-2012	Commercial Pilots	157	\$101,940	\$85,030
53-7021	Crane and Tower Operators	192	\$70,880	\$72,210
53-2022	Airfield Operations Specialists	43	\$66,480	\$63,230
51-4011	Computer-Controlled Machine Tool Operators, Metal and Plastic	969	\$62,940	\$57,810
49-9041	Industrial Machinery Mechanics	878	\$58,930	\$56,280
33-9021	Private Detectives and Investigators	92	\$63,990	\$54,520
51-9061	Inspectors, Testers, Sorters, Samplers, and Weighers	3,906	\$57,860	\$52,520
51-4194	Tool Grinders, Filers, and Sharpeners	76	\$55,360	\$52,490
51-9122	Painters, Transportation Equipment	734	\$58,350	\$50,610
51-4035	Milling and Planing Machine Setters, Operators, and Tenders, Metal and Plastic	113	\$57,370	\$50,420
51-4041	Machinists	1,943	\$51,020	\$49,070
43-5061	Production, Planning, and Expediting Clerks	2,043	\$49,140	\$45,380
51-2031	Engine and Other Machine Assemblers	296	\$47,580	\$43,840
51-4034	Lathe and Turning Machine Tool Setters, Operators, and Tenders, Metal and Plastic	40	\$46,550	\$42,040
51-6093	Upholsterers	78	\$44,530	\$41,080
51-9191	Adhesive Bonding Machine Operators and Tenders	286	\$46,570	\$41,050
51-2091	Fiberglass Laminators and Fabricators	447	\$44,460	\$39,950
51-4191	Heat Treating Equipment Setters, Operators, and Tenders, Metal and Plastic	25	\$47,170	\$39,740
51-4031	Cutting, Punching, and Press Machine Setters, Operators, and Tenders, Metal and Plastic	355	\$43,770	\$39,660
51-4023	Rolling Machine Setters, Operators, and Tenders, Metal and Plastic	38	\$42,960	\$39,290
51-9121	Coating, Painting, and Spraying Machine Setters, Operators, and Tenders	151	\$36,500	\$34,360
51-4033	Grinding, Lapping, Polishing, and Buffing Machine Tool Setters, Operators, and Tenders, Metal and Plastic	331	\$36,490	\$33,780
51-2011	Aircraft Structure, Surfaces, Rigging, and Systems Assemblers	10,901	*	*
51-4012	Computer Numerically Controlled Machine Tool Programmers, Metal and Plastic	256	*	*
51-4111	Tool and Die Makers	1,450	*	*

** indicates data is suppressed by the U.S. Bureau of Labor Statistics in order to comply with nondisclosure rules. Employment figures are estimated based on the latest available data through June 2018.*

Sources: U.S. Bureau of Labor Statistics, 2018; Washington State Employment Security Department, 2019; Community Attributes Inc., 2019.

On-the-job training, associate degree or postsecondary award, bachelor's degree and master's degree or higher are categories used to break core occupations into key groupings. These categories are based on Bureau of Labor Statistics minimum education requirements for entry. These education levels are set at a national level and may not be fully reflective of the hiring practices in Washington, or within individual companies. Additionally, the education level breakouts are attached to the occupation, actual openings for

these occupations may have different requirements, and the talent pool for these occupations may have a greater level of education than indicated by the minimum education level. These minimum education levels are used to group occupations by the relative level of education and training required for entry.

Exhibit 15. Aerospace Occupations Median Wage and 90th Percentile Wage, Associate Degree or Postsecondary Award or Higher, Washington, 2017

SOC	Occupation	Employment in Industry	Median Wage ↓	90 th Percentile Wage
Associate degree or Postsecondary Award				
17-3012	Electrical and Electronics Drafters	402	\$89,990	\$92,870
17-3021	Aerospace Engineering and Operations Technicians	255	\$92,980	\$88,410
17-3024	Electro-Mechanical Technicians	70	\$76,830	\$83,760
17-3013	Mechanical Drafters	990	\$80,010	\$81,940
17-3025	Environmental Engineering Technicians	121	\$69,470	\$71,690
49-2094	Electrical and Electronics Repairers, Commercial and Industrial Equipment	301	\$72,220	\$70,850
51-1011	First-Line Supervisors of Production and Operating Workers	1,671	\$73,020	\$68,390
49-3011	Aircraft Mechanics and Service Technicians	3,302	\$68,180	\$66,300
17-3027	Mechanical Engineering Technicians	143	\$64,000	\$62,400
17-3026	Industrial Engineering Technicians	1,417	*	*
49-2091	Avionics Technicians	1,728	*	*
Bachelor's degree				
11-9041	Architectural and Engineering Managers	1,038	\$154,140	\$148,230
11-3051	Industrial Production Managers	634	\$126,440	\$117,370
15-1133	Software Developers, Systems Software	1,473	\$117,810	\$117,280
17-2072	Electronics Engineers, Except Computer	527	\$107,060	\$109,280
17-2071	Electrical Engineers	1,465	\$110,360	\$107,570
15-1122	Information Security Analysts	263	\$106,040	\$105,420
17-2112	Industrial Engineers	3,784	\$106,730	\$104,230
17-2199	Engineers, All Other	625	\$101,260	\$102,530
15-1143	Computer Network Architects	716	\$104,890	\$92,830
17-2141	Mechanical Engineers	1,226	\$95,870	\$89,170
13-1081	Logisticians	3,644	\$89,120	\$88,280
15-2031	Operations Research Analysts	904	\$91,740	\$87,800
13-2051	Financial Analysts	650	\$85,860	\$79,090
29-9011	Occupational Health and Safety Specialists	257	\$78,980	\$75,910
13-1023	Purchasing Agents, Except Wholesale, Retail, and Farm Products	2,475	\$71,700	\$67,650
13-2099	Financial Specialists, All Other	524	\$74,130	\$66,910
17-2011	Aerospace Engineers	4,964	*	*
17-2131	Materials Engineers	769	*	*
19-2032	Materials Scientists	145	*	*
Master's degree or higher				
15-2021	Mathematicians	34	\$114,400	\$116,190

* indicates data is suppressed by the U.S. Bureau of Labor Statistics in order to comply with nondisclosure rules. Employment figures are estimated based on the latest available data through June 2018.

Sources: U.S. Bureau of Labor Statistics, 2018; Washington State Employment Security Department, 2019; Community Attributes Inc., 2019.

Demand Analysis

Total demand² for occupations matching the workforce needs of aerospace³ in Washington are projected to average nearly 19,600 annual openings between 2021 and 2026. Looking at the aerospace industry specifically, aerospace occupations are forecasted to have more than 6,000 openings between 2021 and 2026, with the most openings found in the aircraft structure, surfaces, rigging and systems assemblers occupation at more than 1,000 average annual openings. The occupation with the second highest forecasted demand is inspectors, testers, sorters, samplers and weighers, with more than 500 openings annually between 2021 and 2026. (**Exhibit 16**)

Forecasted occupational openings are sourced from the occupational projections developed by the Washington State Employment Security Department (ESD). Average annual openings include both openings generated by growth and openings generated by separations. Separations are created when workers leave an occupation for a different occupation or exit the labor force. Thus, average annual openings include openings created by growth, retirements and workers moving to different occupations.

Occupations with very low and negative growth rates have average annual openings generated exclusively by separations. Aircraft structure, surfaces, rigging, and systems assemblers is projected to decline in overall employment between 2021 and 2026, however, this occupation is also projected to have more than 1,000 openings annually, driven by retirements and other separations.

Total demand does not account for job openings that go unfilled annually. In 2018, there were an average of more than 150,500 job postings monthly across Washington, according to Help Wanted Online data from The Conference Board. Occupations with high projected demand also have significant job postings monthly. Computer specialist occupations, which include software developers averaged nearly 16,300 job postings monthly in 2018. Engineering occupations averaged nearly 3,900 job postings monthly. Production occupations also had significant numbers of job postings in 2018. Supervisors of production workers averaged more than 800 job postings each month. Assemblers and fabricators, which includes aircraft structure, surfaces, rigging and systems assemblers, had nearly 470 job postings each month. Metal and plastic workers averaged nearly 690 job postings monthly.

² Total demand may be underestimated, as the occupational projections used by the Employment Security Department represent the point of equilibrium between employment demand and supply. Thus, employment projections do not account for unmet demand or unfilled jobs.

³ Total demand for occupations covers demand across all industries in Washington and includes but is not limited to the aerospace industry.

All other production workers averaged nearly 1,400 job postings each month in 2018.

Exhibit 16. Washington Aerospace Occupational Demand per Year, 2021 and 2026

SOC	Occupation	Estimated Employment 2021	Estimated Employment 2026	Average Annual Openings (2021-2026)	Average Annual Openings in Industry (2021-2026)	CAGR (2021-2026)
15-1133	Software Developers, Systems Software	18,568	20,972	1,722	176	2.5%
51-1011	First-Line Supervisors of Production and Operating Workers	15,688	16,012	1,585	190	0.4%
51-9061	Inspectors, Testers, Sorters, Samplers, and Weighers	11,926	12,020	1,433	507	0.2%
43-5061	Production, Planning, and Expediting Clerks	10,881	11,325	1,195	255	0.8%
51-4041	Machinists	10,888	11,090	1,137	225	0.4%
51-2011	Aircraft Structure, Surfaces, Rigging, and Systems Assemblers	10,932	10,664	1,055	1,031	-0.5%
13-1023	Purchasing Agents, Except Wholesale, Retail, and Farm Products	9,414	9,603	846	245	0.4%
13-2051	Financial Analysts	7,897	8,502	800	81	1.5%
49-9041	Industrial Machinery Mechanics	7,313	7,514	674	92	0.5%
13-1081	Logisticians	6,412	6,587	653	399	0.5%
15-1143	Computer Network Architects	7,357	8,052	627	74	1.8%
17-2112	Industrial Engineers	7,991	8,461	617	330	1.1%
17-2141	Mechanical Engineers	8,291	8,688	605	102	0.9%
17-2071	Electrical Engineers	6,652	6,976	492	122	1.0%
49-3011	Aircraft Mechanics and Service Technicians	5,376	5,343	397	257	-0.1%
11-9041	Architectural and Engineering Managers	4,853	4,983	362	87	0.5%
13-2099	Financial Specialists, All Other	3,675	3,918	362	60	1.3%
17-2011	Aerospace Engineers	6,292	6,194	345	274	-0.3%
51-9122	Painters, Transportation Equipment	2,730	2,911	327	102	1.3%
15-1122	Information Security Analysts	2,900	3,424	315	38	3.4%
15-2031	Operations Research Analysts	3,799	4,194	312	90	2.0%
17-2072	Electronics Engineers, Except Computer	4,020	4,118	275	39	0.5%
17-2199	Engineers, All Other	3,523	3,647	252	50	0.7%
51-4031	Cutting, Punching, and Press Machine Setters, Operators, and Tenders, Metal and Plastic	2,073	2,074	232	43	0.0%
11-3051	Industrial Production Managers	2,787	2,841	205	52	0.4%
17-3013	Mechanical Drafters	2,189	2,215	189	91	0.2%
49-2091	Avionics Technicians	2,378	2,398	188	144	0.2%
29-9011	Occupational Health and Safety Specialists	2,960	3,114	182	18	1.0%
51-9121	Coating, Painting, and Spraying Machine Setters, Operators, and Tenders	1,628	1,661	177	19	0.4%
51-4111	Tool and Die Makers	1,905	1,872	170	130	-0.3%
17-3026	Industrial Engineering Technicians	2,034	2,016	167	118	-0.2%
51-4011	Computer-Controlled Machine Tool Operators, Metal and Plastic	1,650	1,629	156	94	-0.3%
53-7021	Crane and Tower Operators	1,403	1,427	151	23	0.3%
51-2091	Fiberglass Laminators and Fabricators	1,315	1,305	149	54	-0.2%
49-2094	Electrical and Electronics Repairers, Commercial and Industrial Equipment	1,579	1,586	137	28	0.1%
53-2012	Commercial Pilots	1,181	1,268	130	21	1.4%
51-4033	Grinding, Lapping, Polishing, and Buffing Machine Tool Setters, Operators, and Tenders, Metal and Plastic	1,087	1,092	115	38	0.1%
	All Other Occupations (19)	8,944	9,003	829	302	0.1%
	Total	212,491	220,699	19,565	6,001	0.8%

Sources: U.S. Bureau of Labor Statistics, 2019; Washington State Employment Security Department, 2019; Community Attributes Inc., 2019.

Supply Analysis

The local workforce supply is primarily composed of two elements: the entry of new graduates into the available talent pool and the existing talent pool of qualified unemployed workers actively seeking employment. It is important to note that workers from outside Washington can fill talent gaps but are not assessed in this analysis.

There are a total of 6,800 graduates in 2017 who are qualified for the needs of the aerospace industry. Among those graduates, 95% are assumed to seek work within Washington. Among these qualified graduates, 943 graduates are qualified for aerospace occupations that require on-the-job training.⁴ Among the total graduates from Washington institutions qualified for aerospace occupations, only a portion can be expected to seek work in the aerospace industry.

Total supply is defined as the sum of local qualified graduates and qualified unemployment insurance claimants. Within Washington, there are a total of 2,307 local graduates and 1,043 unemployment insurance claimants who can reasonably be expected to fill the needs of the aerospace industry within Washington. In total 69% of total supply is projected to be local graduates. Graduates qualified for aerospace occupations that require an associate degree or postsecondary award for entry represent 43% of total graduate supply, followed by graduates qualified for occupations that require a bachelor's degree for entry, representing 38%. (**Exhibit 17**)

Exhibit 17. Total Talent Supply, Washington, 2017

Source of Supply	Qualified Workers
On-the-Job Training	415
Associate Degree or Postsecondary Award	1,003
Bachelor's Degree	879
Master's Degree or Higher	10
Graduate Subtotal	2,307
Unemployment Insurance Claimants	1,043
Total	3,350

Sources: National Center for Education Statistics' Integrated Postsecondary Education System, 2018; Washington State Employment Security Department, 2019; Community Attributes Inc, 2019.

A wide range of educational institutions, high school programs and training centers provide training options for aerospace occupations. Completions data only includes information about postsecondary schools, some of the graduates from Washington training programs are not captured in the Washington

⁴ These occupations are undercounted due to the lack of information linking programs to occupations outside of IPEDS.

workforce supply. Additionally, high school students who may be qualified for some aerospace occupations are not counted in this supply analysis. For example, the Washington Aerospace Training & Research Center in Everett has training programs for aerospace manufacturing assembly mechanics, aerospace electrical assembly mechanics, aerospace quality assurance, aerospace tooling and aerospace composites.

Apprenticeships are also not included among the graduate supply estimates. The primary feature of an apprenticeship program is on-the-job training. Therefore, these individuals are already counted among the individuals employed in the industry. If they were to be added to the talent pool calculations, they would be double-counted within this analysis.

The Aerospace Joint Apprenticeship Committee (AJAC) provides advanced manufacturing training to improve the skills of the aerospace workforce through classroom and on-the-job training. Training programs offered by AJAC enhance worker skills for occupations including machinist; precision metal fabricator; tool and die maker; industrial maintenance technician; plastics process technician; industrial manufacturing technician. AJAC also provides youth apprenticeship and training for production technicians.

Across Washington, important initiatives and investment are being made to prepare students for STEM jobs, like those in the aerospace industry. The Career Connected Washington Task Force is a public private partnership with the aim of providing 100,000 youth in Washington with career connected learning over five years. Regional programs are also working to understand the skills needed by employers and matches training to meet those needs. Snohomish STEM for example is a non-profit working to link training with the STEM skills needed by regional employers.

Skills Centers across Washington provide high school students with vocational training options. Sno-Isle TECH is an effort of 14 school districts in the Snohomish County region, which provides students with a variety of training opportunities including information technology; business marketing and management; science and health; and trade and industry. These Skills Centers also offer high school students dual credit options to learn skills for career pathways and earn credit from regional higher education institutions. Sno-Isle TECH, for example, offers high school students dual credit courses in aerospace; precision machining; welding and metal fabrication; computers, servers and networking among others.

Supply and Demand

The combined elements of expected supply and projected occupational demand yields a summary of annual occupational gaps within the aerospace industry. **Exhibits 19** and **20** summarize graduate supply, total demand, UI claimant supply and the expected gaps for each aerospace occupation.

The aerospace industry's annual workforce supply in Washington is projected to total 3,350, composed of Washington graduates entering the workforce after completing an aerospace-related educational program (69%) and unemployed persons whose most recent occupation was in aerospace (31%). Total openings in Washington's aerospace industry is projected to total more than 6,000 annually. Taken together, projected annual supply and demand indicate an overall shortage of 2,651 workers annually from 2021 to 2026. Although the overall workforce supply and demand analysis indicates a shortage, it is important to note that there are both shortages and surpluses in key aerospace occupations. (**Exhibit 18**)

An examination of occupations by the minimum education level requirements reveals where the significant gaps exist. Jobs that require on-the-job training are projected to experience a shortage of 1,976 in qualified workers in Washington. Jobs that require a bachelor's degree are also forecasted to see a gap of qualified workers, nearly 43% of forecasted annual openings could go unfilled by Washington workers. The opposite situation is expected to occur among occupations that require an associate degree, these occupations are projected to experience a surplus of 305 qualified candidates from Washington. (**Exhibit 18**)

Exhibit 18. Summary of Annual Aerospace Talent Supply and Demand by Education Requirement, 2021 -2026

Educational Requirements	Total Graduate Supply	Total Demand	Interim Gap	Total UI Claims Supply	Final Gap
On-the-Job Training	414	2,772	(2,358)	382	(1,976)
Associate Degree or Postsecondary Award	1,004	919	85	220	305
Bachelor's Degree	879	2,307	(1,428)	441	(987)
Master's Degree or Higher	10	3	7	0	7
Total	2,307	6,001	(3,694)	1,043	(2,651)

Sources: U.S. Bureau of Labor Statistics, 2019; Washington State Employment Security Department, 2019; National Center for Education Statistics' Integrated Postsecondary Education System, 2018; Community Attributes Inc., 2019.

It is important to bear in mind not all occupations within an educational grouping are easily substitutable. A surplus in one occupation may not necessarily be countered by a shortage in another occupation. The skills required may not be the same between occupations. As such, a detailed

account of the prospective supply and demand for each primary occupation can help organizations anticipate and plan for possible labor shortages and surpluses in the future.

While significant gaps are expected among specific occupations it is important to note that these jobs will be filled through other sources of talent. In some cases, high school students may have the necessary skills to fill jobs that require on-the-job training. Additionally, these jobs may be filled by individuals graduating from aerospace training programs. Out-of-state workers are also expected to fill projected occupational gaps.

The largest expected gap in the talent pool for aerospace occupations requiring on-the-job training is projected to be among aircraft structure, surfaces, rigging and systems assemblers, with a statewide shortage of 800 qualified workers. The occupation with the largest projected surplus is among computer numerically controlled machine tool programmers, metal and plastic with a projected oversupply of 36 trained workers. (**Exhibit 19**)

**Exhibit 19. Annual Supply and Demand, On-the-Job Training, Washington,
2021-2026**

Occupation	Total Graduate Supply	Total Demand	Interim Gap	Total UI Claims Supply	Final Gap ↓
Aircraft Structure, Surfaces, Rigging, and Systems Assemblers	153	1,031	(878)	78	(800)
Inspectors, Testers, Sorters, Samplers, and Weighers	3	507	(504)	97	(407)
Production, Planning, and Expediting Clerks	1	255	(254)	25	(229)
Machinists	6	225	(219)	34	(185)
Painters, Transportation Equipment	9	102	(93)	10	(83)
Industrial Machinery Mechanics	2	92	(90)	9	(81)
Tool and Die Makers	54	130	(76)	8	(68)
Fiberglass Laminators and Fabricators	0	54	(54)	12	(42)
Cutting, Punching, and Press Machine Setters, Operators, and Tenders, Metal and Plastic	5	43	(38)	6	(32)
Adhesive Bonding Machine Operators and Tenders	0	31	(31)	2	(29)
Engine and Other Machine Assemblers	2	25	(23)	0	(23)
Grinding, Lapping, Polishing, and Buffing Machine Tool Setters, Operators, and Tenders, Metal and Plastic	10	38	(28)	10	(18)
Coating, Painting, and Spraying Machine Setters, Operators, and Tenders	0	19	(19)	6	(13)
Crane and Tower Operators	0	23	(23)	14	(9)
Commercial Pilots	14	21	(7)	2	(5)
Computer-Controlled Machine Tool Operators, Metal and Plastic	52	94	(42)	38	(4)
Tool Grinders, Filers, and Sharpeners	0	9	(9)	7	(2)
Private Detectives and Investigators	8	11	(3)	2	(1)
Rolling Machine Setters, Operators, and Tenders, Metal and Plastic	3	4	(1)	0	(1)
Upholsterers	8	10	(2)	2	0
Lathe and Turning Machine Tool Setters, Operators, and Tenders, Metal and Plastic	6	4	2	2	4
Milling and Planing Machine Setters, Operators, and Tenders, Metal and Plastic	9	11	(2)	6	4
Heat Treating Equipment Setters, Operators, and Tenders, Metal and Plastic	8	3	5	0	5
Airfield Operations Specialists	11	5	6	1	7
Computer Numerically Controlled Machine Tool Programmers, Metal and Plastic	50	25	25	11	36
On-the-Job Training Subtotal	414	2,772	(2,358)	382	(1,976)

Sources: U.S. Bureau of Labor Statistics, 2019; Washington State Employment Security Department, 2019; National Center for Education Statistics' Postsecondary Education System, 2018; Community Attributes Inc., 2019.

Among occupations requiring an associate degree or postsecondary award, first-line supervisors of production and operating workers are projected to experience the largest gap of local qualified workers, with projected demand of 190 workers annually and projected supply of 26 qualified workers from Washington. The occupation with the largest projected surplus is industrial engineering technicians with a projected surplus of 512 local qualified workers. **(Exhibit 20)**

The occupation with the largest projected gap among aerospace occupations requiring a bachelor's degree is among logisticians, with a shortfall of 354 qualified workers annually statewide. Architectural and engineering

managers are projected to have an annual surplus of 276 qualified workers, with projected supply of 363 annual qualified candidates from Washington and annual demand in the aerospace industry of 87. (**Exhibit 20**)

Exhibit 20. Annual Supply and Demand, Associate Degree or Postsecondary Award and Higher, Washington, 2021-2026

Occupation	Total Graduate Supply	Total Demand	Interim Gap	Total UI Claims Supply	Final Gap ↓
First-Line Supervisors of Production and Operating Workers	1	190	(189)	25	(164)
Avionics Technicians	4	144	(140)	31	(109)
Aircraft Mechanics and Service Technicians	120	257	(137)	81	(56)
Electrical and Electronics Repairers, Commercial and Industrial Equipment	2	28	(26)	4	(22)
Environmental Engineering Technicians	6	12	(6)	1	(5)
Aerospace Engineering and Operations Technicians	2	22	(20)	20	0
Mechanical Drafters	77	91	(14)	19	5
Mechanical Engineering Technicians	16	14	2	4	6
Electrical and Electronics Drafters	62	37	25	9	34
Electro-Mechanical Technicians	96	6	90	14	104
Industrial Engineering Technicians	618	118	500	12	512
Associate Degree or Postsecondary Award Subtotal	1,004	919	85	220	305
Logisticians	3	399	(396)	42	(354)
Industrial Engineers	4	330	(326)	22	(304)
Purchasing Agents, Except Wholesale, Retail, and Farm Products	0	245	(245)	18	(227)
Software Developers, Systems Software	30	176	(146)	19	(127)
Electrical Engineers	11	122	(111)	22	(89)
Operations Research Analysts	0	90	(90)	8	(82)
Financial Analysts	3	81	(78)	9	(69)
Mechanical Engineers	7	102	(95)	31	(64)
Financial Specialists, All Other	4	60	(56)	10	(46)
Materials Engineers	1	56	(55)	10	(45)
Electronics Engineers, Except Computer	6	39	(33)	4	(29)
Engineers, All Other	11	50	(39)	22	(17)
Materials Scientists	0	14	(14)	0	(14)
Computer Network Architects	53	74	(21)	9	(12)
Occupational Health and Safety Specialists	6	18	(12)	4	(8)
Information Security Analysts	58	38	20	4	24
Aerospace Engineers	174	274	(100)	145	45
Industrial Production Managers	165	52	113	42	155
Architectural and Engineering Managers	343	87	256	20	276
Bachelor's Degree Subtotal	879	2,307	(1,428)	441	(987)
Mathematicians	10	3	7	0	7
Master's Degree or Higher Subtotal	10	3	7	0	7
Total	2,307	6,001	(3,694)	1,043	(2,651)

Sources: U.S. Bureau of Labor Statistics, 2019; Washington State Employment Security Department, 2019; National Center for Education Statistics' Postsecondary Education System, 2018; Community Attributes Inc., 2019.

Overall, the aerospace industry's projected annual workforce supply in Washington is expected to total 3,350 annually between 2021 and 2026. The industry is projected to have average annual openings of 6,001. Taken together Washington's aerospace supply and demand indicate a shortfall of 2,651 qualified workers annually between 2021 and 2026. (**Exhibit 21**)

Exhibit 21. Summary of Annual Talent Supply and Demand by Education Requirement, Washington, 2021 -2026

Annual Surplus or (Shortage)	
Total Openings (Demand)	6,001
Unemployed	1,043
Newly-Trained Candidates	2,307
Total Supply	3,350
Surplus or (Shortage)	(2,651)

Sources: U.S. Bureau of Labor Statistics, 2019; Washington State Employment Security Department, 2019; National Center for Education Statistics' Integrated Postsecondary Education System, 2018; Community Attributes Inc., 2019.

LOCAL AND REGIONAL IMPACTS

The aerospace industry and The Boeing Company have large, varied impacts to communities across the state. This section reviews each of these impacts, defined as follows:

- Jobs and income among aerospace workers—and the associated benefits to the communities these workers live in.
- The spending of income among these workers, both in their own communities and in nearby commercial areas.
- Wealth effects from dividends and capital gains from appreciation in The Boeing Company stock value, and the many individuals and families who own Boeing stock, either directly or through a retirement investment plan or other financial investment that includes Boeing stock.
- Employee charitable contributions and The Boeing Company matches.

Aerospace Jobs by Zip Code and Region

The majority of aerospace jobs by place of work and residence are within the Puget Sound region, owing to the concentration of Boeing and supplier operations in the region. **Exhibits 22** illustrates key aerospace facilities across the state, highlighting Boeing offices and facilities in the region.

These facilities serve as anchors for aerospace employment residencies in the region. Outside of the Puget Sound region, there are concentrations of aerospace workers living in areas in Southwestern Washington, Spokane, as well as in Central Washington (**Exhibit 23** and **24**).

Exhibit 22. Aerospace Jobs by Place of Work, 2016

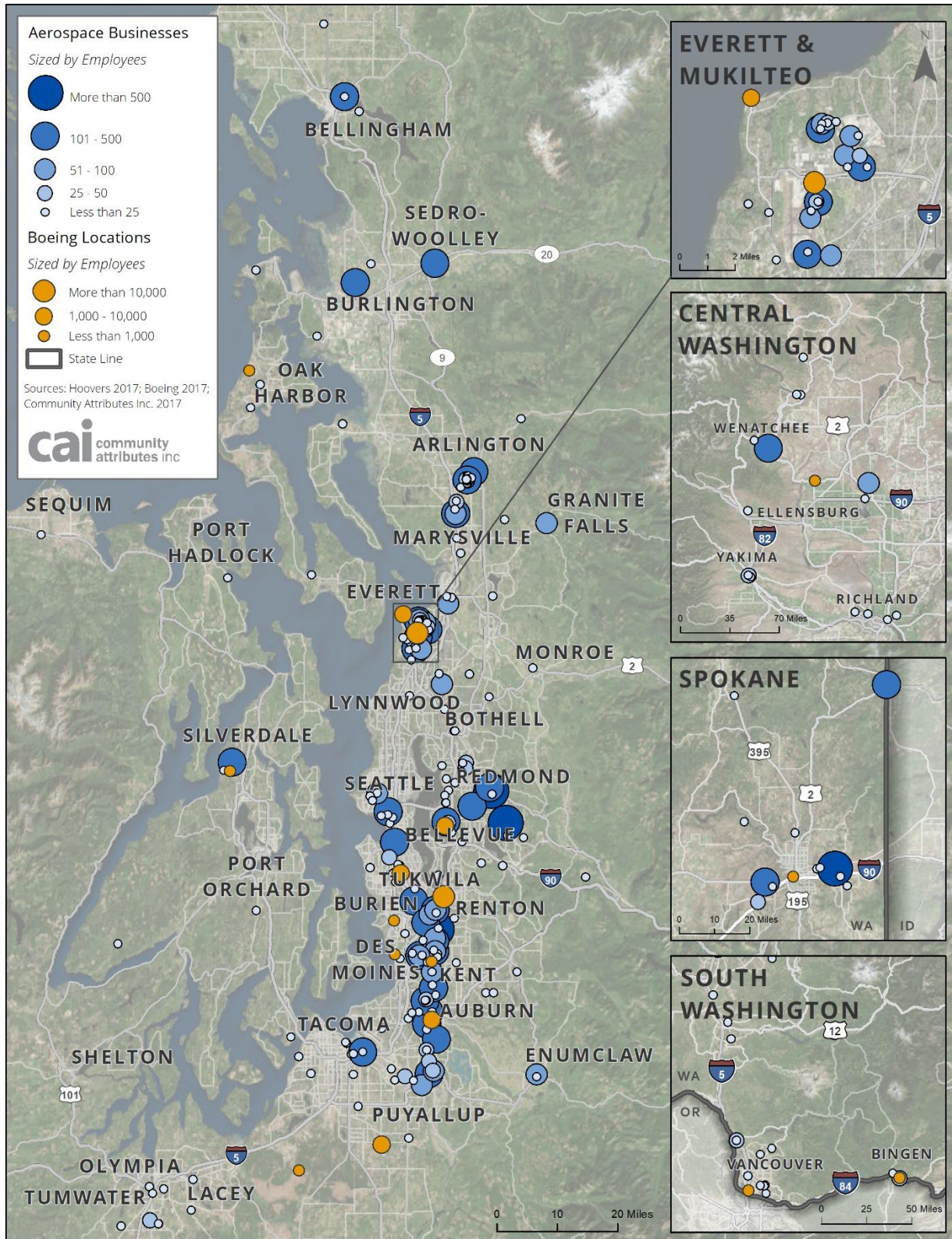
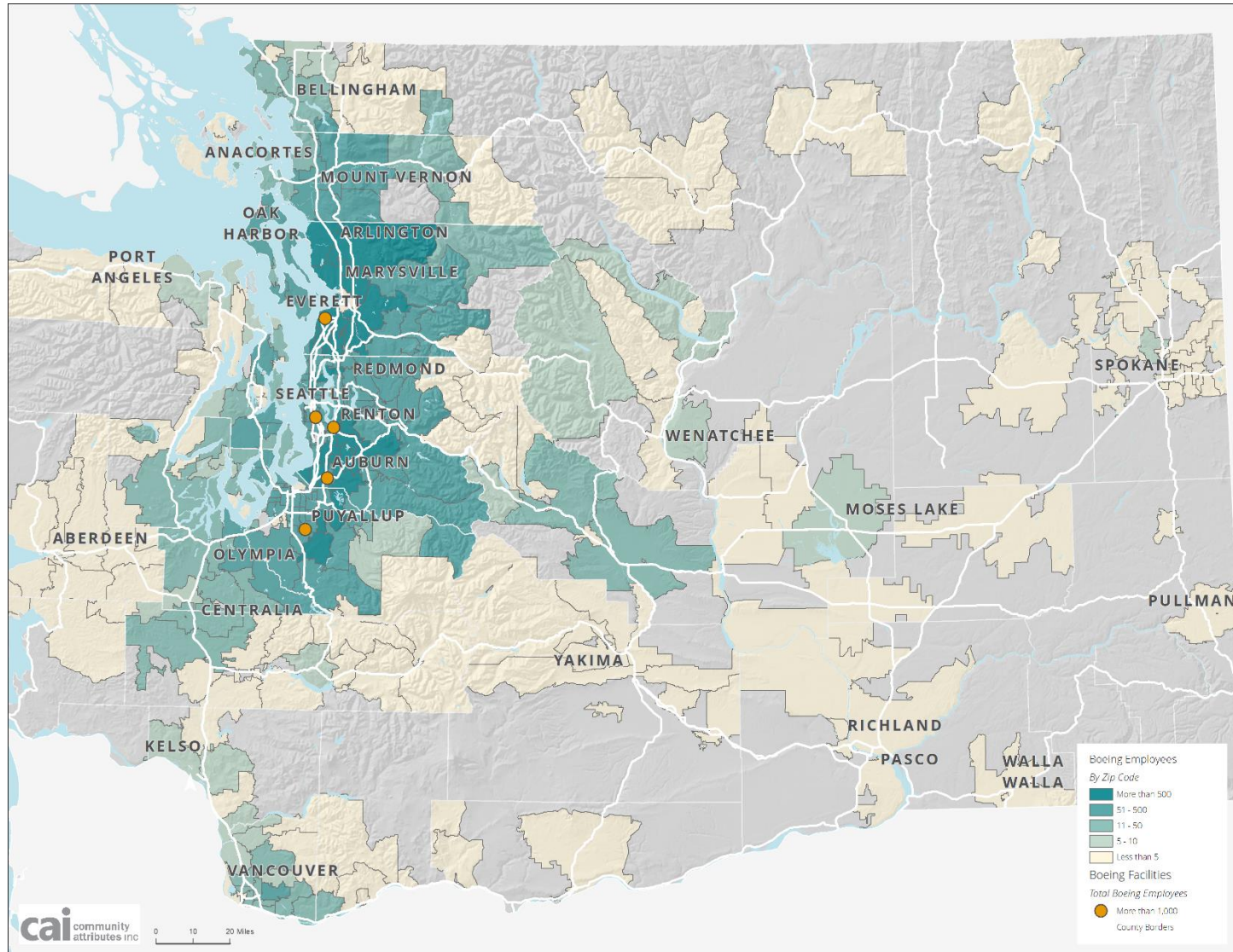


Exhibit 23. Boeing Workers by Place of Residence, 2017



Source: The Boeing Company, 2017.

Exhibit 24. Aerospace Workers by Place of Residence, As Share of Local Workforce, and Wages, 20 Largest Zip Codes by Aerospace Workers, 2016

Zip Code	City	Aerospace Workforce	Share of Total Labor Force	Aerospace Wages
98208	Arlington	3,100	9.8%	\$109,900
98258	Arlington	2,900	17.0%	\$329,800
98270	Arlington	2,600	10.2%	\$329,800
98223	Arlington	2,300	10.9%	\$250,780,100
98203	Everett	2,100	11.0%	\$227,692,000
98275	Everett	1,900	16.9%	\$1,099,400
98204	Arlington	1,700	7.4%	\$109,900
98012	Bothell	1,400	4.3%	\$153,150,700
98290	Lynnwood	1,300	7.0%	\$109,900
98087	Camano Island	1,300	6.3%	\$109,900
98058	Kenmore	1,200	5.2%	\$109,900
98391	Bonney Lake	1,200	4.5%	\$131,381,900
98271	Everett	1,200	8.4%	\$329,800
98092	Auburn	1,200	5.1%	\$126,544,400
98296	Everett	1,100	6.9%	\$109,900
98059	Newcastle	1,100	5.4%	\$15,941,700
98292	Arlington	1,100	10.0%	\$109,900
98038	Maple Valley	1,000	5.7%	\$114,560,600
98012	Bothell	1,000	3.0%	\$153,150,700
98031	Kent	900	4.3%	\$95,870,300

Sources: Washington State Employment Security Department, 2017; U.S. Census Bureau, American Community Survey 5-year estimates, 2017; Community Attributes Inc., 2018.

Regional Analysis and Impacts

Four regions were selected for assessment of aerospace worker spending impacts: 1) Everett-Lynnwood; 2) North of Everett to Arlington; 3) Auburn-Renton; and 4) Pierce and South King County, representing a much larger region encompassing the Auburn-Renton area plus neighboring zip codes and all of Pierce County. In 2016, more than 25,500 aerospace workers lived in the Pierce and South King County region, with another nearly 25,000 in the Everett-Lynnwood region. Workers in Everett-Lynnwood earned, before benefits, more than \$2.7 billion in wages that in turn supported nearly \$1 billion in personal consumption within the resident region (**Exhibit 25**).

Exhibit 25. Summary of Workers, Wages and Spending by Area, 2016

	Everett-Lynnwood	North of Everett to Arlington	Auburn-Renton	Pierce and South King County
Resident Aerospace workers	24,784	11,332	14,170	25,543
Wage and salary income (mils \$)	\$2,724.8	\$1,245.9	\$1,557.9	\$2,808.3
Estimated personal consumption within resident region (mils \$)	\$1,461.9	\$445.6	\$668.7	\$1,004.5

Sources: Washington State Employment Security Department, 2017; Washington State Department of Revenue, 2017; U.S. Bureau of Economic Analysis, 2018; Community Attributes Inc., 2018.

Aerospace jobs in these regions were then grouped into high, medium and low wage occupations, relative to the statewide average wage. As is the case with aerospace jobs in general in Washington, the majority of positions are those that earn at or above 120% of the state average, with many of these jobs well above this threshold. Roughly about one third (34%) of all aerospace jobs are estimated to earn within 20% of the state average (**Exhibit 26**).

Exhibit 26. Aerospace Jobs by Region and Wage Range, 2016

Wage Category	Everett-Lynnwood	North of Everett to Arlington	Auburn-Renton	Pierce and South King County	All Aerospace Jobs
High Wage Jobs (+20% state average wage)	14,803	6,761	8,465	15,259	50,249
Medium Wage Jobs (within 20% state average wage)	8,409	3,843	4,804	8,661	28,546
Low Wage Jobs (20% below state average wage)	1,572	716	892	1,618	5,326
Total	24,784	11,320	14,161	25,538	84,121

Sources: Washington State Employment Security Department, 2017; Washington State Department of Revenue, 2017; U.S. Bureau of Economic Analysis, 2018; Community Attributes Inc., 2018.

Exhibit 27 below provides a summary of estimated aerospace worker personal consumption expenditures in their home region. Analytics are based on regional assumptions of the amount of spending in that region equivalent to a share of each worker's personal income spending, the remainder being spent in other regions or saved in a financial institution. The assumptions per region, based on taxable retail sales analysis for each region, are as follows:

Everett-Lynnwood:	75%
North Everett to Arlington:	50%
Auburn to Renton:	60%
Pierce and South King County:	50%

**Exhibit 27. Aerospace Worker Estimated Personal Consumption
Expenditures by Resident Region, 2016**

PCE Category	Everett- Lynnwood	North of Everett to Arlington	Auburn- Renton	Pierce and South King County
Durable Goods	\$165,088,140	\$50,322,219	\$75,509,972	\$113,429,265
Motor vehicles and parts	\$45,980,811	\$14,015,885	\$21,031,249	\$31,592,636
Furnishings and durable household equipment	\$37,602,085	\$11,461,879	\$17,198,888	\$25,835,756
Recreational goods and vehicles	\$62,091,124	\$18,926,636	\$28,399,975	\$42,661,760
Other durable goods	\$19,380,060	\$5,907,436	\$8,864,282	\$13,315,711
Nondurable goods	\$285,217,265	\$86,940,016	\$130,456,057	\$195,967,953
Food and beverages purchased for off-premises consumption	\$109,059,671	\$33,243,603	\$49,883,006	\$74,933,053
Clothing and footwear	\$36,954,948	\$11,264,619	\$16,902,893	\$25,391,119
Gasoline and other energy goods	\$22,172,969	\$6,758,771	\$10,141,736	\$15,234,671
Other nondurable goods	\$117,029,678	\$35,673,023	\$53,528,423	\$80,409,110
Services	\$1,011,611,894	\$308,359,855	\$462,703,052	\$695,061,400
Household consumption expenditures (for services)	\$966,652,879	\$294,655,434	\$442,139,164	\$664,170,822
Housing and utilities	\$285,285,385	\$86,960,781	\$130,487,215	\$196,014,757
Health care	\$234,978,972	\$71,626,364	\$107,477,471	\$161,450,072
Transportation services	\$49,591,156	\$15,116,392	\$22,682,591	\$34,073,243
Recreation services	\$62,840,441	\$19,155,043	\$28,742,707	\$43,176,603
Food services and accommodations	\$87,738,199	\$26,744,385	\$40,130,738	\$60,283,430
Financial services and insurance	\$113,828,051	\$34,697,102	\$52,064,025	\$78,209,326
Other services	\$132,390,675	\$40,355,367	\$60,554,418	\$90,963,391
Total	\$1,461,917,300	\$445,622,091	\$668,669,081	\$1,004,458,618

Based on the above analytics, several spending impacts by industry are estimated. Examples of spending are provided in **Exhibit 28** below.

- **Car and truck sales.** Aerospace workers in the Everett-Lynnwood region spent an estimated \$46.0 million in automobile purchases within the region in 2016, the equivalent of 1,800 cars sold, or approximately five whole dealerships in the region.
- **Restaurants.** Aerospace workers in the region North of Everett to Arlington spent an estimated \$24.3 million at food and beverage establishments in the region in the 2016, the equivalent of 3.5% of all restaurant sales in the region and supporting more than 400 jobs.
- **Doctor and dentist offices.** Aerospace workers in Pierce and South King County spent an estimated \$161.5 million on healthcare services in the region in 2016, equal to 2.0% of all healthcare spending in the region.
- **Retail.** In the Auburn-Renton region, aerospace workers spent \$130.5 million on retail in the region, equivalent to 400,000 square feet of retail space.

Exhibit 28. Spending Impacts from Aerospace Workers by Region, 2016

PCE Category	Everett-Lynnwood	North of Everett to Arlington	Auburn-Renton	Pierce and South King County
Car sales supported by aerospace workers	\$45,981,000	\$14,016,000	\$21,031,000	\$31,593,000
Equivalent number of cars sold	1,800	600	800	1,200
Equivalent car dealerships	5	2	2	3
Restaurants				
Estimated sales	\$76,384,776	\$24,318,876	\$36,643,761	\$54,255,087
Estimated % all restaurant sales in region	9.1%	3.5%	11.3%	4.0%
Jobs supported by aerospace workers	1,295	412	621	920
Estimated restaurants supported by aerospace workers	89	28	43	63
Doctor and dentist offices, including labs and outpatient clinics				
Estimated spending	\$234,978,972	\$71,626,364	\$107,477,471	\$161,450,072
Estimated % all healthcare revenues in region	6.9%	6.9%	3.4%	2.0%
Jobs supported by aerospace workers	1,892	577	866	1,300
Estimated offices supported by aerospace workers	121	27	51	55
Retail				
Estimated sales	\$285,217,265	\$86,940,016	\$130,456,057	\$195,967,953
Sqft supported by aerospace workers (based on \$322/sqft in sales)	885,114	269,801	404,844	608,147

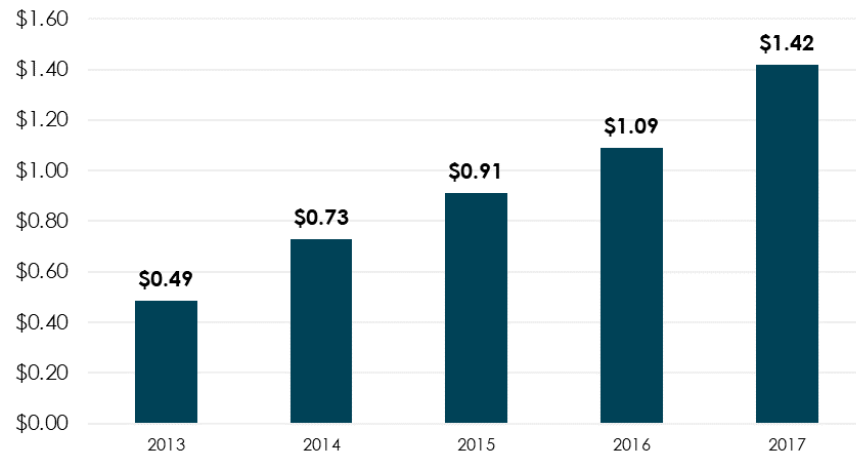
Sources: Washington State Employment Security Department, 2017; Washington State Department of Revenue, 2017; U.S. Bureau of Economic Analysis, 2018; Community Attributes Inc., 2018.

Boeing Dividend Payments

The aerospace industry creates wealth for Washington residents through stock ownership and dividend payments. While data does not exist on the precise number of Boeing shareholders in Washington state, a large number reside in the state. Some investors are passive, in the sense that they own Boeing stock as part of an indexed fund or other instrument and did not directly purchase Boeing stock. Boeing's recent stock value increases translate into greater wealth among its shareholders in Washington state.

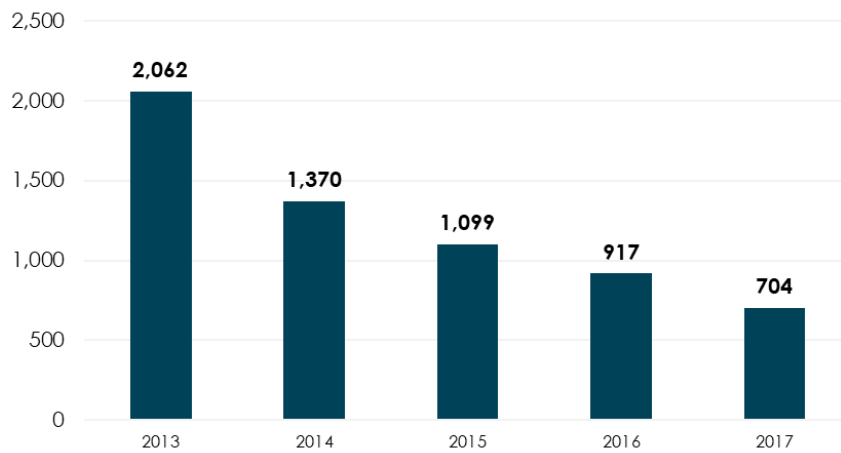
From 2013 to 2017, Boeing's dividend payments increased from \$0.49 in 2013 to \$1.42 in 2017 (**Exhibit 29**). Conversely, for a shareholder to earn annual dividend payments of \$1,000, one would need to own just 704 shares in 2017, compared with 2,062 in 2013 (**Exhibit 30**).

Exhibit 29. Boeing Dividend Payments per Share, 2013-2017



Sources: Yahoo! Finance, 2017; Community Attributes Inc., 2017.

Exhibit 30. Shares Needed to Earn \$1,000 in Annual Dividend Payments



Sources: Yahoo! Finance, 2017; Community Attributes Inc., 2017.

Boeing Charitable Contributions

Boeing's community impacts extend to charitable contributions by The Boeing Company and its employees. A large share of company-wide contributions accrue to Washington state.

In 2016, The Boeing Company contributed \$125.9 million in charitable donations nationwide, up from \$75.0 million in 2015. Boeing employees contributed an additional \$35.3 million (**Exhibit 31**).

Exhibit 31. Boeing Company-wide Charitable Investments in Communities, 2009-2016

Year	Charitable and Business Contributions (\$ Million)	Employee Giving (\$ Million)	Charitable Trust (\$ Million)	In-kind Donations (\$ Million)	Total Giving (\$ Million)
2009	\$45.47	\$39.47	\$57.00	\$0.95	\$142.89
2010	\$60.00	\$43.00	\$57.00	-	\$160.00
2011	\$52.30	\$38.00	\$57.00	-	\$147.30
2012	\$71.00	\$42.00	\$66.00	-	\$179.00
2013	\$67.00	\$42.70	\$66.60	-	\$176.30
2014	\$76.00	\$41.00	\$71.00	-	\$188.00
2015	\$75.00	\$39.00	\$76.00	-	\$190.00
2016	\$125.90	\$35.30	\$1.80	-	\$163.00

Sources: The Boeing Company, 2017; Community Attributes Inc., 2017.

SUMMARY AND CONCLUSIONS

Washington's aerospace industry employed an estimated 83,400 workers in 2018, anchored by employment at The Boeing Company of 69,800. These activities drive economic activities across the state economy, ranging from upstream suppliers and worker income-supported household consumption expenditures on other goods and services in the economy. Together, these direct and multiplier impacts statewide summed to 223,700 jobs, \$20.5 billion in labor income and \$94.4 billion in business revenues in 2018.

The large numbers of statewide impacts can overshadow an understanding of how local communities benefit from aerospace and its employees that live and shop in their communities. Analysis of typical spending patterns of Aerospace workers in their places of residence demonstrate how local communities throughout Washington prosper from and depend on Aerospace workers living, working and engaging in all aspects of their community.

Looking into the near future, workforce supply-demand challenges will continue to be an important concern for the industry, economic development

practitioners and policymakers. Across the Washington state aerospace industry, more than 62,300 employees work in core aerospace industry occupations. These core aerospace occupations span a wide diversity of skills, ranging from aerospace engineers to machinists to software developers and computer numerically controlled machine tool programmers.

Core aerospace industry occupation employment is projected to grow at a compound annual growth rate of 0.8% between 2021 and 2026. In total, the openings among core aerospace industry annual openings are projected to total more than 6,000 per year between 2021 and 2026. Annual openings include new jobs created due to growth as well as job openings created by existing employees exiting employment to retire, move or change occupations.

Based on findings from this report, between 2021 and 2026, Washington is forecasted to have a net shortage of 2,651 among core aerospace occupations annually. Among 56 core aerospace occupations, 39 are projected to experience an undersupply of workers annually. Aircraft structure, surfaces, rigging and systems assemblers in the aerospace industry are forecasted to have an annual shortage of 800 workers, the largest projected talent gap in the industry. Qualified candidates from Washington are projected to fill just 22% of annual openings.

APPENDIX A. WORKFORCE SUPPLY AND DEMAND DETAILED METHODOLOGY AND ANALYSIS

Assessing occupational gaps in an industry relies on a strict operational definition of which occupations compose that industry. Some occupations are present in nearly every industry and do not characterize the skills that specifically comprise the industry. Many administrative roles, for example, fit into this category. The first step in determining the core occupations that represent the primary set of skills within Washington's aerospace industry is developing an operable definition of the industry. The North American Industry Classification System (NAICS) groups industries in increasingly specific segments from the two-digit to the six-digit level. For the purposes of this analysis, the aerospace industry is defined by the four-digit NAICS code 3364, Aerospace Product and Parts Manufacturing.

The four-digit NAICS code for aerospace is composed of six more detailed six-digit NAICS codes that track employment within aircraft manufacturing; aircraft parts and equipment manufacturing; guided missile and space vehicle manufacturing; guided missile and space vehicle propulsion unit and parts manufacturing.

Another method for defining the aerospace industry is to identify the core occupations that represent the primary skills within the industry. **Exhibits A1** and **A2** lay out the core occupations that define the aerospace industry in Washington. The process of assembling this list began with examining the structure of the occupation codes with employment within the aerospace industry. The Bureau of Labor Statistics defines occupations using the Standard Occupation Code system (SOC). These occupations have a two-digit prefix, grouping occupations of similar types, followed by a more detailed four-digit code, identifying each individual occupation. Occupations matching aerospace are first grouped by their concentration within the aerospace industry.

Occupations with fewer than 25 employees, or less than 10% concentrated within the industry, are excluded from the analysis, as they are not considered core jobs within the industry. The core occupations identified represent only a portion of total employment within the aerospace industry. However, these occupations are highlighted because they represent the primary skills that define employment within this industry. Overall employment within the aerospace industry includes employment in other occupations that are not core to the industry. Additionally, core aerospace occupations are also present in industries other than aerospace throughout Washington.

Exhibit A1. Aerospace Architecture and Engineering Occupations and Production Occupations, Estimated Employment in Industry and Total Employment, Washington, 2018

SOC	Occupation	Employment in Industry	Employment in Other Industries	Total Employment	Share in Industry
51-2011	Aircraft Structure, Surfaces, Rigging, and Systems Assemblers	10,901	259	11,160	98%
51-9061	Inspectors, Testers, Sorters, Samplers, and Weighers	3,906	7,140	11,046	35%
51-4041	Machinists	1,943	7,873	9,815	20%
51-1011	First-Line Supervisors of Production and Operating Workers	1,671	12,270	13,941	12%
51-4111	Tool and Die Makers	1,450	444	1,893	77%
51-4011	Computer-Controlled Machine Tool Operators, Metal and Plastic	969	639	1,608	60%
51-9122	Painters, Transportation Equipment	734	1,624	2,358	31%
51-2091	Fiberglass Laminators and Fabricators	447	780	1,227	36%
51-4031	Cutting, Punching, and Press Machine Setters, Operators, and Tenders, Metal and Plastic	355	1,541	1,895	19%
51-4033	Grinding, Lapping, Polishing, and Buffing Machine Tool Setters, Operators, and Tenders, Metal and Plastic	331	672	1,004	33%
51-2031	Engine and Other Machine Assemblers	296	608	904	33%
51-9191	Adhesive Bonding Machine Operators and Tenders	286	294	580	49%
51-4012	Computer Numerically Controlled Machine Tool Programmers, Metal and Plastic	256	101	357	72%
51-9121	Coating, Painting, and Spraying Machine Setters, Operators, and Tenders	151	1,287	1,438	11%
51-4035	Milling and Planing Machine Setters, Operators, and Tenders, Metal and Plastic	113	186	298	38%
51-6093	Upholsterers	78	392	471	17%
51-4194	Tool Grinders, Filers, and Sharpeners	76	181	257	30%
51-4034	Lathe and Turning Machine Tool Setters, Operators, and Tenders, Metal and Plastic	40	108	149	27%
51-4023	Rolling Machine Setters, Operators, and Tenders, Metal and Plastic	38	310	348	11%
51-4191	Heat Treating Equipment Setters, Operators, and Tenders, Metal and Plastic	25	64	89	28%
Production Occupations Subtotal		24,066	36,772	60,838	40%
17-2011	Aerospace Engineers	4,964	1,288	6,252	79%
17-2112	Industrial Engineers	3,784	3,297	7,081	53%
17-2071	Electrical Engineers	1,465	4,430	5,895	25%
17-3026	Industrial Engineering Technicians	1,417	587	2,004	71%
17-2141	Mechanical Engineers	1,226	6,047	7,272	17%
17-3013	Mechanical Drafters	990	1,056	2,047	48%
17-2131	Materials Engineers	769	200	969	79%
17-2199	Engineers, All Other	625	2,531	3,156	20%
17-2072	Electronics Engineers, Except Computer	527	3,149	3,677	14%
17-3012	Electrical and Electronics Drafters	402	420	822	49%
17-3021	Aerospace Engineering and Operations Technicians	255	124	379	67%
17-3027	Mechanical Engineering Technicians	143	808	951	15%
17-3025	Environmental Engineering Technicians	121	312	433	28%
17-3024	Electro-Mechanical Technicians	70	63	133	53%
Architecture and Engineering Occupations Subtotal		16,758	24,311	41,070	41%

*Employment figures are estimated based on the latest available data through June 2018.
Sources: Bureau of Labor Statistics, 2019; Washington State Employment Security Department, 2019; Community Attributes Inc., 2019.*

Exhibit A2. All Other Aerospace Occupations, Estimated Employment in Industry and Total Employment, Washington, 2018

SOC	Occupation	Employment in Industry	Employment in Other Industries	Total Employment	Share in Industry
13-1081	Logisticians	3,644	2,316	5,961	61%
13-1023	Purchasing Agents, Except Wholesale, Retail, and Farm Products	2,475	6,061	8,536	29%
13-2051	Financial Analysts	650	5,759	6,409	10%
13-2099	Financial Specialists, All Other	524	2,615	3,140	17%
	Business and Financial Operations Occupations Subtotal	7,294	16,752	24,046	30%
49-3011	Aircraft Mechanics and Service Technicians	3,302	1,799	5,101	65%
49-2091	Avionics Technicians	1,728	534	2,262	76%
49-9041	Industrial Machinery Mechanics	878	5,591	6,470	14%
49-2094	Electrical and Electronics Repairers, Commercial and Industrial Equipment	301	1,149	1,450	21%
	Installation, Maintenance, and Repair Occupations Subtotal	6,210	9,074	15,283	41%
15-1133	Software Developers, Systems Software	1,473	12,904	14,378	10%
15-2031	Operations Research Analysts	904	2,229	3,133	29%
15-1143	Computer Network Architects	716	5,363	6,079	12%
15-1122	Information Security Analysts	263	1,933	2,196	12%
15-2021	Mathematicians	34	110	144	24%
	Computer and Mathematical Occupations Subtotal	3,390	22,540	25,930	13%
11-9041	Architectural and Engineering Managers	1,038	3,300	4,338	24%
11-3051	Industrial Production Managers	634	1,880	2,514	25%
	Management Occupations Subtotal	1,672	5,180	6,852	24%
53-7021	Crane and Tower Operators	192	1,070	1,261	15%
53-2012	Commercial Pilots	157	826	983	16%
53-2022	Airfield Operations Specialists	43	224	267	16%
	Transportation and Material Moving Occupations Subtotal	392	2,119	2,512	16%
43-5061	Production, Planning, and Expediting Clerks	2,043	7,542	9,585	21%
29-9011	Occupational Health and Safety Specialists	257	2,278	2,535	10%
19-2032	Materials Scientists	145	124	270	54%
33-9021	Private Detectives and Investigators	92	519	611	15%
	All Occupations	62,321	127,211	189,531	33%

Employment figures are estimated based on the latest available data through June 2018. Sources: Bureau of Labor Statistics, 2019; Washington State Employment Security Department, 2019; Community Attributes Inc., 2019.

On-the-job training, associate degree or postsecondary award, bachelor's degree and master's degree or higher are categories used to break core occupations into key groupings. These categories are based on Bureau of Labor Statistics minimum education requirements for entry. These education levels are set at a national level and may not be fully reflective of the hiring practices in Washington, or within individual companies. Additionally, the education level breakouts are attached to the occupation, actual openings for these occupations may have different requirements, and the talent pool for these occupations may have a greater level of education than indicated by the minimum education level. These minimum education levels are used to group occupations by the relative level of education and training required for entry.

Demand Analysis

Total demand for occupations covers demand across all industries in Washington and includes but is not limited to the aerospace industry. Additionally, total demand may be underestimated as the occupational projections used by the Employment Security Department represent the point of equilibrium between employment demand and supply. Thus, employment projections do not account for unmet demand and unfilled jobs.

Forecasted occupational openings are sourced from the occupational projections developed by the Washington State Employment Security Department (ESD). Average annual openings include both openings generated by growth and openings generated by separations. Separations are created when workers leave an occupation for a different occupation or exit the labor force. Thus, average annual openings include openings created by growth, retirements and workers moving to different occupations.

Systems software developers, for example, is projected to have more than 70% of the average annual openings generated through separations. Occupations with very low and negative growth rates have average annual openings generated exclusively by separations. Aircraft structure, surfaces, rigging, and systems assemblers is projected to decline in overall employment between 2021 and 2026, however, this occupation is also projected to have more than 1,000 openings annually, driven by retirements and other separations.

Exhibit A3. Washington Aerospace Occupational Demand per Year, 2021 and 2026

SOC	Occupation	Estimated Employment 2021	Estimated Employment 2026	Average Annual Openings (2021-2026)	Average Annual Openings in Industry (2021-2026)	CAGR (2021-2026)
15-1133	Software Developers, Systems Software	18,568	20,972	1,722	176	2.5%
51-1011	First-Line Supervisors of Production and Operating Workers	15,688	16,012	1,585	190	0.4%
51-9061	Inspectors, Testers, Sorters, Samplers, and Weighers	11,926	12,020	1,433	507	0.2%
43-5061	Production, Planning, and Expediting Clerks	10,881	11,325	1,195	255	0.8%
51-4041	Machinists	10,888	11,090	1,137	225	0.4%
51-2011	Aircraft Structure, Surfaces, Rigging, and Systems Assemblers	10,932	10,664	1,055	1,031	-0.5%
13-1023	Purchasing Agents, Except Wholesale, Retail, and Farm Products	9,414	9,603	846	245	0.4%
13-2051	Financial Analysts	7,897	8,502	800	81	1.5%
49-9041	Industrial Machinery Mechanics	7,313	7,514	674	92	0.5%
13-1081	Logisticians	6,412	6,587	653	399	0.5%
15-1143	Computer Network Architects	7,357	8,052	627	74	1.8%
17-2112	Industrial Engineers	7,991	8,461	617	330	1.1%
17-2141	Mechanical Engineers	8,291	8,688	605	102	0.9%
17-2071	Electrical Engineers	6,652	6,976	492	122	1.0%
49-3011	Aircraft Mechanics and Service Technicians	5,376	5,343	397	257	-0.1%
11-9041	Architectural and Engineering Managers	4,853	4,983	362	87	0.5%
13-2099	Financial Specialists, All Other	3,675	3,918	362	60	1.3%
17-2011	Aerospace Engineers	6,292	6,194	345	274	-0.3%
51-9122	Painters, Transportation Equipment	2,730	2,911	327	102	1.3%
15-1122	Information Security Analysts	2,900	3,424	315	38	3.4%
15-2031	Operations Research Analysts	3,799	4,194	312	90	2.0%
17-2072	Electronics Engineers, Except Computer	4,020	4,118	275	39	0.5%
17-2199	Engineers, All Other	3,523	3,647	252	50	0.7%
51-4031	Cutting, Punching, and Press Machine Setters, Operators, and Tenders, Metal and Plastic	2,073	2,074	232	43	0.0%
11-3051	Industrial Production Managers	2,787	2,841	205	52	0.4%
17-3013	Mechanical Drafters	2,189	2,215	189	91	0.2%
49-2091	Avionics Technicians	2,378	2,398	188	144	0.2%
29-9011	Occupational Health and Safety Specialists	2,960	3,114	182	18	1.0%
51-9121	Coating, Painting, and Spraying Machine Setters, Operators, and Tenders	1,628	1,661	177	19	0.4%
51-4111	Tool and Die Makers	1,905	1,872	170	130	-0.3%
17-3026	Industrial Engineering Technicians	2,034	2,016	167	118	-0.2%
51-4011	Computer-Controlled Machine Tool Operators, Metal and Plastic	1,650	1,629	156	94	-0.3%
53-7021	Crane and Tower Operators	1,403	1,427	151	23	0.3%
51-2091	Fiberglass Laminators and Fabricators	1,315	1,305	149	54	-0.2%
49-2094	Electrical and Electronics Repairers, Commercial and Industrial Equipment	1,579	1,586	137	28	0.1%
53-2012	Commercial Pilots	1,181	1,268	130	21	1.4%
51-4033	Grinding, Lapping, Polishing, and Buffing Machine Tool Setters, Operators, and Tenders, Metal and Plastic	1,087	1,092	115	38	0.1%
	All Other Occupations (19)	8,944	9,003	829	302	0.1%
	Total	212,491	220,699	19,565	6,001	0.8%

Sources: U.S. Bureau of Labor Statistics, 2019; Washington State Employment Security Department, 2019; Community Attributes Inc., 2019.

Supply Analysis

The local workforce supply is primarily composed of two elements: the entry of new graduates into the available talent pool and the existing talent pool of qualified unemployed workers actively seeking employment. Qualified graduates are drawn from the National Center for Education Statistics' Integrated Postsecondary Education System (IPEDS) data via a match of Classification Instructional Program (CIP) codes to the appropriate SOC codes. These are totaled by SOC code, including duplicates, and are then adjusted down according to the workforce-wide occupational demand. Unemployment insurance claimants are organized by their most recent occupation (i.e. SOC codes) and represent the second element of supply. It is important to note that workers from outside Washington can fill talent gaps but are not assessed in this analysis.

Local Graduates

IPEDS standardizes educational curriculum with CIP codes. Each CIP code matches several SOC codes because graduates from the same program are qualified to be employed in a variety of occupations and industries. Similarly, each occupation may draw on graduates from several relevant CIP codes. For example, graduates in airframe mechanics and aircraft maintenance technology/technician programs are qualified to work as aircraft structure, surfaces, rigging and system assemblers as well as aircraft mechanics and services technicians. The latter occupation also draws on graduates from aircraft powerplant technology/technician programs (**Exhibit A4**).

Exhibit A4. Other Occupational Matches for Graduates Qualified to Work as Aircraft Structure, Surfaces, Rigging, and Systems Assemblers

CIP	Description	SOC	Description
47.0607	Airframe Mechanics and Aircraft Maintenance Technology/Technician	49-3011	Aircraft Mechanics and Service Technicians
47.0608	Aircraft Powerplant Technology/Technician	51-2011	Aircraft Structure, Surfaces, Rigging, and Systems Assemblers
47.0609	Avionics Maintenance Technology/Technician	49-2091	Avionics Technicians

Sources: National Center for Education Statistics' Integrated Postsecondary Education System, 2018; Community Attributes Inc., 2019.

Accredited programs matching to one or more aerospace occupation(s) must be summarized across educational institutions located in the state in order to determine the number of graduates that will be able to fill forecasted annual openings within the aerospace industry in Washington. Graduation data is tied to the primary location of the educational institution providing the accredited program. Therefore, institutions located outside of Washington are not included as part of the local talent supply.

Across Washington, a total of 21,434 annual educational program completions are in programs that match to one or more aerospace occupation(s). Statewide 24 programs have more than 200 annual completions. The top program, Business Administration and Management accounts for 17% of total statewide completions that match to one or more aerospace occupation(s). Completions among the top 24 programs accounts for 77% of total statewide completions matching to an aerospace occupation. **(Exhibit A5)**

Exhibit A5. Total Graduates by CIP Codes that Match to One or More Aerospace Occupation(s), Washington, 2017

CIP	Description	Graduates
52.0201	Business Administration and Management, General	3,707
52.0101	Business/Commerce, General	2,305
14.1901	Mechanical Engineering	891
51.0000	Health Professions And Related Programs	274
52.0801	Finance, General	817
11.0701	Computer Science	772
14.1001	Electrical and Electronics Engineering	721
11.0101	Computer and Information Sciences, General	711
11.0901	Computer Systems Networking and Telecommunications	682
11.1003	Computer and Information Systems Security/Information Assurance	668
15.0612	Industrial Technology/Technician	572
27.0101	Mathematics, General	537
14.0801	Civil Engineering, General	509
11.0201	Computer Programming/Programmer, General	499
15.0000	Engineering Technologies And Engineering-Related Fields	156
15.1301	Drafting and Design Technology/Technician, General	442
43.0107	Criminal Justice/Police Science	367
48.0501	Machine Tool Technology/Machinist	338
15.0613	Manufacturing Engineering Technology/Technician	329
47.0607	Airframe Mechanics and Aircraft Maintenance Technology/Technician	296
52.0299	Business Administration, Management and Operations, Other	246
11.1001	Network and System Administration/Administrator	235
52.0205	Operations Management and Supervision	229
11.0103	Information Technology	225
	All Other Programs	4,906
Total		21,434

Sources: National Center for Education Statistics' Integrated Postsecondary Education System, 2018; Community Attributes Inc., 2019.

These same completions examined by the institution from which they graduated shows the geographic source of qualified aerospace candidates statewide and the institutions from which Washington residents graduate and move on to fill aerospace occupational openings. The Seattle Campus of the University of Washington produces the largest number of graduates qualified for aerospace occupations, representing 18% of total statewide completions. Three institutions statewide produce more than 1,000 graduates

annually qualified for one or more occupation in the aerospace industry: The University of Washington, Washington State University and Edmonds Community College. These three institutions account for 33% of total statewide completions qualified for the aerospace industry. (**Exhibit A6**)

Exhibit A6. Washington's Educational Institutions by Graduates Qualified for Aerospace Occupations, 2017

Institution	County	Graduates Qualified for Aerospace Occupations
University of Washington-Seattle Campus	King County	3,927
Washington State University	Whitman County	2,076
Edmonds Community College	Snohomish County	1,045
Olympic College	Kitsap County	990
Green River College	King County	833
University of Washington-Bothell Campus	King County	733
Seattle University	King County	673
Central Washington University	Kittitas County	639
University of Washington-Tacoma Campus	Pierce County	629
Gonzaga University	Spokane County	573
Western Washington University	Whatcom County	541
Eastern Washington University	Spokane County	513
City University of Seattle	King County	398
Everett Community College	Snohomish County	397
Clover Park Technical College	Pierce County	386
Bellevue College	King County	363
Shoreline Community College	King County	332
Spokane Community College	Spokane County	288
Clark College	Clark County	279
Lake Washington Institute of Technology	King County	275
Seattle Central College	King County	260
Bellingham Technical College	Whatcom County	246
International Air and Hospitality Academy	Clark County	246
Tacoma Community College	Pierce County	243
Pacific Lutheran University	Pierce County	229
Renton Technical College	King County	227
Saint Martin's University	Thurston County	225
Highline College	King County	220
Columbia Basin College	Franklin County	210
All Other Institutions		3,438
Total		21,434

Sources: National Center for Education Statistics' Integrated Postsecondary Education System, 2018; Community Attributes Inc., 2019.

In order to determine the number of potential graduates that are likely to fill occupations within Washington's aerospace industry, qualified graduates are totaled by every possible combination of CIP and SOC codes. Each combination is adjusted to match the ratio of occupational employment to total occupational employment for all possible occupations matching to relevant CIPs. This method results in an estimate of how many graduates could potentially be employed in each available occupation. Each estimate is adjusted to account for the approximate share of local graduates who obtain work locally after graduation, by multiplying the estimates by a 95% local retention rate. Lastly, the number of graduates expected to seek work locally

is adjusted again to account for the number of local graduates who can be reasonably expected to fill positions within the aerospace industry.

This approach yields a total of 6,800 graduates in 2017 who are qualified for the needs of the aerospace industry. Among these qualified graduates, 943 graduates are qualified for aerospace occupations that require on-the-job training⁵. (**Exhibits A7 and A8**)

IPEDS data is only available through the 2016-2017 academic year. Because the majority of completions occur at the end of the spring semester, students who complete programs during the 2016-2017 academic year are most likely to seek employment in 2017. Completions data provides a snapshot of what educational programs are expected to look like in future years if current conditions do not change.

IPEDS data only captures information on people who complete programs in postsecondary schools. This means that high school graduates, many of whom may be appropriately qualified for certain positions, are not counted in this analysis. Additionally, a wide range of training centers that provide educational options for the aerospace industry are not captured in IPEDS data.

Apprenticeships are not included among the graduate supply estimates. The primary feature of an apprenticeship program is on-the-job training. Therefore, these individuals are already counted among the individuals employed in the industry. If they were to be added to the talent pool calculations, they would be double-counted within this analysis.

In 2017, educational institutions in Washington conferred degrees to 6,460 graduates qualified aerospace occupations who stayed in the state. Of those graduates qualified to work in aerospace occupations, 2,307 graduates are expected to seek employment in the aerospace industry. (**Exhibit A8**)

Among the 56 total core aerospace occupations, 21 that require on-the-job training as a minimum qualification have qualified candidates graduating from local institutions. These occupations have just 415 graduates that can be expected to work in the aerospace industry. (**Exhibit A7**)

⁵ These occupations are undercounted due to the lack of information linking programs to occupations outside of IPEDS.

Exhibit A7. Aerospace Occupations by Total Graduates, On-the-Job Training, Washington, 2017

SOC	Occupation	All Graduates	Graduates After 95% Retention	Graduates in Industry
51-2011	Aircraft Structure, Surfaces, Rigging, and Systems Assemblers	165	157	153
51-4111	Tool and Die Makers	74	70	54
51-4011	Computer-Controlled Machine Tool Operators, Metal and Plastic	90	86	52
51-4012	Computer Numerically Controlled Machine Tool Programmers, Metal and Plastic	74	70	50
53-2012	Commercial Pilots	93	89	14
53-2022	Airfield Operations Specialists	74	70	11
51-4033	Grinding, Lapping, Polishing, and Buffing Machine Tool Setters, Operators, and Tenders, Metal and Plastic	32	30	10
51-4035	Milling and Planing Machine Setters, Operators, and Tenders, Metal and Plastic	25	24	9
51-9122	Painters, Transportation Equipment	30	28	9
51-4191	Heat Treating Equipment Setters, Operators, and Tenders, Metal and Plastic	32	30	8
51-6093	Upholsterers	50	48	8
33-9021	Private Detectives and Investigators	53	51	8
51-4034	Lathe and Turning Machine Tool Setters, Operators, and Tenders, Metal and Plastic	25	24	6
51-4041	Machinists	32	30	6
51-4031	Cutting, Punching, and Press Machine Setters, Operators, and Tenders, Metal and Plastic	28	26	5
51-9061	Inspectors, Testers, Sorters, Samplers, and Weighers	10	9	3
51-4023	Rolling Machine Setters, Operators, and Tenders, Metal and Plastic	28	26	3
49-9041	Industrial Machinery Mechanics	14	13	2
51-2031	Engine and Other Machine Assemblers	5	5	2
43-5061	Production, Planning, and Expediting Clerks	7	7	1
53-7021	Crane and Tower Operators	3	3	0
On-the-Job Training Subtotal		943	896	415

Sources: National Center for Education Statistics' Integrated Postsecondary Education System, 2018; Community Attributes Inc., 2019.

There are 1,679 graduates qualified for aerospace occupations requiring an associate degree or postsecondary award that can be expected to seek employment in Washington and a further 3,842 graduates qualified for occupations requiring a bachelor's degree that can be expected to seek employment in Washington. Among graduates qualified for jobs requiring an associate degree or postsecondary award 1,003 are expected to pursue employment in the aerospace industry. Similarly, 879 graduates qualified for aerospace occupations requiring a bachelor's degree are expected to pursue employment in the aerospace industry. **(Exhibit A8)**

Exhibit A8. Aerospace Occupations by Total Graduates, Associate Degree or Postsecondary Award or Higher, Washington, 2017

SOC	Occupation	All Graduates	Graduates After 95% Retention	Graduates in Industry
17-3026	Industrial Engineering Technicians	919	873	618
49-3011	Aircraft Mechanics and Service Technicians	195	185	120
17-3024	Electro-Mechanical Technicians	192	182	96
17-3013	Mechanical Drafters	167	158	77
17-3012	Electrical and Electronics Drafters	133	126	62
17-3027	Mechanical Engineering Technicians	116	110	16
17-3025	Environmental Engineering Technicians	21	20	6
49-2091	Avionics Technicians	6	6	4
49-2094	Electrical and Electronics Repairers, Commercial and Industrial Equipment	12	11	2
17-3021	Aerospace Engineering and Operations Technicians	3	3	2
51-1011	First-Line Supervisors of Production and Operating Workers	5	4	1
Associate Degree or Postsecondary Award Subtotal		1,767	1,679	1,003
11-9041	Architectural and Engineering Managers	1,509	1,433	343
17-2011	Aerospace Engineers	230	219	174
11-3051	Industrial Production Managers	689	655	165
15-1122	Information Security Analysts	507	482	58
15-1143	Computer Network Architects	470	447	53
15-1133	Software Developers, Systems Software	308	292	30
17-2071	Electrical Engineers	47	45	11
17-2199	Engineers, All Other	57	54	11
17-2141	Mechanical Engineers	43	41	7
17-2072	Electronics Engineers, Except Computer	47	45	6
29-9011	Occupational Health and Safety Specialists	66	63	6
17-2112	Industrial Engineers	9	8	4
13-2099	Financial Specialists, All Other	23	22	4
13-2051	Financial Analysts	32	30	3
13-1081	Logisticians	5	4	3
17-2131	Materials Engineers	2	2	1
15-2031	Operations Research Analysts	1	1	0
Bachelor's Degree Subtotal		4,044	3,842	879
15-2021	Mathematicians	46	43	10
Master's Degree or Higher Subtotal		46	43	10
Total		6,800	6,460	2,307

Sources: National Center for Education Statistics' Integrated Postsecondary Education System, 2018; Community Attributes Inc., 2019.

Unemployment Insurance

The second key element of the local talent supply is the pool of unemployment insurance (UI) claimants whose previous occupations match those in Washington' aerospace industry. Due to nondisclosure rules, not all UI data is available for every SOC.

There are an expected 3,258 total qualified UI claimants whose previous occupation was in an aerospace occupation in Washington. Of these UI claimants, 1,043 are expected to pursue work in the aerospace industry. A total of 1,164 UI claimants are from aerospace occupations requiring on-the-job training, of which 382 UI claimants are expected to seek employment in aerospace. The aerospace occupation requiring on-the-job training with the most qualified unemployment claimants is Inspectors, Testers, Sorters,

Samplers, and Weighers, with 271 UI claimants, of which 97 are expected to seek employment in aerospace. (**Exhibits A9 and A10**)

Exhibit A9. Unemployment Insurance Claimants by Previous SOC, On-the-Job Training, Washington, 2017

SOC	Occupation	Total Qualified Unemployment Insurance Claimants	Unemployment Insurance Claimants in Sector ↓
51-9061	Inspectors, Testers, Sorters, Samplers, and Weighers	274	97
51-2011	Aircraft Structure, Surfaces, Rigging, and Systems Assemblers	80	78
51-4011	Computer-Controlled Machine Tool Operators, Metal and Plastic	63	38
51-4041	Machinists	171	34
43-5061	Production, Planning, and Expediting Clerks	119	25
53-7021	Crane and Tower Operators	95	14
51-2091	Fiberglass Laminators and Fabricators	33	12
51-4012	Computer Numerically Controlled Machine Tool Programmers, Metal and Plastic	16	11
51-9122	Painters, Transportation Equipment	32	10
51-4033	Grinding, Lapping, Polishing, and Buffing Machine Tool Setters, Operators, and Tenders, Metal and Plastic	29	10
49-9041	Industrial Machinery Mechanics	63	9
51-4111	Tool and Die Makers	10	8
51-4194	Tool Grinders, Filers, and Sharpeners	24	7
51-4035	Milling and Planing Machine Setters, Operators, and Tenders, Metal and Plastic	17	6
51-4031	Cutting, Punching, and Press Machine Setters, Operators, and Tenders, Metal and Plastic	32	6
51-9121	Coating, Painting, and Spraying Machine Setters, Operators, and Tenders	53	6
51-9191	Adhesive Bonding Machine Operators and Tenders	5	2
51-4034	Lathe and Turning Machine Tool Setters, Operators, and Tenders, Metal and Plastic	9	2
53-2012	Commercial Pilots	11	2
33-9021	Private Detectives and Investigators	11	2
51-6093	Upholsterers	9	2
53-2022	Airfield Operations Specialists	4	1
51-4023	Rolling Machine Setters, Operators, and Tenders, Metal and Plastic	4	0
On-the-Job Training Subtotal		1,164	382

Sources: Washington State Employment Security Department, 2018; Community Attributes Inc., 2019.

There are 558 UI claimants whose previous occupation was an aerospace occupation requiring an associate degree or postsecondary award, of which 220 are expected to seek work in the aerospace industry. Additionally, among the 1,536 UI claimants whose previous occupation has a minimum education requirement of a bachelor's degree, 441 are estimated to seek employment in aerospace. The occupation requiring an associate degree with the most qualified UI claimants are first-line supervisors of production and operating workers with 212 UI claimants of which 25 are expected to seek employment in the aerospace industry. Among occupations requiring a bachelor's degree

there are 184 UI claimants whose previous occupation was as a Mechanical Engineer, of these UI claimants, 31 are expected to seek employment in the aerospace industry. (**Exhibit A10**)

Exhibit A10. Unemployment Insurance Claimants by Previous SOC, Associate Degree or Postsecondary Award or Higher, Washington, 2017

SOC	Occupation	Total Qualified Unemployment Insurance Claimants	Unemployment Insurance Claimants in Sector
49-3011	Aircraft Mechanics and Service Technicians	125	81
49-2091	Avionics Technicians	41	31
51-1011	First-Line Supervisors of Production and Operating Workers	212	25
17-3021	Aerospace Engineering and Operations Technicians	30	20
17-3013	Mechanical Drafters	39	19
17-3024	Electro-Mechanical Technicians	26	14
17-3026	Industrial Engineering Technicians	17	12
17-3012	Electrical and Electronics Drafters	18	9
17-3027	Mechanical Engineering Technicians	29	4
49-2094	Electrical and Electronics Repairers, Commercial and Industrial Equipment	17	4
17-3025	Environmental Engineering Technicians	4	1
Associate Degree or Postsecondary Award Subtotal		558	220
17-2011	Aerospace Engineers	183	145
11-3051	Industrial Production Managers	167	42
13-1081	Logisticians	68	42
17-2141	Mechanical Engineers	184	31
17-2199	Engineers, All Other	113	22
17-2071	Electrical Engineers	90	22
17-2112	Industrial Engineers	41	22
11-9041	Architectural and Engineering Managers	82	20
15-1133	Software Developers, Systems Software	181	19
13-1023	Purchasing Agents, Except Wholesale, Retail, and Farm Products	61	18
17-2131	Materials Engineers	13	10
13-2099	Financial Specialists, All Other	59	10
15-1143	Computer Network Architects	78	9
13-2051	Financial Analysts	84	9
15-2031	Operations Research Analysts	29	8
29-9011	Occupational Health and Safety Specialists	41	4
17-2072	Electronics Engineers, Except Computer	29	4
15-1122	Information Security Analysts	33	4
Bachelor's Degree Subtotal		1,536	441
Total		3,258	1,043

Sources: Washington State Employment Security Department, 2018; Community Attributes Inc., 2019.

Total supply is defined as the sum of local qualified graduates and qualified unemployment insurance claimants. Within Washington, there are a total of 2,307 local graduates and 1,043 unemployment insurance claimants who can reasonably be expected to fill the needs of the aerospace industry within Washington (**Exhibit A11**).

Exhibit A11. Total Talent Supply, Washington, 2017

Source of Supply	Qualified Workers
On-the-Job Training	415
Associate Degree or Postsecondary Award	1,003
Bachelor's Degree	879
Master's Degree or Higher	10
Graduate Subtotal	2,307
Unemployment Insurance Claimants	1,043
Total	3,350

Sources: National Center for Education Statistics' Integrated Postsecondary Education System, 2018; Washington State Employment Security Department, 2019; Community Attributes Inc, 2019.

Supply and Demand

The combined elements of expected supply and projected occupational demand yields a summary of annual occupational gaps within the aerospace industry. **Exhibits A12** summarizes graduate supply, total demand, UI claimant supply, and the expected gaps across the aerospace industry.

The aerospace industry's annual workforce supply in Washington is projected to total 3,350, composed of Washington graduates entering the workforce after completing an aerospace-related educational program (69%) and unemployed persons whose most recent occupation was in aerospace (31%). Total openings in Washington's aerospace industry is projected to total more than 6,000 annually. Taken together, projected annual supply and demand indicate an overall shortage of 2,651 workers annually from 2021 to 2026. Although the overall workforce supply and demand analysis indicates a shortage, it is important to note that there are both shortages and surpluses in key aerospace occupations. (**Exhibit A12**)

Exhibit A12. Summary of Annual Talent Supply and Demand by Education Requirement, Washington, 2021-2026

Annual Surplus or (Shortage)	
Total Openings (Demand)	6,001
Unemployed	1,043
Newly-Trained Candidates	2,307
Total Supply	3,350
Surplus or (Shortage)	(2,651)

Sources: U.S. Bureau of Labor Statistics, 2019; Washington State Employment Security Department, 2019; National Center for Education Statistics' Integrated Postsecondary Education System, 2018; Community Attributes Inc., 2019.