2017 EMPLOYMENT PROJECTIONS

Industries
Occupations
Growth Rates
Job Openings
Skill Projections
Occupations in Demand
Projections process overview

Employment Security Department
WASHINGTON STATE

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About the employment, industry and occupational projections

Employment projections provide a general outlook for industry and occupational employment in Washington state. They provide job seekers, policy makers and training providers an idea of how much an industry or occupation is projected to change over time and show the future demand for workers.

On an annual basis, the Employment Security Department produces industry employment projections for two, five and 10 years from a base period. The base period for the two-year (short-term) projections is second quarter 2016. The base period for the five-year (medium-term) and 10-year (long-term) projections is 2015.

Staffing patterns for each industry are used to convert industry projections into occupational projections.

Industry classifications are based on the North American Industry Classification System (NAICS). However, they have been modified to match the industry definitions used by the U.S. Bureau of Labor Statistics' (BLS) Occupational Employment Statistics (OES) program. These modified industry definitions are called Industry Control Totals (ICTs). The Standard Occupational Classification (SOC) system is used to group occupations. Appendix 4 contains flow chart summaries of the 2017 projections process. Appendix 5 contains frequently asked questions relating to projections. Appendix 6 provides a glossary of terms.

Data sets used to develop projections

The following data sets are used to produce projections:

1. Historical employment time series, in this case the U.S. Bureau of Labor Statistics' Quarterly Census of Employment and Wages (QCEW).

2. Employment not covered by the unemployment insurance system from the U.S. Bureau of Labor Statistics' Current Employment Statistics (CES) program.

3. Occupational employment by industries (staffing patterns) based on an OES survey.

4. Independent variables (predictive indicators), which help to project the future direction of the economy, from IHS Global Insight's national forecasts.

Use of employment projections

Employment projections are intended for career development over time, not as the basis for budget or revenue projections, or for immediate corrective actions within the labor market.

Employment projections are the basis of the Occupations in Demand (OID) list covering Washington's 12 workforce development areas (WDAs) and the state as a whole. This list is used to determine eligibility for a variety of training and support programs, but was created to support the unemployment insurance Training Benefits Program. Appendix 2 contains a technical description of the OID list.

The full OID list is accessible through the "Learn about an occupation" tool located at: **https://esd.wa.gov/labormarketinfo/learn-about-an-occupation#/search**.

Executive summary

This report highlights findings on specific aspects of Washington's employment outlook. In the first section, industry projections results, we describe changes in employment by industry from 2015 to 2025. In the next section, occupational projections results, we look at:

- Major occupational groups
- Specific occupations

Detailed information on the projected demand for industry and occupational employment is available in the Employment Projections data files at: **https://esd.wa.gov/labormarketinfo/projections**.

In addition, detailed skill projections information is available in *Appendix 3* of this report.

Key findings

The 10-year average annual growth rate for total nonfarm employment for the 2015 to 2025 period is projected to be 1.55 percent. This is the same average annual growth rate predicted last year for 2014 to 2024.[1]

Industry projections

- The largest increase by share of employment is projected for the professional and business services sector.
- The largest decrease by share of employment is projected for the manufacturing sector.

Occupational projections

Major occupational groups

- Two occupational groups that stand out with projected increases in shares of employment are computer and mathematical occupations and construction and extraction occupations.
- The largest decreases by shares of employment are projected for the production and sales and related occupations.
- The largest employment shares in 2025 are projected for the office and administrative support occupations, sales and related occupations and food preparation and serving related occupations. However, all three occupational groups are projected to have declining employment shares.

[1] See: "*2016 Employment Projections*," Washington State Employment Security Department, Labor Market and Performance Analysis, *Figure* 2, page 7.

Specific occupations

- The retail salespersons occupations are projected to have the largest number of average annual total openings.
- Job openings caused by turnover exceed job openings by growth for all occupations.
- Totals of job openings caused by turnover are about 20 times greater than openings due to growth.

2017 industry projections results

Figure 1 presents 2015 estimated employment, 2015, 2020 and 2025 employment shares, and changes in employment shares from 2015 to 2020 and 2020 to 2025 by industry for Washington state.

Through 2025, the three industry sectors with the largest increases in employment shares are projected to be professional and business services, health services and social assistance and construction.

For this same time period, the two industry sectors with the largest decreases in employment shares are projected to be manufacturing and financial activities.

Figure 1. Base and projected nonfarm industry employment
Washington state, 2015, 2020 and 2025
Source: Employment Security Department/WITS; U.S. Bureau of Labor Statistics, Quarterly Census of Employment and Wages

Industry sector*	WA state est. empl. 2015	WA state est. empl. shares 2015	WA state proj. empl. shares 2020	WA state proj. empl. shares 2025	WA state percentage point change in empl. shares 2015-2020	WA state percentage point change in empl. shares 2020-2025	WA state percentage point change in empl. shares 2015-2025
Natural resources and mining	6,300	0.20%	0.18%	0.17%	-0.02%	-0.01%	-0.03%
Construction	173,100	5.49%	5.93%	6.08%	0.43%	0.15%	0.58%
Manufacturing	290,700	9.23%	8.20%	7.66%	-1.02%	-0.54%	-1.56%
Wholesale trade	132,600	4.21%	3.98%	3.84%	-0.23%	-0.14%	-0.36%
Retail trade	355,100	11.27%	11.40%	11.30%	0.13%	-0.09%	0.03%
Utilities	4,900	0.16%	0.14%	0.13%	-0.02%	-0.01%	-0.02%
Transportation and warehousing	96,400	3.06%	3.03%	2.96%	-0.03%	-0.07%	-0.10%
Information	114,300	3.63%	3.95%	4.10%	0.32%	0.15%	0.47%
Financial activities	147,800	4.69%	4.49%	4.32%	-0.20%	-0.18%	-0.38%
Professional and business services	388,000	12.32%	13.01%	13.67%	0.69%	0.65%	1.35%
Education services	55,800	1.77%	1.85%	1.98%	0.08%	0.13%	0.21%
Health services and social assistance	397,300	12.61%	12.80%	13.22%	0.19%	0.42%	0.61%
Leisure and hospitality	309,400	9.82%	9.93%	9.65%	0.11%	-0.28%	-0.17%
Other services	116,000	3.68%	3.61%	3.52%	-0.07%	-0.09%	-0.16%
Federal government	73,200	2.32%	2.17%	2.04%	-0.16%	-0.12%	-0.28%
State and local gov. (including education)	489,500	15.54%	15.33%	15.36%	-0.21%	0.03%	-0.18%

*The sectors presented in the table are based on CES definitions.

The largest growth sectors for the state are projected for professional and business services, health services and social assistance and construction.

Historical and projected growth rates

Figure 2 shows the historical and projected growth rates for the state and Washington's 12 workforce development areas (WDAs).

Six of the 12 WDAs have projected growth rates greater than the previous 10 years' growth and six have projected growth less than the previous 10 years' growth. The statewide projected growth rate is 0.26 percentage points less than the historical growth rate.

The six WDAs with projected growth greater than the past are: Olympic Consortium, Pacific Mountain, Spokane, Northwest, Eastern Washington and South Central.

The largest positive difference between historical growth rates and projected growth rates is in the Olympic Consortium. For this area, the difference between the historical and projected rates is 0.49 percentage points. Pacific Mountain was a close second with a difference of 0.42 percentage points.

The six WDAs with projected growth less than the past 10 years are: Snohomish County, Benton-Franklin, North Central, Southwest Washington, Seattle-King County and Pierce County.

Figure 2. Historical and projected total nonfarm employment growth
Washington state and workforce development areas, 1990 to 2015 and 2015 to 2025
Source: Employment Security Department/WITS; U.S. Bureau of Labor Statistics, Quarterly Census of Employment and Wages

Workforce development area[1]	Historical growth[2] rate 2005-2015	Projected growth rate 2015-2025	Historical trend growth[3] 1990-2015
Statewide	**1.81%**	**1.55%**	**1.35%**
Olympic Consortium	0.71%	1.20%	1.14%
Pacific Mountain	1.03%	1.45%	1.29%
Northwest	1.20%	1.39%	1.81%
Snohomish County	2.88%	1.15%	2.14%
Seattle-King County	1.95%	1.69%	1.20%
Pierce County	1.76%	1.60%	1.70%
Southwest Washington	1.83%	1.54%	1.75%
North Central	1.94%	1.47%	1.35%
South Central	1.26%	1.35%	0.83%
Eastern Washington	1.16%	1.29%	0.98%
Benton-Franklin	2.39%	1.76%	2.25%
Spokane	1.23%	1.47%	1.28%

[1] Workforce development areas are regions within Washington state with economic and geographic similarities.
[2] Historical growth is based only on covered employment.
[2] Historical trend growth is defined as the growth rate of the linear trend line.

Six of the 12 WDAs have projected growth less than the previous 10 years' growth.

2017 occupational projections results

The detailed state level occupational projections cover 812 occupations, 805 of which are publishable. This publication, however, provides only a summary of the top occupations. For a complete list of occupations and projected employment, see the 2017 Employment Projections data files available at: **https://esd.wa.gov/labormarketinfo/projections**.

Major occupational groups

Figure 3 shows occupational employment estimates and employment shares for Washington state.

At the state level, two occupational groups stand out with increases in employment shares from 2015 to 2025. Computer and mathematical occupations are projected to increase employment shares from 4.71 percent to 5.58 percent for an increase of 0.87 percentage points. The next highest increase in shares is projected for construction and extraction occupations with an increase of 0.48 percentage points.[2]

The largest decreases in employment shares at the state level are in production occupations, with a projected decrease of 0.60 percentage points, and in sales and related occupations, with a projected decrease of 0.40 percentage points.

By 2025, the top three major occupational groups for shares of employment are projected to be:

1. Office and administrative support occupations (12.24 percent)
2. Sales and related occupations (9.17 percent)
3. Food preparation and serving related occupations (7.76 percent)

By 2025, these three major occupational groups combined, are projected to represent nearly 30 percent of total employment shares for the state.

[2] Displayed numbers in tables might not add up to actual totals due to rounding.

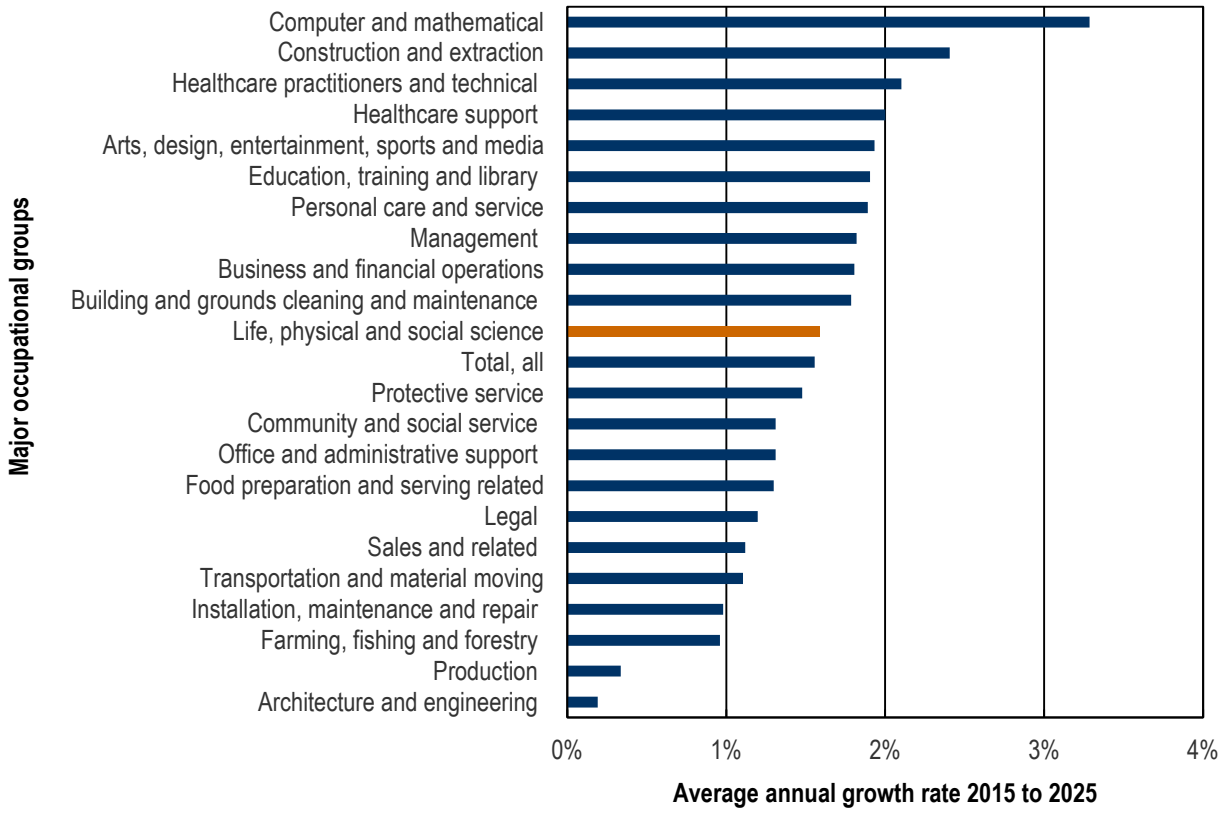
Figure 3. Base and projected occupational employment
Washington state, 2015, 2020 and 2025
Source: Employment Security Department/WITS; U.S. Bureau of Labor Statistics, Quarterly Census of Employment and Wages, Occupational Employment Statistics

2-digit SOC	Major occupational group	WA state est. empl. 2015	WA state est. empl. shares 2015	WA state proj. empl. shares 2020	WA state proj. empl. shares 2025	WA state percentage point change in empl. shares 2015 -2020	WA state percentage point change in empl. shares 2020 -2025
11-0000	Management	201,436	5.62%	5.70%	5.76%	0.08%	0.07%
13-0000	Business and financial operations	216,364	6.03%	6.10%	6.18%	0.07%	0.08%
15-0000	Computer and mathematical	168,888	4.71%	5.24%	5.58%	0.53%	0.34%
17-0000	Architecture and engineering	84,760	2.36%	2.15%	2.06%	-0.22%	-0.08%
19-0000	Life, physical and social sciences	38,477	1.07%	1.07%	1.08%	-0.01%	0.01%
21-0000	Community and social services	59,765	1.67%	1.63%	1.63%	-0.04%	0.00%
23-0000	Legal	28,207	0.79%	0.76%	0.76%	-0.03%	0.00%
25-0000	Education, training and library	216,242	6.03%	6.09%	6.24%	0.05%	0.15%
27-0000	Arts, design, entertain., sports and media	67,709	1.89%	1.93%	1.96%	0.04%	0.03%
29-0000	Healthcare practitioners and technical	167,823	4.68%	4.78%	4.94%	0.10%	0.16%
31-0000	Healthcare support	89,056	2.48%	2.52%	2.59%	0.03%	0.08%
33-0000	Protective service	62,806	1.75%	1.74%	1.74%	-0.01%	-0.01%
35-0000	Food preparation and serving related	285,347	7.96%	7.99%	7.76%	0.03%	-0.24%
37-0000	Bldg. and grounds cleaning and maint.	116,668	3.25%	3.29%	3.33%	0.04%	0.03%
39-0000	Personal care and service	149,254	4.16%	4.23%	4.30%	0.06%	0.08%
41-0000	Sales and related	343,301	9.57%	9.37%	9.17%	-0.21%	-0.20%
43-0000	Office and administrative support	449,756	12.54%	12.36%	12.24%	-0.18%	-0.12%
45-0000	Farming, fishing and forestry	93,779	2.62%	2.52%	2.47%	-0.09%	-0.06%
47-0000	Construction and extraction	199,454	5.56%	5.92%	6.05%	0.36%	0.12%
49-0000	Installation, maintenance and repair	130,739	3.65%	3.54%	3.44%	-0.11%	-0.09%
51-0000	Production	188,915	5.27%	4.88%	4.67%	-0.38%	-0.22%
53-0000	Transportation and material moving	227,291	6.34%	6.20%	6.06%	-0.14%	-0.14%

The largest increases in employment shares are expected for the computer and mathematical occupations and construction and extraction.

The projected average annual growth rates for the major occupational groups in Washington state are presented in *Figure 4*. Computer and mathematical (3.29 percent), construction and extraction (2.41 percent), and healthcare practitioners and technical (2.10 percent), are projected to grow faster than other major occupational groups from 2015 to 2025. In the long term, four occupational groups are projected to fall below a 1.0 percent average annual growth rate: installation, maintenance and repair (0.98 percent), farming, fishing and forestry (0.96 percent), production (0.34 percent) and architecture and engineering (0.19 percent).

Figure 4. Projected average annual growth rates for major occupational groups
Washington state, 2015 to 2025
Source: Employment Security Department/WITS; U.S. Bureau of Labor Statistics, Quarterly Census of Employment and Wages, Occupational Employment Statistics



Computer and mathematical, construction and extraction and healthcare practitioners and technical occupations are projected to experience the largest growth rates from 2015 to 2025 (3.29, 2.41 and 2.10 percent, respectively).

Replacement, separations and alternative methods

The Bureau of Labor Statistics (BLS) concluded that the current replacement methodology undercounts occupational openings. As a result, they created a new separations methodology. BLS created replacement and separation results for the 2012 to 2022 and 2014 to 2024 projections. They will not completely omit the replacement methodology until the 2016 to 2026 projections. This gives states time to convert their projections software over to the separations methodology.

More detailed information about the separations and replacement approaches can be found at: http://www.bls.gov/emp/ep_separations_methods.htm and http://www.bls.gov/emp/ep_replacements.htm, respectively.

The separations and replacement methods measure workers who leave their occupation and need to be replaced by new entrants into the occupation. The separations method is different in how it estimates workers who leave permanently from the replacement methodology used in previous years.

In the replacement methodology, workers who leave an occupation and are replaced by workers from different age cohorts are considered to have permanently left and are identified as generating replacement openings. Workers replaced by workers from the same age cohort are not identified as generating replacement openings. The inability to track openings generated by replacement workers of the same age cohort causes a significant undercount of openings.

In the separations methodology, workers who exit the labor force or transfer to an occupation with a different Standard Occupational Classification (SOC) are identified as generating separations openings.

For all methods, average annual openings due to growth are calculated by subtracting base year values from projected year values and then dividing by the number of years used for the calculation period.

For this year's 2017 projections cycle, we created a new state specific alternative method to the BLS replacement and separations methods. The BLS methods are based on national data. Our alternative method is based on Washington state wage records, making results specific to our state.

The alternative rate not only measures when workers leave one occupation for another or leave the workforce, but also measures openings created by turnover within occupations, i.e., workers stay within an occupation but transfer to different companies.

The data for the alternative rates comes from Washington state wage files. We estimate the numbers of annual transfers between industries, inside industries and in and out of wage files. Then we use occupation-to-industry staffing patterns (shares of occupations for each industry) to convert industry transfers to occupational transfers. Alternative replacement rates are calculated as the shares of total transfers, minus growth or decline, divided by estimated occupational employment for a base period

Comparison of replacement, separations and alternative methodologies

Figure 5 presents a comparison between replacement, separations and alternative methodologies. Average annual total openings are compared at the two-digit SOC level. Separations openings are three times larger than replacement openings, and alternative openings are more than two and a half times larger than separations openings. The alternative method increase makes sense since the alternative method measures openings not tracked by BLS. The alternative method measures turnover within occupations, while the BLS methods do not.

In *Figure 5*, the three largest separations to replacement ratios are for farming, fishing and forestry (4.46), production (4.31) and personal care and service (4.16). These higher than average values mean that compared to other occupations, these three have high exit rates. A higher proportion of workers within these occupations leave their occupations.

For these same three occupations, the alternative to separations ratios are; farming, fishing and forestry (2.59), production (2.27) and personal care and service (2.41). All three of these ratios are below the average alternative to separations ratio of 2.63. These lower ratios mean that for workers that stay within these occupations, the transfer rate to other jobs within the same occupation is low.

Figure 5. Comparison of replacement, separations and alternative methodologies on total openings
Washington state, 2015 to 2025
Source: Employment Security Department/WITS; U.S. Bureau of Labor Statistics, Quarterly Census of Employment and Wages

2-digit SOC title	Est. empl. 2015	Est. empl. 2025	Separations average annual total openings 2015-2025	Alternative average annual total openings 2015-2025	Ratio separations to replacement	Ratio alternative to separations
Architecture and engineering	84,760	86,389	5,772	17,750	2.48	3.08
Arts, design, entertainment, sports and media	67,709	81,994	8,821	24,033	2.74	2.72
Building and grounds cleaning and maintenance	116,668	139,247	18,290	49,047	3.78	2.68
Business and financial operations	216,364	258,768	24,432	66,835	2.74	2.74
Community and social service	59,765	68,083	7,339	17,289	3.31	2.36
Computer and mathematical	168,888	233,355	19,080	60,107	2.01	3.15
Construction and extraction	199,454	252,989	26,999	97,277	3.09	3.60
Education, training and library	216,242	261,139	25,743	52,838	2.64	2.05
Farming, fishing and forestry	93,779	103,178	15,592	40,356	4.46	2.59
Food preparation and serving related	285,347	324,617	57,510	129,073	3.75	2.24
Healthcare practitioners and technical	167,823	206,643	13,250	53,466	1.67	4.04
Healthcare support	89,056	108,580	13,254	35,044	3.30	2.64
Installation, maintenance and repair	130,739	144,136	13,854	43,358	3.05	3.13
Legal	28,207	31,777	1,984	7,350	2.27	3.70
Life, physical and social science	38,477	45,055	4,481	10,282	2.41	2.29
Management	201,436	241,252	20,382	66,747	2.27	3.27
Office and administrative support	449,756	512,331	58,932	148,342	3.64	2.52
Personal care and service	149,254	179,993	26,870	64,832	4.16	2.41
Production	188,915	195,351	22,131	50,230	4.31	2.27
Protective service	62,806	72,725	8,334	17,638	3.23	2.12
Sales and related	343,301	383,725	52,254	122,679	3.63	2.35
Transportation and material moving	227,291	253,695	31,720	79,548	3.74	2.51
Totals	**3,586,037**	**4,185,022**	**477,021**	**1,254,118**	**3.19**	**2.63**

On average, alternative openings are more than two and a half times larger than separations openings.

Specific occupations

Figure 6 shows the top 20 specific occupations by total openings based on the alternative methodology. *Figure 7* shows the top 20 specific occupations by total openings based on the BLS separations methodology.

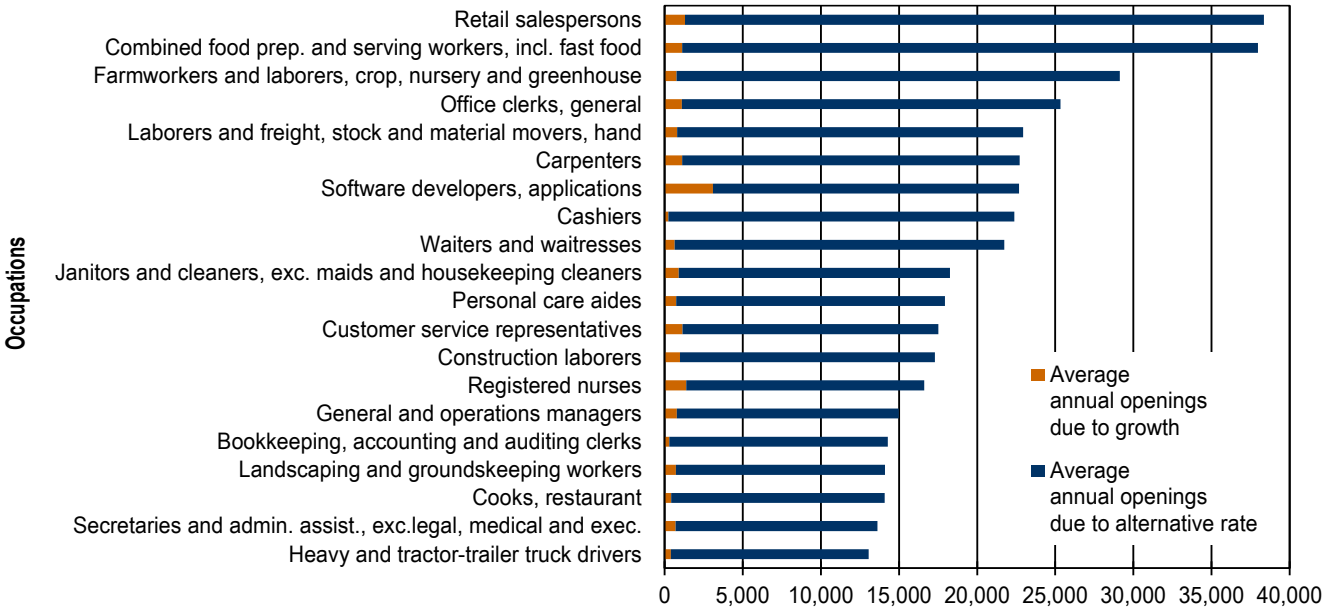
Within these two methodologies, 18 of the top 20 specific occupations are identical. Heavy and tractor-trailer truck drivers and general and operations managers are in the alternative top 20, but are not in the separations top 20. Teacher assistants and sales representatives, wholesale and manufacturing, except technical and scientific products, are in the separations top 20, but are not in the alternative top 20.

In the alternative method, at the six-digit SOC level, retail salespersons are projected to have the largest number of total openings followed by combined food preparation and serving workers, including fast food. In the separations method, the same two occupations are in the top spots, but in reverse order.

At the state level, the total number of openings due to the alternative rate are about 20 times greater than the number of openings due to growth. Under the separations methodology, the total number of openings due to separations are 7 times larger than the number of openings due to growth.

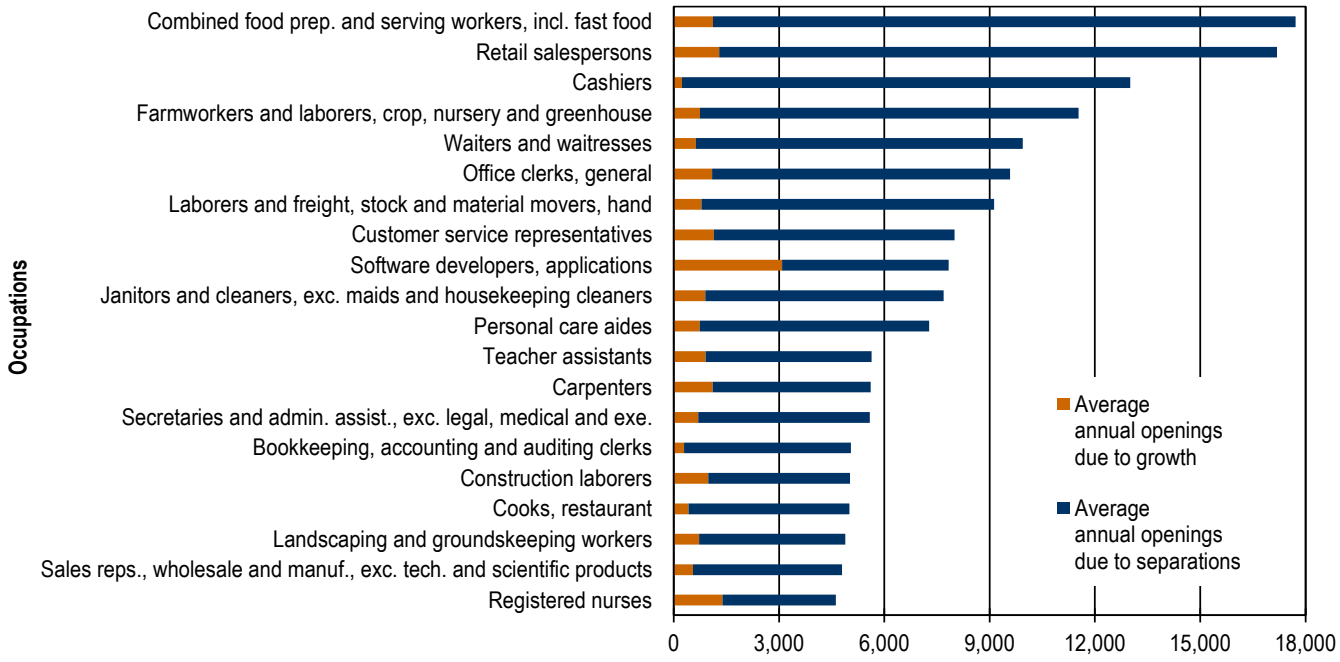
Neither method contains occupations where growth openings are greater than alternative or separations openings.

Figure 6. Top 20 specific occupations by average annual total openings, alternative methodology
Washington state, 2015 to 2025
Source: Employment Security Department/WITS; U.S. Bureau of Labor Statistics, Quarterly Census of Employment and Wages, Occupational Employment Statistics



The alternative methodology measures when workers leave one occupation for another and turnover within occupations.

Figure 7. Top 20 specific occupations by average annual total openings, separations methodology
Washington state, 2015 to 2025
Source: Employment Security Department/WITS; U.S. Bureau of Labor Statistics, Quarterly Census of Employment and Wages, Occupational Employment Statistics



The separations methodology measures when workers leave occupations entirely and when workers leave the labor force entirely. It does not measure turnover within occupations.

Appendices

Appendix 1. Use and misuse of employment projections

Employment projections provide a general outlook for industries and occupations in Washington state. Occupational projections show how many job openings are projected due to occupational employment growth and turnover.[3]

The Bureau of Labor Statistics (BLS) created two methods to track turnover between occupations; the replacement and separations methods. These methods measure when workers leave the labor force or transfer from one occupation to an entirely different occupation. Neither of the BLS methods measure turnover within occupations, i.e., when workers stay within the same occupation, but change employers.

In contrast, the state specific alternative rate measures turnover within occupations. In the alternative method, projected total openings now represent projected total demand.

State and regional occupational employment details, for occupations with at least 10 jobs, are found in our projections files. Data for all three methods, replacement (repl), separations (sep) and alternative (alt) can be found at: **https://esd.wa.gov/labormarketinfo/projections**.

Observed and predicted extremes in employment growth and other indicators, such as fastest growing occupations and shortage of skills, can be used for placement and short-term training decisions. However, these should be limited for use when developing long-term education programs. There are two main reasons for this limitation:

1. First, with more education targeting occupations with skills shortages, there is a higher probability that this will cause an oversupply in those occupations and skills sets.[4]

2. Second, the general development of transferable skills is much more productive than trying to catch up with a skills shortage.

The U.S. Bureau of Labor Statistics cautions: "The 2010 SOC was designed solely for statistical purposes. Although it is likely that the 2010 SOC also will be used for various non-statistical purposes (e.g., for administrative, regulatory or taxation functions), the requirements of government agencies or private users that choose to use the

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[3] This is discussed in the Employment Projections Technical Report at: https://esd.wa.gov/labormarketinfo/projections. Due to the non-additive formula for calculating total openings, in this round of projections we calculated total openings for aggregated occupations as a total for detailed occupations. As a result, the aggregated level of total openings might not equal the total of growth plus replacement.

[4] Occupational projections are the basis of the Occupations in Demand list. This list is used for determining eligibility for a retraining program (Training Benefits), as well as other education and training programs. See https://esd.wa.gov/labormarketinfo/projections.

2010 SOC for non-statistical purposes have played no role in its development, nor will the Office of Management and Budget (OMB) modify the classification to meet the requirements of any non-statistical program."

Consequently, the 2010 SOC is not to be used in any administrative, regulatory or tax program unless the head of the agency administering that program has first determined that the use of such occupational definitions is appropriate to the implementation of the program's objectives."[5]

Different programs use different SOC coding systems. Combining employment projections with other data sources generally requires a case-by-case analysis; an understanding of the differences of each program should be clearly explained and properly handled.

Occupations in Demand list

The methodology for determining whether an occupation is "in demand," "not in demand" or "balanced" is based on industry and occupational projections. Specific levels of job growth and job openings are used to designate an occupation as "in demand," "not in demand" or "balanced." For more details and methodology, see *Appendix 2* in this report and refer to: https://esdorchardstorage.blob.core.windows.net/esdwa/Default/ESDWAGOV/labor-market-info/Libraries/Industry-reports/Employment-projections/Occupations%20in%20Demand%20methodology.pdf

[5] See: www.bls.gov/soc/soc_2010_user_guide.pdf, pages xxv-xxvi.

Appendix 2. Occupations in Demand (OID) methodology

Employment Projections are intended for career development over time, not as the basis for budget or revenue projections, or for immediate corrective actions within the labor market.

Employment projections are the basis of the Occupations in Demand (OID) list covering Washington's 12 workforce development areas and the state as a whole. This list is used to determine eligibility for a variety of training and support programs, but was created to support the unemployment insurance Training Benefits Program.

The full OID list is accessible through the "Learn about an occupation" tool located at: https://esd.wa.gov/labormarketinfo/LAAO.

All occupations in the list have demand indication definitions. The definitions come in three forms; **in demand**, **not in demand** or **balanced**. These definitions indicate the probability of a job seeker gaining employment in a given occupation. The term **in demand** indicates a greater probability of gaining employment. The term **not in demand** indicates a lesser probability and **balanced** indicates an uncertain probability between success and failure in gaining employment.

The definitions are created through a four-step process.

The data sources for the OID list:

The 2017 list is based on projections with state specific alternative rates used for turnover openings:

- Five-year projections for 2015-2020, using average annual growth rates and total job openings.
- Ten-year projections for 2015-2025, using average annual growth rates and total job openings.
- A combination of two-year (second quarter 2016 to second quarter 2018) and ten-year (2015-2025) projections, using average annual growth rates and total job openings.

All of these time frames use unsuppressed occupations with employment in a base year (2015), consisting of 50 or more employees, for the state and workforce development areas (WDAs).

In addition to projections, the OID list is created using supply and demand data:

- Supply data: annual counts of unemployment claimants for WDAs for the most recent full year (April 2017 and the preceding 11 months).
- Demand data: annual counts of job announcements from Help Wanted OnLine (HWOL) mid-monthly time series (April 2017 and the preceding 11 months).

Step one: Identify initial "in demand" and "not in demand" categories for each period.

- For each time frame, occupations with average annual growth rates of at least 90 percent of their respective geographic areas (statewide or workforce development area), total average annual growth rates and a share of total openings of at least 0.08 percent are defined as **in demand**.
- Occupations with average annual growth rates less than 70 percent of their respective geographic areas total growth rates *and* a share of total openings of less than 1.0 percent are defined as **not in demand**.

Step two: Identify provisional occupational categories.

- If within any of the three projection time frames (five-year, 10-year and two-/10-years combined), an occupation is categorized as being **in demand**, it receives the first provisional identification as **in demand**.
- If within any of the three projection time frames, an occupation is categorized as **not in demand**, it receives a second provisional identification of **not in demand**.

Step three: Create final projections definitions.

- If an occupation has only one provisional definition, it equals the final projections definition.
- If an occupation has two provisional definitions of **in demand** and **not in demand**, it gets identified as **balanced**.
- All other occupations, without provisional definitions (i.e., not meeting the thresholds from step one), are identified as **balanced**.

Step four: Create final adjustment definitions.

The projections definitions are now put through an adjustment process, using current labor market supply/demand data which compares online job announcements to information on unemployment insurance (UI) claimants.

Adjustments are applied when current supply/demand data significantly contradicts the model-based projections definitions.

The adjustment methodology[6]

- Supply/demand data are used for adjustments if they are significant. Significant supply/demand data exist when the largest values between announcements and UI claimants are greater than 100 or are between 50 and 100 and these values are more than 10 percent of annual job openings for the period 2015-2025.
- If the projections definition is **in demand** or **balanced** but the ratio of supply to demand is more than 2.5, then the adjusted definition is **not in demand**.
- If the projections definition is **in demand** and the ratio of supply to demand is not larger than 2.5, but more than 1.5, then the adjusted definition is **balanced**.
- If the projections definition is **not in demand** or **balanced**, but the ratio of supply to demand is less than 0.4, then the adjusted definition is **in demand**.
- If the projections definition is **not in demand** and the ratio is at least 0.4, but less than 0.6, then the adjusted definition is **balanced**.

The final list: Local adjustments

The Employment Security Department's Workforce Information and Technology Services (WITS) division uses the methodology outlined above to prepare the initial lists for the state as a whole and by workforce development area. Those lists are then given to local workforce development councils to review, adjust and approve based on their local, on-the-ground experience.

[6] Due to changes in data and improvements in 2017 methodology, adjustment values/percent thresholds were changed and rules modified from last year's 2016 methodology.

Appendix 3. Skill projections

In the development of skills projections, occupational projections are converted into skills projections. We rely on the content of employers' job postings rather than predefined, general O*NET skills to make skills projections possible.

Data sources

As in previous years, the main source for this analysis was a download of the top 100 hard skills for each detailed (six-digit SOC) occupation for Washington state from WANTED Analytics. The downloaded files represent the extracted hard skills from online job announcements posted in the last three years. This year we downloaded files from May 2014 to April 2017. Each skill is displayed with the number of job announcements from which it was extracted. This skill announcement(s) pairing permits every occupation to display the relative importance of each skill. Theoretically, each occupation could contain a vector of up to 100 components with announcement numbers indicating the relative importance of each skill. A vector is a single entity (i.e., a column) consisting of an ordered collection of numbers. A skill drawn from a greater number of job announcements is relatively more important. The number of job announcements is summed for each occupation. Only vectors with a summation value of at least 5.0 percent and not less than 2.0 percent of base year employment were used. Some occupations contain very limited (if any) numbers of skill components.

Vectors were normalized (i.e., scaled) to totals of one. With this type of normalization, we created skills–to-occupations matrices. These matrices were used to convert occupational estimations and projections into comparable numbers expressed as hard skills.

The skills–to-occupations matrices are similar in structure and function to normalized matrices used for occupation-industry staffing patterns. The skill matrices were based on statewide data and were used to convert alternative occupational projections for the state and all areas into skill projections.

After conversion, we deleted all records where estimated or projected employment numbers were below five. We consider estimations below five as unreliable. As a result of filtering out missing skill/ occupation vectors and removing results below five, only a portion of the occupational employment estimates were converted into skills.

The conversion size (occupational employment to skills), calculated on base year employment, varies between about 89.8 percent for Seattle-King County WDA, to a low of 69.1 percent for the North Central Washington WDA. The average ratio for WDAs is 82.6 percent and for the state is 86.7 percent.

Some results

The skills-to-occupations matrices have different dimensions for the state's areas based on data availability. As a result, the largest number of detailed skills were 3,544 for Washington state, followed by King County at 2,999.

The top six detailed hard skills for the state and all areas, based on projected numbers of openings and available number of jobs, are relatively stable between areas. The top six are: **Food preparation**, **Bilingual**, **Mathematics**, **Quality Assurance**, **Forklifts** and **Freight+**. The stability among areas is no surprise since the same statewide matrix was used for all areas. The combined top six skills represent 15.6 percent of total openings for the state. The ranking order is slightly different for different areas, depending on sorting criteria (by number of jobs or total openings). For instance, for the state, sorting results by total openings are the same as the top six detailed hard list, but sorting results by numbers of jobs in the second quarter of 2016, switches the top two skills: **Bilingual** became first and **Food preparation** second. The order of the other four skills remains the same.

For Seattle-King County, sorting results by total openings is different from the state, where the order of **Quality Assurance** (became number three) and **Mathematics** (became number four) switch places. All other rankings for the top six skills remains the same as for the state. Sorting by employment modifies rankings more significantly for the top four skills: **Bilingual**, **Quality Assurance**, **Mathematics** and **Food preparation**.

The list of top skills are relatively consistent with the previous year's results; where four of the top six skills remain the same: **Food preparation**, **Bilingual**, **Quality Assurance** and **Forklifts**. However, it is apparent that the algorithm for extracting skills used by HWOL this year was different than last year. Two of the top six skills this year (**Mathematics** and **Freight+**) were not among extracted skills last year.

The fastest growth is projected for skills related to information technology (IT). The IT skills are very specific, vary from area to area and the majority, individually, are not large in terms of employment and job openings. The largest annual average growth rates for the state between 2015 and 2025 for skills with total openings of at least 100 are expected to be: **Asynchronous JavaScript** and **XML**, **AngularJS**, **Spring**, **CSS3 (Cascading Style Sheets)**, **JavaScript Object Notation**, and **RESTful Web Services**. However, the combined totals for these top six detailed occupations represented an insignificant share, less than 0.1 percent of total openings represented in the skill projections.

[7] Bolded skills are spelled exactly as they are found on the internet.

The top 20 detailed skills for Washington state based on a combined rank of annual average openings and growth for 2015 to 2025 are presented in *Appendix figure A3-1*.

Appendix figure A3-1. Top 20 skills ranked by combined growth and openings
Washington state, 2015 to 2025
Source: Employment Security Department/WITS; WANTED Analytics

Combined rank	Hard skill titles	Estimated hard skill employment numbers 2015	Projected hard skill employment numbers	Average annual growth rate 2015-2025	Total average annual openings
1	Java	8,818	12,117	3.23%	3,057
2	C-sharp	4,477	6,312	3.50%	1,568
3	JavaScript	3,331	4,833	3.79%	1,238
4	C/C++	4,950	6,808	3.24%	1,666
5	Linux	6,128	8,125	2.86%	2,069
6	Amazon Web Services	2,970	4,190	3.50%	1,069
7	Hypertext markup language	3,869	5,246	3.09%	1,430
8	Systems Development Life Cycle	3,311	4,582	3.30%	1,173
9	Distributed system	2,815	3,965	3.48%	1,011
10	Cascading Style Sheets	2,304	3,292	3.63%	876
11	Python	6,115	8,034	2.77%	1,982
12	Microsoft SQL Server	3,319	4,509	3.11%	1,163
13	User Experience design	1,944	2,794	3.70%	728
14	Big Data	4,719	6,194	2.76%	1,592
15	Data structures	2,036	2,913	3.65%	729
16	Web services	9,043	11,645	2.56%	3,074
17	Graphical User Interface design	3,297	4,396	2.92%	1,166
18	Microsoft .NET Framework	2,117	2,963	3.42%	747
19	Machine learning techniques	3,062	4,103	2.97%	1,046
20	Scrum agile methodology	2,726	3,682	3.05%	969

All of the top 20 skills are related to information technology.

All of the top 20 skills are related to IT. The top 20 occupations represent 2.6 percent of total openings in the skills forecast. Fourteen of the top 20 skills are identical to last year.

In the entire list of skills, some skills are quite general and represent a significant share of total numbers and openings. Examples are the top three skills based on openings: **Food preparation**, **Bilingual**, **Mathematics**, etc. The majority of skills, especially related to IT and high-tech, are very specific and their numbers are dispersed among all occupations. As a result, such detailed skills normally do not represent a significant share of total numbers.

Results change significantly if we group all detailed skills together, based on primary type of skill within a skill category (e.g., engineering skills, IT skills). This type of skill category grouping is quite challenging since a significant number of skills are a combination of specific fields and IT skills. A good example of this is the grouping of CAD software with the field of architectural drawing.

In the skills forecast, by far the largest group of skills are IT related. They represent more than one-fourth of estimated skill numbers and openings for replacement and 21.3 percent for separations. The IT group is projected to be the fastest growing for the period 2015 to 2025, with an annual average growth rate of slightly more than 2.0 percent. The second and third largest groups of skills are related to production and maintenance, which accounts for almost 12.1 and 7.2 percent of all openings. This is closely followed by healthcare with 6.8 percent of openings. Healthcare also has the second largest projected growth rate of 1.79 percent.

It is interesting to note that out of a total of 644 occupations, IT skills are present in 595 occupations. For 240 of these occupations, IT skills comprise more than one-quarter of total numbers and for 90 they comprise more than one-half of total numbers.

The IT skills naturally dominate shares in computer related occupations, but also have a very high share in occupations whose primary occupational focus is not computers. The top 15 occupations with high computer skill requirements, based on IT shares (with IT skill numbers more than 100) are presented in *Appendix figure A3-2*. The residual occupations, for example, Life Scientists, All other, are not included in the table.

Appendix figure A3-2. Occupations, not primarily computer related, with the largest shares of computer skill requirements
Washington state, second quarter 2016, occupational estimations
Source: Employment Security Department/WITS; WANTED Analytics

SOC	Occupation	Share of skills that are IT
492095	Electrical and Electronics Repairers, Powerhouse, Substation, and Relay	0.863
271022	Fashion Designers	0.842
193011	Economists	0.808
271014	Multimedia Artists and Animators	0.808
439111	Statistical Assistants	0.791
271013	Fine Artists, Including Painters, Sculptors, and Illustrators	0.755
514122	Welding, Soldering, and Brazing Machine Setters, Operators, and Tenders	0.750
254011	Archivists	0.745
131161	Market Research Analysts and Marketing Specialists	0.730
132051	Financial Analysts	0.728
271024	Graphic Designers	0.728
152031	Operations Research Analysts	0.725
131111	Management Analysts	0.725
152011	Actuaries	0.725
271021	Commercial and Industrial Designers	0.723

Nine of the current occupations are the same as in last year's report.

Skill based related occupations

Skills–to-occupations matrices allowed us to create a tool for defining related occupations based on common skills. To achieve this, we calculated a matrix of correlations based on skills between occupations. The results are presented in the macro-enabled file, reloccup_skills_2017.xlsm. The matrix in the file's "main" tab is symmetric around the main diagonal. The main diagonal has all 1s in it. There are two ways of using the file's data when opened with the macro-enabled feature:

1. You can select an occupational title of interest from a column heading in the "main" tab, and then sort the numbers below the title of interest from largest to smallest. Starting from row 3 in column B, you would see the sorted list of related occupations (row 2 will be the same occupation as selected). To restore the original sort configuration, sort the key column (column A) from smallest to largest.

2. You can select an occupation of interest from a column heading in the "main" tab, and then click the "Ctrl" and "A" keys simultaneously. This will execute a macro. The macro opens a table in a "table" tab. In the table you will find a list of the top 15 occupations related to your occupation of interest.

An example of a list of occupations related to computer programmers is in *Appendix figure A3-3*.

Appendix figure A3-3. Top 15 occupations related to computer programmers
Washington state,
Source: Employment Security Department/WITS; WANTED Analytics

SOC	Occupation	151131-Computer programmers
151132	Software Developers, Applications	0.779
151121	Computer Systems Analysts	0.718
151134	Web Developers	0.649
151199	Computer Occupations, All Other	0.645
151141	Database Administrators	0.578
152031	Operations Research Analysts	0.459
151133	Software Developers, Systems Software	0.445
151111	Computer and Information Research Scientists	0.44
131111	Management Analysts	0.382
131161	Market Research Analysts and Marketing Specialists	0.373
113021	Computer and Information Systems Managers	0.365
172061	Computer Hardware Engineers	0.357
151142	Network and Computer Systems Administrators	0.344
173019	Drafters, All Other	0.344
152011	Actuaries	0.342

Numbers in the table represent coefficients of correlations for normalized vectors of skill shares.

The related occupations tool could be useful for job seekers. The results are specific for Washington state since the skills come from job announcements in this state.

Conclusions

Some significant data limitations were encountered when converting occupational data from job announcements into skills. In spite of these limitations, useful results were produced. It is our conclusion that it is more important to connect education and training programs with real world skill requirements than with generic occupational skill definitions.

Some skills with large projected numbers of openings are well defined and can be linked to different levels of training. Examples of skills with the largest numbers of projected openings are: **Food preparation**, **Bilingual** (with a separate skill in bilingual Spanish), **Mathematics**, **Customer relationship management**, **Pediatrics**, **Behavioral health**, etc.

A second significant group of skills which for the most part are well defined in terms of primary activities, but which require significant secondary skills related to information technology are: **Quality control**, **Risk assessment** and Lean related skills. These types of skills are much more dispersed than the first group. Relating this

second skill group to training is more complicated. While primary fields are relatively stable and well defined, IT skill sets are ever changing. IT skills are concentrated mainly in software, algorithms, some hardware and in web applications. Since required IT skill sets change frequently, specific software applications should be given a secondary emphasis in training.

Though IT skills are a very large group, they are highly dispersed amongst detailed skills and are subject to frequent changes. Some specific skills, like those in *Appendix figure A3-2*, are important and help graduates enter the labor market or move to higher paid jobs. However, in the long run, it might be worth giving priority to foundational academic subjects like math and formal logic, multidimensional design and foundational concepts in object oriented programming. In other words, foundational abilities to learn, develop and implement new knowledge and technology in the long run should take priority for career preparation.

Future possibilities

It is important to establish a direct connection between specific skills required by employers and education and training programs.

Appendix 4. Skill projections

Appendix 4 contains flow chart summaries of the 2017 projections process. Minimal details are used for chart descriptions. This overview is composed of six charts preceded by narrative. R software was used to produce projections. The same software was used to create the flow charts.

The six major projections steps (charts) are:

1. Data preparation and series projections
2. Combine and adjust series
3. Industry Control Totals (ICT) projections
4. Benchmarking
5. Base occupational projections
6. Final occupational projections

Data preparation and series projections

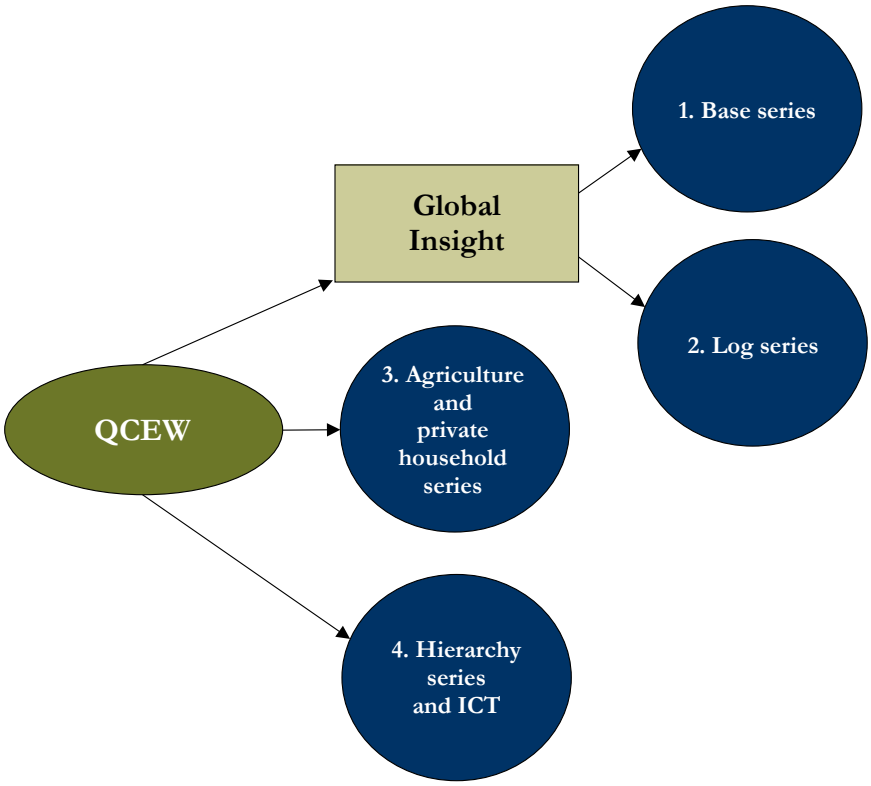
Quarterly Census of Employment and Wages (QCEW) and Global Insight (GI) data are prepared and industry series projections created.

QCEW is Washington state industry employment data collected within the unemployment insurance (UI) system and processed to county levels.

QCEW is also called "covered employment" since employers and their employees are "covered" by unemployment insurance.

GI data are national industry forecasts used as regressors for series projections

Appendix figure A4-1. Projections data preparation and series projections
Washington state, 2015 to 2025
Source: Employment Security Department/WITS



Combine and adjust state series projections

Projections methods' outputs are collected in Combined #1.

Combined #1 is an input to the major breakpoint definitions process.

The addition of breakpoints to Combined #1 creates Combined #2.

Combined #2 contains base, log, hierarchy and breakpoint output.

Combined #2 is adjusted.

"Adjusted" means that the amount of variation in projected employment values is restricted.

Adjustments are derived from historical employment.

Historical employment variation is measured (12-month, one-step-ahead process).

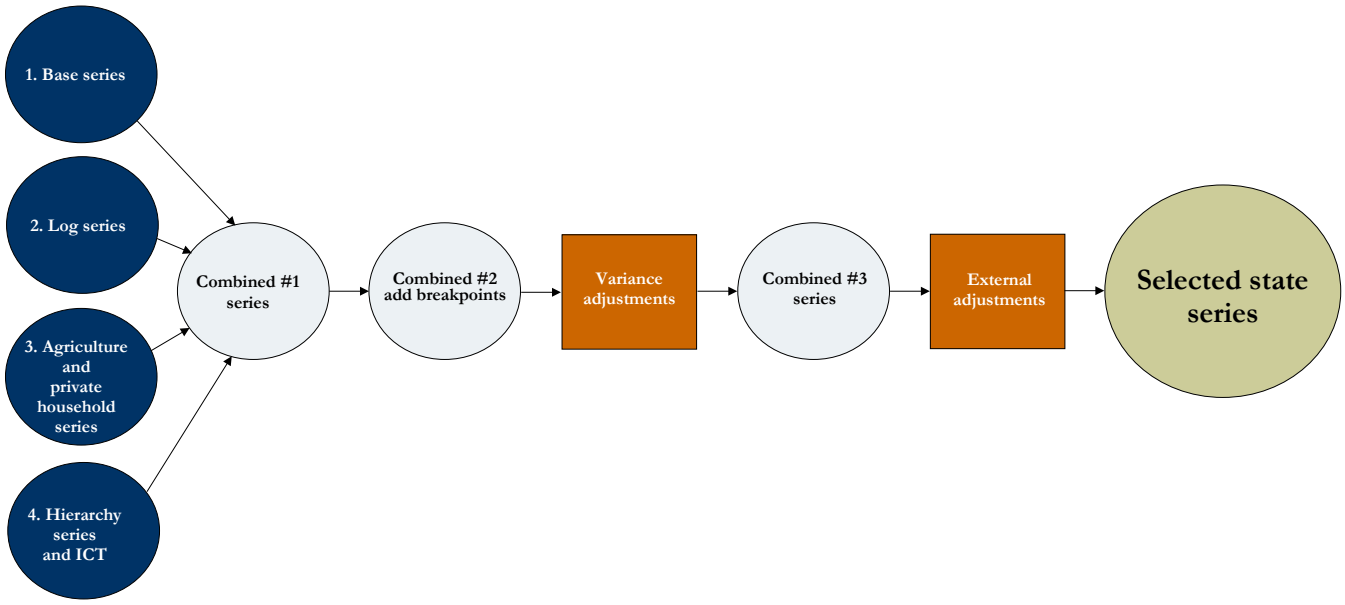
Projected values are allowed to vary inside confidence intervals, but not more than plus/minus 4 percent from historical means (percentage is subject to change).

After adjustments, series are consolidated in Combined #3 and then exported out of R into Excel.

External, manual adjustments are applied to Combined #3.

A review process selects one state series, from multiple model outputs, for each industry.

Appendix figure A4-2. Projections data combination and adjustment
Washington state, 2015 to 2025
Source: Employment Security Department/WITS

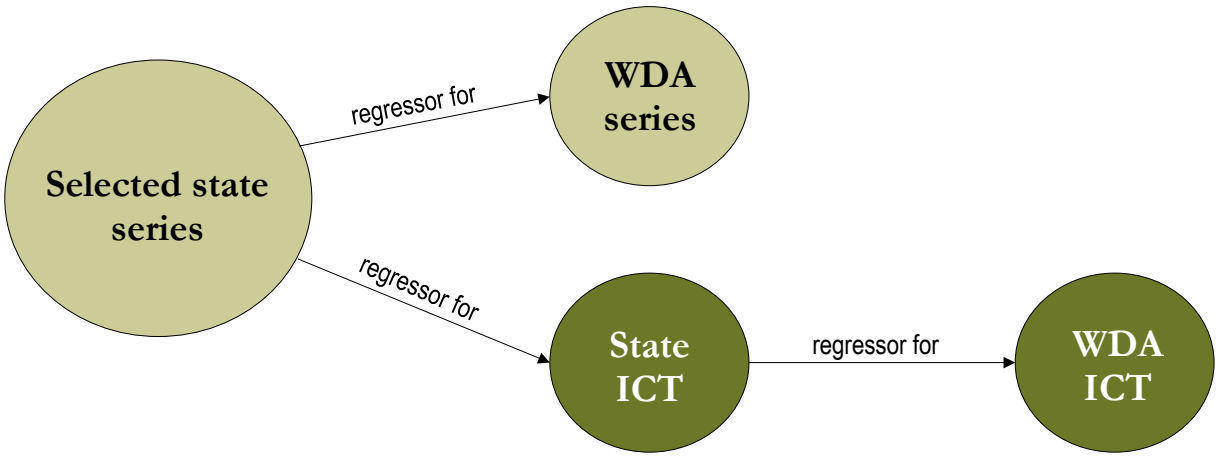


Workforce development area series and ICT projections

Selected state series projections are used as regressors for WDA series projections and state ICT projections.

In turn, state ICT projections are used as regressors for WDA ICT projections.

Appendix figure A4-3. WDA series and ICT projections
Washington state, 2015 to 2025
Source: Employment Security Department/WITS



Benchmarking

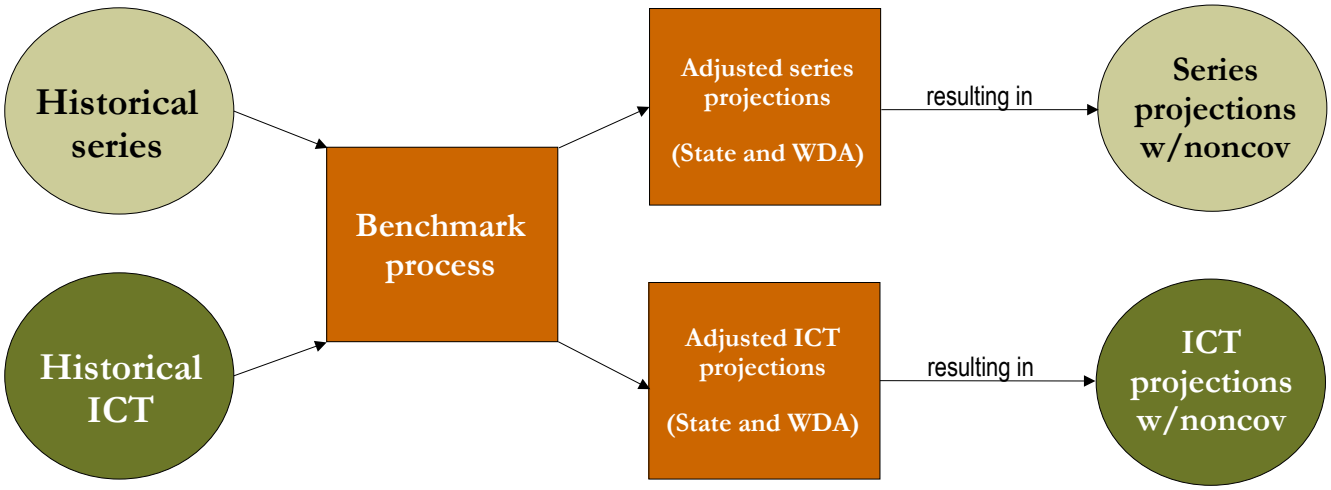
Adjusted historical aggregated series and adjusted historical ICT are benchmarked for base periods (year 2015 and the second quarter 2016).

Benchmarking is the adding of non-covered employment to QCEW covered employment (including non-covered exempt corporate officers).

Projected growth rates for non-covered employment are applied to benchmarked base periods to produce industry projections for second quarter 2018, and all four quarters for 2020 and 2025.

A reconciliation process adjusts results between aggregated series projections and detailed ICT projections.

Appendix figure A4-4. Benchmarking
Washington state, 2015 to 2025
Source: Employment Security Department/WITS



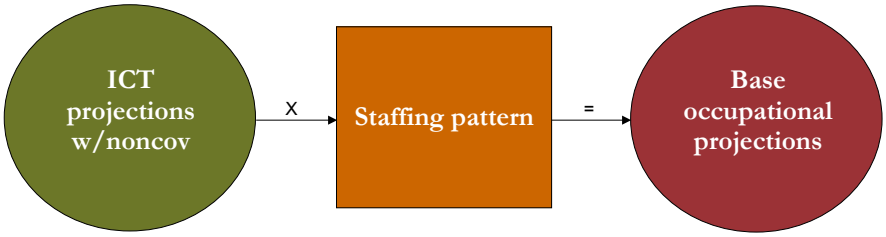
Base occupational projections

ICT projections with non-covered employment are multiplied by occupational shares within a staffing pattern.

The results are aggregated by SOC.

The results of this aggregation are occupational projections.

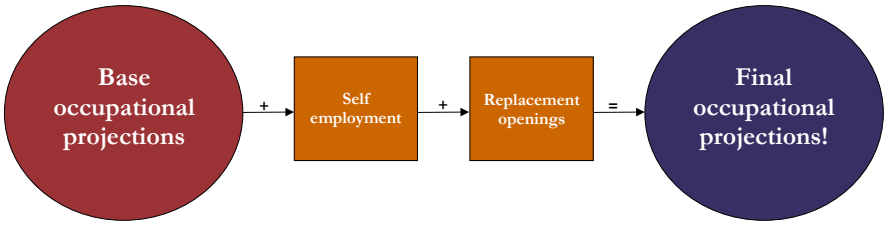
Appendix figure A4-5. Base occupational projections
Washington state, 2015 to 2025
Source: Employment Security Department/WITS



Final occupational projections

Self-employment and "replacement" openings (replacement, separations or alternative methods) are added to occupational projections, resulting in final occupational projections.

Appendix figure A4-6. Final occupational projections
Washington state, 2015 to 2025
Source: Employment Security Department/WITS



Appendix 5. Frequently asked questions

Q: **What are the steps in industry projections?**

A: There are two steps to industry projections. The first step is developing aggregated statewide industry projections using the Global Insight model. The second step produces detailed industry projections. The principal data source for industry projections is a detailed covered employment time series of four-digit NAICS data for all Washington counties, specifically, the U.S. Bureau of Labor Statistics, Quarterly Census of Employment and Wages (QCEW).

Q: **Why are the detailed industry projections not comparable with U.S. Bureau of Labor Statistics, Current Employment Statistics (CES) definitions?**

A: Industry projections are disaggregated according to U.S. Bureau of Labor Statistics, Occupational Employment Statistics (OES) definitions, which are somewhat different from CES.

Q: **What is the source for occupational/industry ratios?**

A: The primary source for occupational/industry ratios is the OES survey. However, this survey uses different area designations than the state's workforce development areas (WDAs) and has limited industry coverage (agriculture, non-covered employment, private households and self-employment are excluded) necessitating the use of other staffing patterns as well.

Q: **Why can the ratio for industry and occupational projections differ from the OES survey outputs?**

A: The ratios can be different from the OES survey outputs due to the reasons stated above and the use of substituted or combined staffing patterns from raw samples.

Q: **Why can occupational/industry ratios differ between the base year and projected years?**

A: This is due to the use of change factors, which predict changes in the occupational shares for each industry over time.

Q: **Why can't projections be benchmarked or verified?**

A: There are no administrative records for employment by occupation; therefore, the data cannot be reliably benchmarked or verified by non-survey means.

Q: **How are occupational projections used?**

A: Occupational projections are the only data source for the statewide and WDA-specific occupational outlook. Projections are also the foundation for developing the Occupations in Demand list, which is used to determine eligibility for a variety of training and support programs, but was created to support the unemployment insurance Training Benefits Program.

Q: **How are industry projections used?**

A: Industry projections can be used by policy makers, job seekers, job counselors and economic analysts. For any policy decisions, the projections should be supplemented with other available data sources (e.g., unemployment insurance claims, educational data, job announcements, etc.).

Q: **Which occupational codes are used?**

A: The 2010 Standard Occupational Classification (SOC) system was used for this round of projections.

Q: **Can the SOC be used for administrative purposes?**

A: According to BLS, the 2010 SOC was designed solely for statistical purposes. To use SOC for administrative programs, the head of an agency considering using SOC must first determine if the use of SOC definitions is appropriate for a program's objectives.

Q: **Why don't the occupational totals by WDA equal the state total?**

A: The totals are not additive due to the use of local staffing patterns for projections by WDA, which differ from the statewide staffing pattern.

Appendix 6. Glossary of terms

Alternative state specific job openings

Job openings due to the alternative state specific method are based on Washington state wage records. The alternative method measures when workers leave one occupation for another and when workers leave the workforce. In addition, this method measures job openings created when workers stay within occupations, but transfer to different companies.

Industries

A classification of business establishments based on their specific economic activity.

Job openings due to growth

Average annual job openings due to growth are calculated by subtracting base year values from projected year values and then dividing by the number of years used for the calculation period.

Job openings due to net replacement

Job openings due to net replacement measures workers who leave occupations and need to be replaced by new entrants. It does not include normal turnover as workers go from one employer to another or from one area to another without changing their occupations. Workers who leave an occupation and are replaced by workers from different age cohorts are considered to have permanently left and are identified as generating replacement openings. Workers replaced by workers from the same age cohort are not identified as generating replacement openings. Replacement rates are based on national data.

Job openings due to separations

Job openings due to separations measures workers who leave occupations and need to be replaced by new entrants. In the separations methodology, workers who exit the labor force or transfer to an occupation with a different Standard Occupational Classification (SOC) are identified as generating separations openings. Workers who leave an occupation and are replaced by workers from the same or different age cohorts are considered to have permanently left and are identified as generating separation openings. Separation rates are based on national data.

North American Industry Classification System (NAICS)

North American Industry Classification System (NAICS) is the system used by federal statistical agencies in classifying business establishments for the purpose of collecting, analyzing and publishing statistical data related to the U.S. business economy. NAICS was developed under the authority of the U.S. Office of Management and Budget.

Occupation

A job or profession, a category of jobs that are similar with respect to the work performed and the skills possessed by the workers.

Occupational projections

Industry projections converted to occupations, based on occupational/industry ratios.

Standard Occupational Codes (SOC)

Standard Occupational Classification (SOC) is the system used by federal statistical agencies in classifying workers into occupational categories for the purpose of collecting, calculating or disseminating data. All workers are classified into one of 841 detailed occupations according to their occupational definition. SOC was developed under the authority of the U.S. Office of Management and Budget.

Total occupational estimations and projections

Total occupational estimations and projections are calculated to describe employment in the base year and future time periods.