Washington Technology Industry Association

Information & Communication Technology Economic and Fiscal Impact Study

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

Principal: Chris Mefford

Analysts: Spencer Cohen
Erin Gengo
Diana Haring
Michaela Jellicoe
Alison Peters
Alexandra Streamer
Eric Viola

Community Attributes Inc.
1411 Fourth Ave, Suite 1401
Seattle, Washington 98101

www.communityattributes.com

Executive Summary

Purpose

After surveying the history of reports, analyses, and data points describing the Information and Communication Technology (ICT) Industry, the Washington Technology Industry Association (WTIA) determined a need to research and publish a current economic and fiscal impact study of the sector. The WTIA commissioned this study to help inform a productive collaboration among industry, education, and government leadership in matters of public policy, investments in public projects, and public-private partnerships.

The ICT Cluster: An Industry, Plus Cross-Industry Talent

Washington's Information & Communication Technology (ICT) industry has two defining dimensions: (1) **Companies** that design and deliver innovative products and services, create economic value, and bring prestige to Washington State; and (2) individual professionals with essential skills ("**Talent**") that make all that innovation, value creation, and prestige possible in ICT companies **and other sectors of the economy**.

Microsoft, for example, is an ICT sector **Company** that hires **Talent** to create exciting new systems and applications. Starbucks is a coffee retailer—not an ICT sector company—that nevertheless employs workers from the same ICT **Talent** pool to create exciting new systems and applications. In fact, **Starbucks employs more ICT Talent than most ICT Companies**. The competition for Talent therefore is not only global. ICT Talent is in demand in almost every sector of the State's economy.

For the foreseeable future, the ICT sector will create jobs at a faster rate than the State's public and private education institutions can produce workers qualified to perform those jobs. As a result, Washington State ranks as the highest importer of ICT talent in the nation[1]. The State's continued economic success is tied to developing and attracting the talent needed to serve the opportunities created by the ICT sector. State investments in ICT training and company support are needed to keep pace with the opportunities.

[1] A per capita observation, given the size of California and other states that rank high in absolute terms.

ICT Metrics and Impacts

Companies

In 2013, Washington State had an estimated **8,610 ICT employment establishments**[2] that provide a wide variety of products and services including Application Software, Voice and Data Systems, Cloud Computing Services, Custom Software Development, Electronic Retail, Internet Publishing, and Manufacturing. More than 90% of all **ICT companies employ fewer than 20 workers**, which means that most ICT company leaders share the challenges and goals of typical small businesses across Washington State.

The total revenue reported in Washington by ICT companies is $36.9 billion. Of this total, Washington ICT companies exported $16.4 billion making it the third highest exporting state (after California and Texas) and growing exports at more than 10%—much faster than its larger rivals. No other state matches Washington's combination of ICT export growth and absolute ICT export value.

The market value of the ICT sector, including only the top ten public ICT companies started in Washington State, is nearly $600 Billion. The total market value of all ICT companies operating in Washington state is in excess of $1 Trillion. While it is true that most of the sales leading to that market valuation are generated outside the state, the benefits of that business activity accrues to Washington through job growth, investment in research, commercial construction, and investment in new companies in the state.

Employment

Employment estimates for ICT are segmented into two main groups. The first is ICT Companies which includes 162,900 covered workers and an additional 13,700 sole proprietors and independent contractors in 2013. **This ICT core represents 176,600 workers,** including workers from across all occupations employed at ICT companies**.**

The second group is Tech Units—blocks of ICT talent and supporting team members that work in non-ICT companies. Tech Units represent an additional 62,300 workers who possess similar skills and face similar project challenges with their ICT Company peers.

Combining these two groups results in **total statewide ICT Talent employment of 238,900 workers in 2013.**

[2] Establishments is the employment data term for places of employment and can count one company more than once if the company has more than one office.

Occupations and density

Within the total employment set of 238,900 ICT workers highlighted above, there are certain occupations, some of which are essential to the ICT cluster. Examples of occupations considered essential to ICT delivery include Application Software Developers, Computer Systems Programmers, Computer Engineers, Network Architects, and Computer Science Researchers.

Washington State has **90,000 resident individuals in these essential ICT occupations.**

Washington State ranks high in the number of resident professionals serving in these essential ICT occupations. The State indexes at **2.5 times** higher than the national average on a per worker basis. The Seattle MSA is the primary regional driver, indexing at **4.3 times** that of the U.S. average. And for the specific Application Software Development occupation, considered by industry experts to be one of the **most essential** occupations in the ICT sector, Seattle MSA indexes at **6.9 times** the US average. This talent density makes the region especially attractive to private and corporate investment.

Wages

In addition to job creation, wages in the sector are also a large driver of economic benefit impact for the Washington economy. **In 2013, the ICT sector paid out $22 billion in wages.** Many of the essential ICT occupations pay very well. Median wages for workers in the essential ICT occupations range from $100,000 to $140,000, with wages in the 90th percentile of those occupations ranging from $150,000 to $187,000, in 2013.

Each ICT Company also employs a full spectrum of workers, including sales positions, administrative support, and many other occupations that do not call for computer science degrees. In most cases, the median wages for these other occupations in ICT Companies index above companies in other sectors.

Multiplicative Impact on Jobs

The economic value of the ICT sector extends to the entire state through two stages of economic multipliers. The archetypal anecdote is: "two developers in a garage code a new app, launch a company, and then hire many other people to build that company – which hopes to become the next IPO."

Each of the 90,000 essential ICT occupations identified earlier – Application Software Developers, Computer Systems Programmers, Computer Engineers, Network Architects, and Computer Science Researchers – is the keystone to creating 1.7 additional jobs in each ICT Company or Tech Unit and resulting in the total of 238,900 jobs in the ICT cluster.

Each of those 238,900 high paying jobs then spurs further economic benefit through the spending generated by those workers, which creates 2.7 more jobs in the wider state economy. Combining the two factors, we have a combined economic impact of **at least 7 additional jobs in Washington State associated with every essential ICT worker.**

By investing into attracting and developing the workers needed for these essential ICT occupations - Software Developers, Computer Engineers, Network Architects, Computer Sciences Researchers – the State could build a sustainable, robust economy for the next several decades.

Tax Revenues

ICT businesses in Washington State paid $776 million directly in State taxes in 2013. The total tax contributions of the ICT sector are significant—when adding the tech units and secondary impacts from spending and business transactions—the total is in excess of $2.8 billion.

ICT State Fiscal Revenue Impacts, 2013

Tax Type	Direct Payments	Tech Units and Secondary Impacts	Total ICT-Supported Tax Payments
State Sales Tax	523.3	1,159.7	1,683.0
Business & Occupation	219.9	652.5	872.5
State Use Tax	33.3	94.5	127.8
Other Taxes (e.g., Utility Tax)	0.0	152.7	152.8
Total	**776.5**	**2,059.5**	**2,836.0**

Washington Start-Ups

Nearly every ICT Company and nearly every tech unit in Washington today did not exist 20 years ago. The state has been awash in startups. And even the largest, oldest ICT companies still possess a startup ethos due to fierce global competition and the requirement to innovate. The entire startup ecosystem—and all its creativity—is driven principally by a survival instinct.

Washington enjoys a vibrant startup ecosystem that is evolving rapidly with many support organizations, entrepreneurial assistance, and tech incubators to help teams form companies and raise private capital to launch their products and services. Washington's 2013 financial support for start-ups was particularly strong—with nearly **$70 million in 60 seed investments** and nearly **$700 million in 140 Venture Capital investments**. However, Washington startup activity is still lagging more established ICT regions including Massachusetts and California and is also being outpaced by new entrants such as New York. **Additional talent and private investment capital will lead to more rapid growth of the industry**.

Despite the smaller stature as a startup ecosystem, the Washington ICT sector has been a **consistent pioneer in the most successful new products and services** including Online Retail, Online Gaming, Cloud Computing, Music and Video Streaming. In recent years, the region's prowess in Cloud Computing and high density of ICT talent has attracted significant private investment and has also resulted in many of the world's most prominent ICT companies—including Hewlett Packard, Oracle, Google, Facebook, Alibaba, Apple and most recently Dropbox—to invest in building tech units in the region.

Workforce Assessment

Washington State forecasts for occupations compared to graduates show a significant shortage of workers to fill demand from in-state students. The greatest shortages are Application Software Developers, Programmers, Help Desk Specialists, Systems Analysts and Systems Administrators. **The annual total shortage of supply versus demand** for these essential ICT occupations is in **excess of 3,000 workers**.

Occupations in this arena are in general not interchangeable; the surplus in one occupation cannot typically serve the shortage in another without substantial retraining. **State investments in ICT talent education and training have not kept pace with ICT Company growth.** Therefore, companies must rely on workers migrating from other U.S. states and other countries to fill the jobs created.

Companies seeking ICT talent rely on significant recruiting efforts in California, Massachusetts and other ICT talent rich regions. Although H-1B visas are a potential source of additional talent from abroad, the current federal cap allocated in a national lottery severely limits this source of talent. **As a result, the State's lack of education investment, in particular in Computer Science, is retarding the growth of the ICT sector.**

Further analysis shows that some occupations with talent shortage could be filled with retraining of unemployed professionals. For example, 396 unfilled jobs in the Computer User Support Specialist (aka Help Desk) occupation might be filled by retraining some of the 595 unemployed workers with prior experience in that field but whose technical skills are not current. **A combination of public and private investment into specific adult re-training may alleviate some of the talent shortage** in some of the less essential ICT occupations.

Washington's Universities and ICT Training

The University of Washington's challenging curricula and internship programs with industry produce some of the best talent for top ICT companies in Washington. The University reports that it graduates just over 300 students each year with degrees in Computer Software Engineering and Programming, making it the largest program of its kind in the state. **The University is a close**

recruiting partner for Washington ICT companies, with approximately 90% of graduates placed in the State.

Meanwhile, accredited higher education institutions in Washington produced a total of 4,864 students in 2-year and longer term programs *intended to prepare a student for entry into the ICT sector.* However, tech leaders agree that most of these programs are not suitable for the 3,000 unfilled essential ICT job openings.

Of the 4,864 graduates in 2013, 2,384 graduated with 2-year degrees and are not qualified for those jobs, according to tech leaders contributing to this study. The 2-year graduates result in a surplus of workers for ICT jobs requiring only a 2-year degree. Of the remaining 2,480 students graduating in 2013 with 4-year degrees or higher, the majority of programs – while leading to other employment opportunities – do not develop the skills or experience required for the leading firms to hire them into essential ICT jobs. As noted earlier, the result is a shortfall of 3,000 candidates that must be filled from out of state applicants.

A few education and industry leaders have begun an effort to better integrate skills requirements and curricula to improve placement of more Washington program graduates in the future. Some early successes are promising, but education and tech leaders interviewed for this study speak to the clear **need for a systematic collaboration among industry and education leaders.**

Conclusion

Washington's ICT cluster drives the Washington State economy through its world-renowned companies and by leading innovation across all sectors of the economy. Employment and occupation forecasts show continued strong growth, yet Washington's education systems do not have the capacity to fill the openings. Global talent will always seek ICT employment in Washington, but the shortage of locally trained talent increases the need for Washington companies to recruit from out of state. This retards growth by increasing recruitment costs and heightening the requirement for local companies to recruit and relocate workers from around the world. This talent shortage also forces growing local companies to invest in other more ICT talent rich regions.

While the industry has and will continue to invest in its own growth, the State would benefit immensely by serving as an investment partner with the industry to fully capture the potential for the region.

ICT talent creates jobs—both in the sector and more broadly in the economy. Each ICT job drives seven additional jobs in the State. A high density of ICT talent also attracts private investment capital, which leads to more companies formed, even more jobs created, and a dramatic economic benefit for the entire State of Washington for many decades to come.

CONTENTS

1. INTRODUCTION

Background and Purpose

Companies that lead Washington's Information & Communication Technology (ICT) industry bring talent, tax revenues, charitable contributions and much more to Washington State, and the ICT talent cluster spans all sectors of Washington's economy. The industry drives innovation across the economy and ICT entrepreneurs create start-ups that grow into employers and bring capital into the region. Our education and workforce development institutions must work to align their training with industry needs to continue to support the state's economic future.

This study provides a quantitative and qualitative assessment of the Information & Communication Technology Cluster in Washington State. The study illuminates the Cluster's strengths and growth potential, and supports targeted economic development policies and initiatives. The report serves a broad range of audiences, including industry associations; leadership in policy, workforce, and education; and all readers interested in the state of ICT in Washington.

Methods

Analysis in the report leverages custom data analysis, interpretation of secondary data sources, and perspectives and insights from local industry leaders gathered through individual interviews. Data reported and the sources of information are as follows:

- Data on firms, jobs, occupations and wages from the Bureau of Labor Statistics and Washington State Employment Security Division
- Business revenues and taxable retail sales from the Washington State Department of Revenue
- National Center for Education Statistics and Integrated Postsecondary Education Data System (IPEDS)
- Input-output model transactions data published by the Washington State Office of Financial Management

Organization of Report

- **Cluster Overview.** Definitions and descriptions of what defines the ICT Cluster.
- **Cluster Profile**. Data summaries and metrics that demonstrate the size and direct impacts of the cluster in Washington.
- **Indirect and Induced Impacts**. Estimates of the full impact of the cluster, including indirect and induced impacts, measured by total jobs,

labor income, business revenues, and tax payments to the state associated with ICT activities.

- **Innovation and Entrepreneurism.** Analysis of the start-up economy and case studies on innovation driving the cluster.
- **Workforce Assessment**. A detailed discussion of the supply and demand of ICT skilled workers.
- **Industry Perspectives**. Results from interviews with more than 30 representatives from industry, higher education, and other stakeholders across the state on industry issues such as talent, competitiveness, and Washington's strength as a hub for future ICT growth.
- **Conclusions**. An interpretation of the overall significance of the cluster and implications for the future of the industry.

2. Cluster Overview

The Information & Communication Technology (ICT) cluster is diverse, extending across manufacturing, software publishing, and other services. The cluster consists of two overlapping constituencies: companies engaged in producing and selling technology products and services, and ICT talent that work in other industries and produce technology products and services from within their organizations and companies. However, for practical measurement, ICT in this study refers only to the production of these goods and services while excluding many different types of content production that leverage software and related tools. This section provides a description of the ICT Cluster and its core industries that define this study.

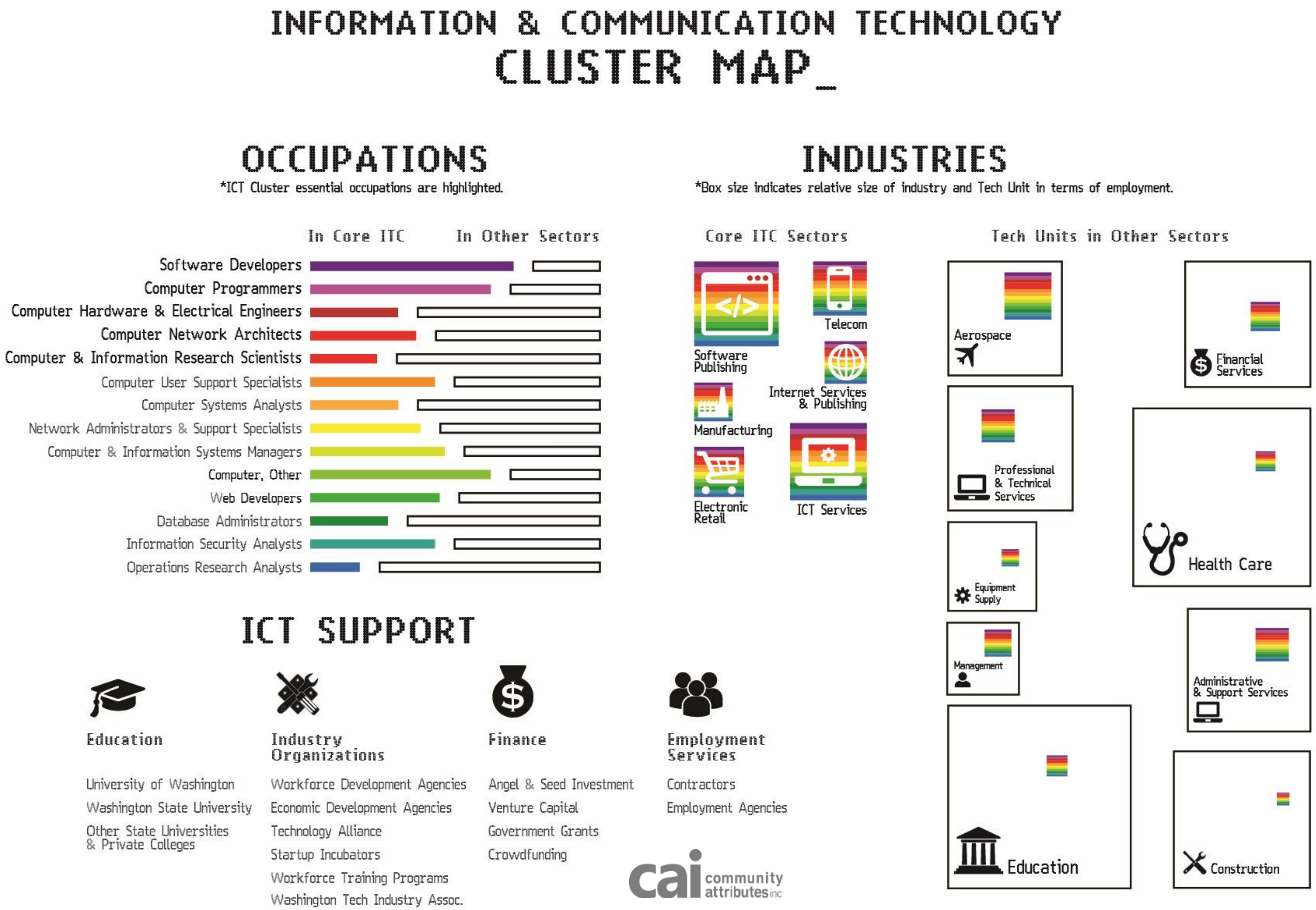
Exhibit 1 provides a schematic map of the cluster that shows the different types of companies and occupations that drive ICT in Washington. Contractors are more prevalent in this field than many fields, and temporary employment agencies serve major ICT employers with a broad range of technical expertise that companies rely on for temporary, project-related support.

Education and workforce institutions training students for careers in ICT occupations. Investors support ICT companies through several types of funding and capital investment.

ICT occupations serve and are found in other industries, whose pursuit of their objectives increasingly rely on custom ICT applications and ICT talent internally to their operations.

The ICT Cluster Map provides a schematic of the breadth and reach of the industry, which the following sections address in further detail and provide data to establish a common understanding of the cluster's impacts in Washington State. The next section outlines the number of companies and organizations engaged directly with ICT, followed by estimates of the number of employees that serve ICT companies. These sections address the impact of ICT talent in other industries and the teams, or tech units. Details on ICT occupations that span the economy follow, along with a profile on wages across ICT occupations.

Exhibit 1.


INFORMATION & COMMUNICATION TECHNOLOGY
CLUSTER MAP_
OCCUPATIONS
*ICT Cluster essential occupations are highlighted.
In Core ITC
In Other Sectors
Software Developers
Computer Programmers
Computer Hardware & Electrical Engineers
Computer Network Architects
Computer & Information Research Scientists
Computer User Support Specialists
Computer Systems Analysts
Network Administrators & Support Specialists
Computer & Information Systems Managers
Computer, Other
Web Developers
Database Administrators
Information Security Analysts
Operations Research Analysts
INDUSTRIES
*Box size indicates relative size of industry and Tech Unit in terms of employment.
Core ITC Sectors
Software Publishing
Telecom
Internet Services & Publishing
Manufacturing
Electronic Retail
ICT Services
Tech Units in Other Sectors
Aerospace
Financial Services
Professional & Technical Services
Health Care
Equipment Supply
Management
Administrative & Support Services
Education
Construction
ICT SUPPORT
Education
University of Washington
Washington State University
Other State Universities & Private Colleges
Industry Organizations
Workforce Development Agencies
Economic Development Agencies
Technology Alliance
Startup Incubators
Workforce Training Programs
Washington Tech Industry Assoc.
Finance
Angel & Seed Investment
Venture Capital
Government Grants
Crowdfunding
Employment Services
Contractors
Employment Agencies
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Core ICT Industries

This study refers to the economic activities that focus on production of ICT goods and services as ***core*** ICT industries. Other industries are analyzed, too, because of their reliance on ICT professionals, such as Aerospace, Retail and others. Employment and other economic data come stratified by the North American Industry Classification System (or NAICS codes), established by the U.S. Census.[3] **Exhibit 2.1** lists core ICT activities identified by NAICS for data analysis. ICT activities are grouped as follows:

- **ICT Business Services**. Business Services in general include a large range of business to business activities, including many that have nothing to do with ICT. Only those related to ICT are included in this report, however, though even so this group is the most diverse among the segments of ICT discussed in this report. Activities range from repair services to custom programming and computer design.
- **Electronic Retail**. Electronic Retail is the fastest growing segment of the cluster in recent years, driven largely by growth in Amazon—the largest member company in this group.
- **Internet Services & Publishing**. Activities in this group include web hosting and data processing.
- **Software**. Anchored by Microsoft, Software includes computer game companies and other well known companies such as Adobe, Tableau and more.
- **Telecommunications Services**. This group includes installation, maintenance, and service provision of broadband and mobile utilities and technologies.
- **Manufacturing**. This segment includes the semiconductor industry, which in Washington are concentrated in Southwest Washington near the Portland cluster of ICT. Many smaller electronics and communications equipment firms throughout Washington belong to this group.

[3] Economists have struggled with assigning codes for ICT activities over the years. Until the late 1990s, NAICS predecessors assigned most computer related activity to either hardware manufacturing or to "Pre-Packaged Software".

Exhibit 2. Core ICT NAICS and Definitions

Industry Group	NAICS	Description
ICT Business Services	541511	Custom computer programming services
	541512	Computer systems design services
	541513	Computer facilities management services
	541519	Other computer related services
	611420	Computer training
	811211	Consumer electronics repair and maintenance
	811212	Computer and office machine repair
	811213	Communication equipment repair
	561499	All other business support services
Electronic Retail	454111	Electronic shopping
	454112	Electronic auctions
	454113	Mail-order houses
Internet Services & Publishing	518111	Internet service providers
	518112	Web search portals
	518210	Data processing, hosting and related services
	519130	Internet publishing and web search portals
Software	511210	Software publishers
Telecommunications Services	517110	Wired telecommunications carriers
	517210	Wireless telecommunications carriers
	517211	Paging
	517212	Cellular and other wireless carriers
	517310	Telecommunications resellers
	517410	Satellite telecommunications
	517510	Cable and other program distribution
	517910	Other telecommunications
	517911	Telecommunications resellers
	517919	All other telecommunications

Industry Group	NAICS	Description
Manufacturing	334210	Telephone apparatus manufacturing
	334220	Broadcast and wireless communications equip.
	334290	Other communications equipment manufacturing
	335921	Fiber optic cable manufacturing
	334111	Electronic computer manufacturing
	334112	Computer storage device manufacturing
	334118	Computer terminal and peripheral equip. mfg.
	334119	Other computer peripheral equipment mfg.
	334113	Computer terminal manufacturing
	334310	Audio and video equipment manufacturing
	334412	Bare printed circuit board manufacturing
	334414	Electronic capacitor manufacturing
	334416	Capacitor, transformer, and inductor mfg.
	334417	Electronic connector manufacturing
	334418	Printed circuit assembly manufacturing
	334419	Other electronic component manufacturing
	334512	Automatic environmental control manufacturing
	334513	Industrial process variable instruments
	333316	Photographic and photocopying equipment mfg.
	333315	Photographic and photocopying equipment mfg.
	333295	Semiconductor machinery manufacturing
	334413	Semiconductors and related device mfg.
	325992	Computer printer toner cartridges manufacturing

ICT Core & Essential Occupations

ICT companies employ people in all types of occupations that serve the entire economy, including computer programming occupations, but also business managers and administrative assistants; bookkeepers and human resource professionals; sales people; and building management and all types of support and personnel. The talent that is specific to ICT includes professionals that create and produce ICT products and services, all listed in **Exhibit 3,** which this study refers to as **core occupations**.

Within these core occupations are a few very select few occupations, however, which this study refers to as **essential occupations,** meaning that they are essential to existence of the ICT Cluster in Washington State. Those **essential occupations** are:

- **Software Developers** (all types)
- **Computer Programmers**
- **Engineers** (including Computer Hardware Engineers and the ICT Electrical Engineers)
- Computer **Network Architects**, and
- **Computer and Information Research Scientists**

The essential nature of these occupations is a central point that this study addresses in subsequent sections.

Exhibit 3. ICT Core Occupations, BLS Codes and Titles

Essential & Core	Occupation Code	Occupation Title
Essential ICT Occuptations	15-1111	Computer and Information Research Scientists
	15-1131	Computer Programmers
	15-1132	Software Developers, Applications
	15-1133	Software Developers, Systems Software
	15-1143	Computer Network Architects
	17-2071	Electrical Engineers (some)
Other Core ICT Occuptations	11-3021	Computer and Information Systems Managers
	15-1121	Computer Systems Analysts
	15-1122	Information Security Analysts
	15-1134	Web Developers
	15-1141	Database Administrators
	15-1142	Network and Computer Systems Administrators
	15-1151	Computer User Support Specialists
	15-1152	Computer Network Support Specialists
	15-1199	Computer Occupations, All Other
	15-2031	Operations Research Analysts
	17-2061	Computer Hardware Engineers

Source: Bureau of Labor Statistics, Community Attributes Inc., 2014.

None of these occupations, essential or core are found ***exclusively*** in ICT companies, however, which is another central point of this study. As profiled in detail in the following sections, ICT occupations are increasingly employed by leading companies in other industries, such as Boeing in Aerospace, Nordstrom in Retail, and several others.

3. ICT CLUSTER DATA PROFILE

At the outset of 2015, the Washington State economy relies heavily on the Information and Communication Technology industries and talent in Washington, and the ICT cluster drives and defines Washington and its future role in the global economy. The cluster is a major employer in the state and pays high wages, helping to drive economic activity and growth across the state. This section provides data that describe the establishments and workers in the ICT cluster in Washington.

Business Revenues

ICT Companies in Washington State generate a tremendous amount of revenue worldwide. The global revenue generates a lot of wealth, incomes, and business to business in Washington State. The leading companies in ICT are global in nature, and their offices and employment in other parts of the world contribute to their global competitiveness and their global revenues.

Microsoft reported $78 billion in revenue in 2013, for worldwide operations. Amazon reported $74 billion in 2013, and revenues may pass $90 billion in 2014 (quarterly reports show sales re up more than 20% in 2013 through Q3). T-Mobile reported $24 billion in 2013. This global economic prominence creates real value for Washington, in the form of wealth creation, jobs and business spending. The global relevance also provides less tangible benefits, such as brand awareness for Washington State and business climate image.

In Washington State, ICT companies reported Gross Business Income (GBI) to Washington totaling $36.9 billion in 2013, as shown in **Exhibit 4**, representing 5.4% of total GBI reported in Washington in 2013.

GBI is not a perfect measure of economic activity, and the data in **Exhibit 4** do not include estimated activity among tech units in other industries. GBI for all industries is self-reported and companies' reporting practices and decisions vary tremendously. Companies with operations in other states and other countries must comply with state laws in reporting income data but multiple places of business allow for cost-accounting choices that vary among companies in their representation of value-added or location activity, measured by revenue.

Exhibit 4. Gross Business Income for Core ICT Industries, Washington State, 2013

Category	Gross Business Income (mils $)
Computer Systems Design & Related Services	12,811.3
Telecommunications Services	9,856.3
Electronic Retail	4,313.5
Software	2,428.5
Semiconductors	1,874.6
Internet Services	1,683.5
Computer & Peripheral Equipment	857.6
Electronic Components	716.3
Internet Publishing and Broadcasting and Web Search Portals	691.9
Measuring & Control Instruments	587.8
Repair Services	408.2
Communications Equipment	394.4
Consumer Electronics	221.5
Computer Training	32.4
Photonics	23.7
Total	**36,901.5**

Source: Washington Department of Revenue (2014).

International Exports

Washington State's Information & Communication Technology sector contributes significantly to the state's international reach, exporting high-value goods and services. Taken together, Washington State's ICT sector exported $16.4 Billion in ICT goods and services in 2012. Washington State ranked third in ICT export value in 2012 (**Exhibit 55**). Nearly a third of Washington's export value comes from Congressional districts 9 and 7, which comprise the Puget Sound region (**Exhibit 6**).

Exhibit 5. Top Five ICT Exporters in 2012, Billions of Dollars

State	Exports
California	62.0
Texas	47.9
Washington	16.4
Florida	16.4
Massachusetts	12.9

Sources: Technology CEO Council, 2014; The Trade Partnership, 2013.

Exhibit 6. Top Three ICT-Exporting Washington Congressional Districts in 2012, Billions of Dollars

District	Areas of Interest	Exports
WA-9	Tacoma, Bellevue	4.8
WA-7	Seattle, part of Tacoma	4.0
WA-8	Rural King and Pierce counties	1.7

Sources: Technology CEO Council, 2014; The Trade Partnership, 2013.

Not only does Washington have the distinct honor of being a top exporter in ICT goods and services, but it can boast a spot in the top fastest-growing ICT-exporting states. **Exhibit 7** compares the top ten ICT-exporting states by total export value. Washington leads export growth states in total export value.

Exhibit 7. Top ICT Exporters by Export Value, Millions of Dollars, 2006-2012

State	2006	2012	CAGR
Washington	9,281	16,433	10.0%
Pennsylvania	3,206	5,116	8.1%
Utah	1,121	3,007	17.9%
Maryland	1,737	2,867	8.7%
South Carolina	1,250	1,818	6.4%
Nevada	699	1,462	13.1%
New Hampshire	563	1,131	12.3%
Mississippi	529	1,039	11.9%
Oklahoma	408	943	15.0%
District of Columbia	520	915	9.9%

Sources: Technology CEO Council, 2014; The Trade Partnership, 2013.

Washington State's unique combination of top-ranking export volume and export growth rate tells a compelling story about the state's ICT cluster: while California and Texas—the top two ICT exporters at $62B and $47.9B, respectively—far outstrip Washington in terms of ICT export value, they have very low export growth rates; Washington may be a distant third, but it is rapidly gaining ground.

In addition to the ICT cluster's export value and impressive export value growth rate, many companies contribute to the cluster's international reach with locations abroad. Aside from customer service centers and sale centers, some of the larger ICT companies have office locations abroad. **Exhibit 8** shows a list of Washington's major ICT companies and their international office locations.

Exhibit 8. Sample of Washington-Based ICT Company International Offices

Company	International Office Locations
Avalara	England, India
DocuSign	Australia, England, France
Big Fish Games	Canada, Ireland, Luxembourg
Express Metrix	Australia, United Kingdom
Halcyon Monitoring Solutions, Inc.	Canada
Impinj	China
Microsoft	China, France, Germany, Singapore, Turkey
Raima	England
Valve	Luxembourg

Sources: Community Attributes, 2014.

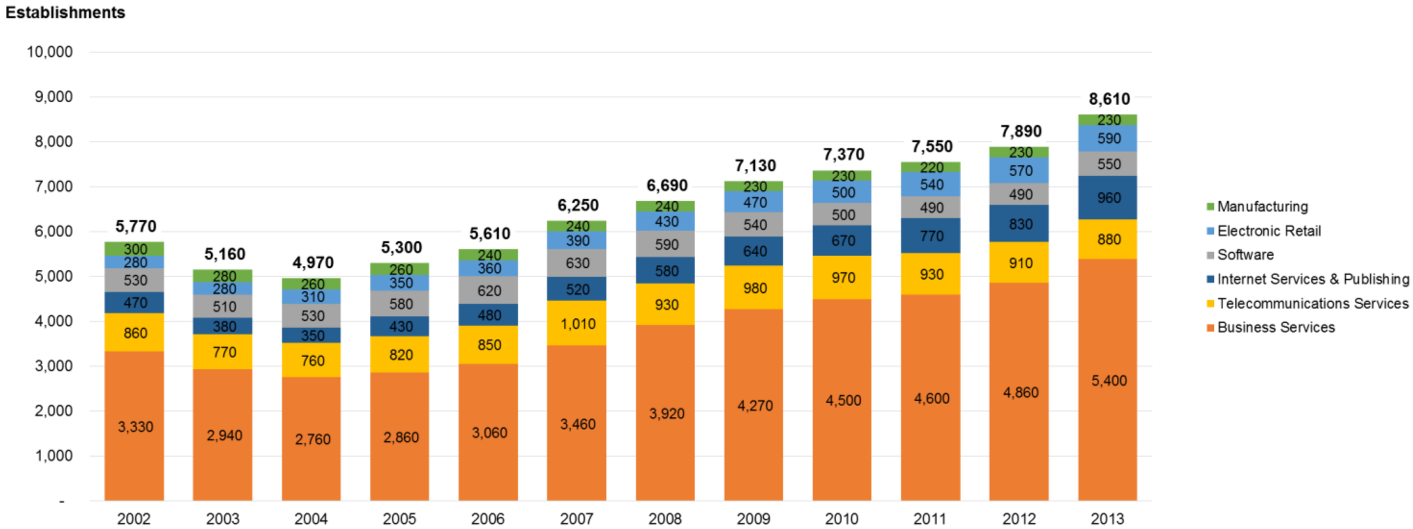
No other state matches Washington's combination of ICT export value growth and absolute ICT export value. Taking into account the large number of international ICT companies that are based in Washington, the state's ICT sector has significant international reach.

Employment Establishments

In 2013, there were an estimated 8,610 ICT establishments with employees in Washington State (**Exhibit 9**).[4] The majority, 5,400, are in ICT Related Business Services, a subsector group that includes Computer Repair, Computer Systems Design & Related Services, and Other Business Support Activities (e.g., cloud computing services).

[4] Establishments is the employment data term for places of employment and can count one company more than once if the company has more than one office.

Exhibit 9. ICT Employment Establishments, Washington State, 2002-2013



Sources: U.S. Bureau of Labor Statistics, 2014; Community Attributes Inc., 2014.

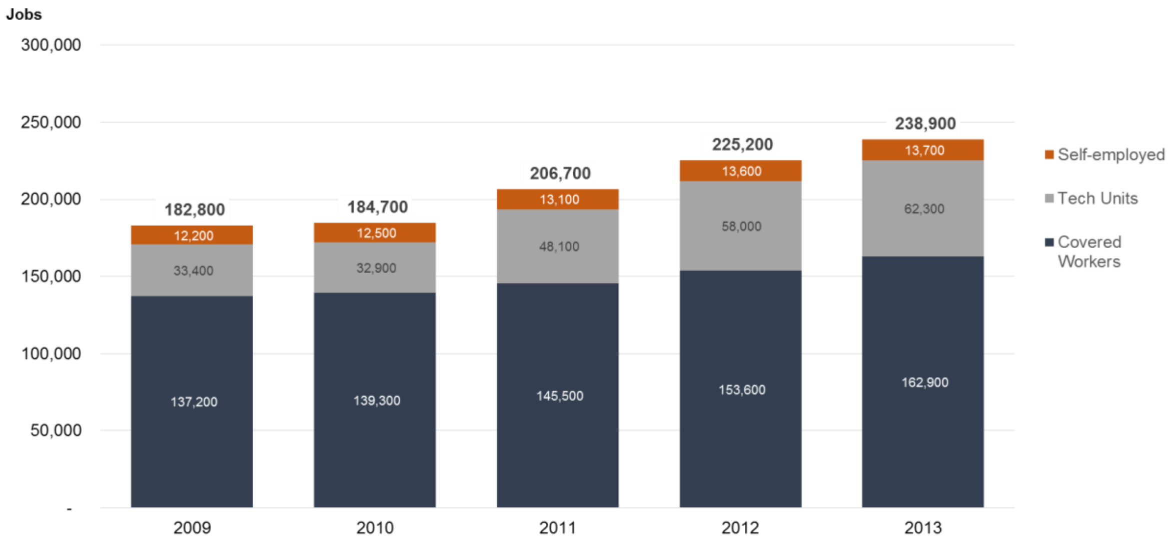
The data in **Exhibit 9** include only companies that have employees. Business owners and proprietors that entirely operate their companies are included in economic data as non-employer data. These individuals are co-mingled in the data with free-lance workers, which ICT are known to be substantial in number. This study includes non-employer data in the following section on employment. Additional information on start-ups follows in subsequent sections as well.

Employment

Employment estimates for ICT are segmented into the Core ICT Industries as defined above, including employees of establishments as well as the self-employed. ICT workers make up tech units in firms in other industries, such as Aerospace, Retail and others, as well. Finally, sole proprietors and independent contracts work throughout the industry.

Combining all three sources of ICT employment—core ICT activities, tech units, and the self-employed—results in total employment of 238,900 workers in 2013 (**Exhibit 10**). Between 2009 and 2013, total ICT employment has increased by 56,100 workers, with a compound annual growth rate of 2.7%. Detailed data on the three employment segments follow.

Exhibit 10. Total ICT Employment in Washington, 2009-2013



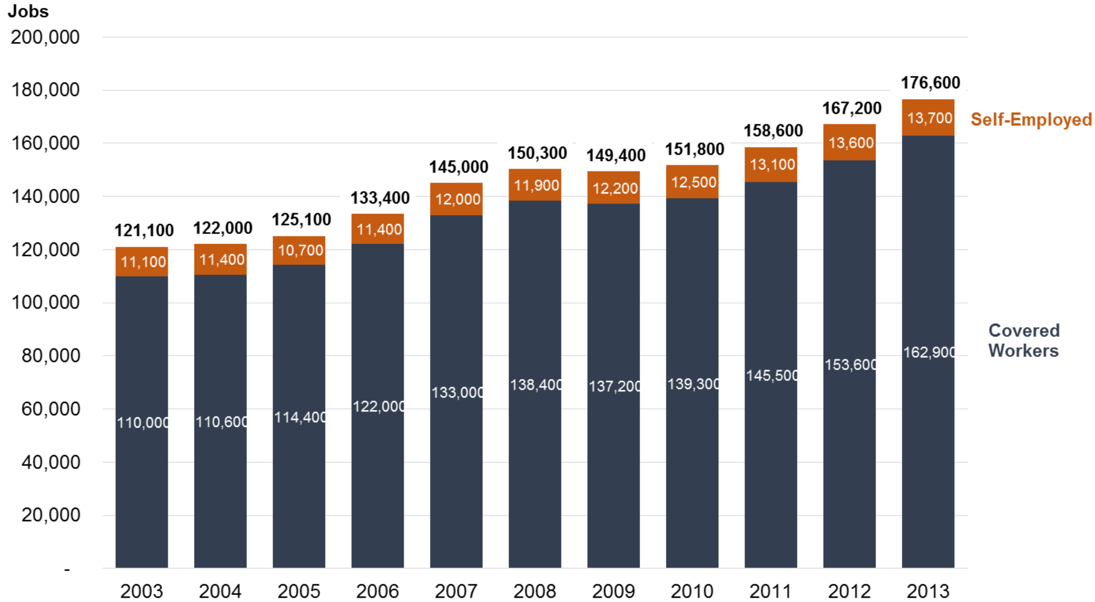
Source: U.S. Bureau of Labor Statistics, 2014; Community Attributes Inc., 2014.

Core ICT Industries

In 2013, these industries employed an estimated 176,600 workers across the state (**Exhibit 11**). The largest share is in software publishing (53,800), followed by ICT-related Business Services (44,100), Telecom (22,000), and Electronic Retail (19,300), of which the largest employer is Amazon. Since a recent low of 149,400 jobs in 2009 during the Great Recession, ICT jobs among these industries have grown in aggregate 4.3% per year (compound annual growth rate, or "CAGR"); this compares with non-farm employment statewide of just 1.1% per year over the same period.

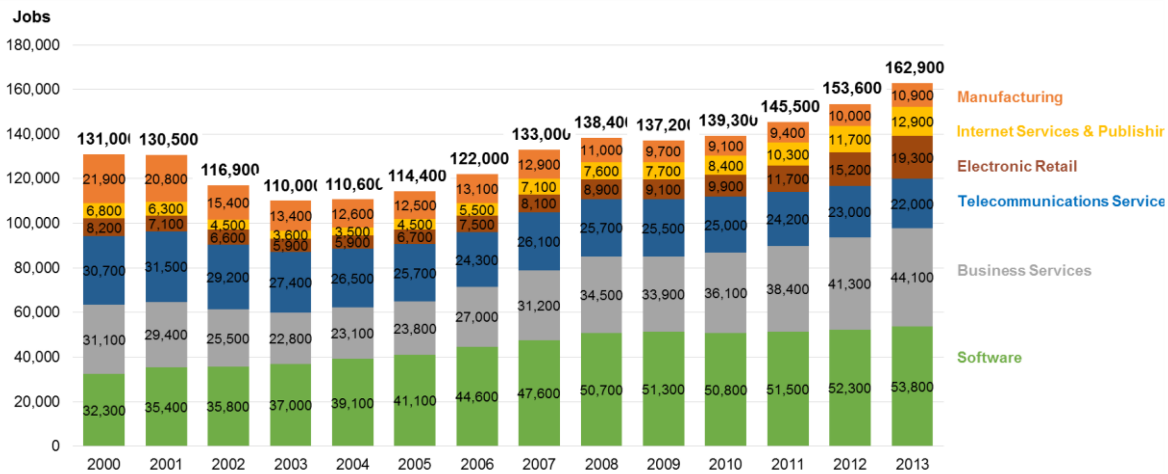
Covered employment in ICT grew from 110,000 in 2003 to a historic high of 162,900 jobs in 2013—a compound annual growth rate of 4.0% over this period. The two largest segments of the ICT cluster in 2013 were Software Publishing and Business Services (**Exhibit 12)**.

Exhibit 11. Core ICT Employment in Washington, 2004-2013



Source: U.S. Bureau of Labor Statistics, 2014; U.S. Census Bureau, 2014; Community Attributes Inc., 2014.

Exhibit 12. Employment by Core ICT Group in Washington, 2000-2013



Source: U.S. Bureau of Labor Statistics, 2014; Community Attributes Inc., 2014.

Among ICT industry segments, the fastest growth in employment over the past 10 years occurred in Internet Services & Publishing (13.6% per year; 9,300 jobs added), followed by Electronic Retail (predominately due to growth within Amazon), growing at a compound annual rate of 12.6% and adding 13,400 jobs. Software Publishing—of which Microsoft is the largest firm, but also includes Avalara, Valve, and Inrix —grew at 3.8% per year. Within Business Services, the two largest components were Computer Systems Design Services (21,000 employees) and Custom Computer Programming Services (14,700 employees; **Exhibit 13**).

Among the large core ICT groups, the fastest growth in covered employment between 2003 and 2013 occurred within Internet Services & Publishing (which includes firms that provide data processing services), with a 15.6% CAGR over the same period. Electronic Retail, of which the largest employer is Amazon (even when not including Amazon Web Services), grew at 14.1% per year, reaching 19,300 in 2013.

Industries that experienced declines from 2003 to 2013 included Telecom (-2.0% per year) and Manufacturing (-1.6% per year). Together, these two industry groups shed 6,200 jobs, though this was more than offset by gains in software (14,700 new jobs), Business Services (21,000), Electronic Retail (13,400), and Internet Services & Publishing (9,400).

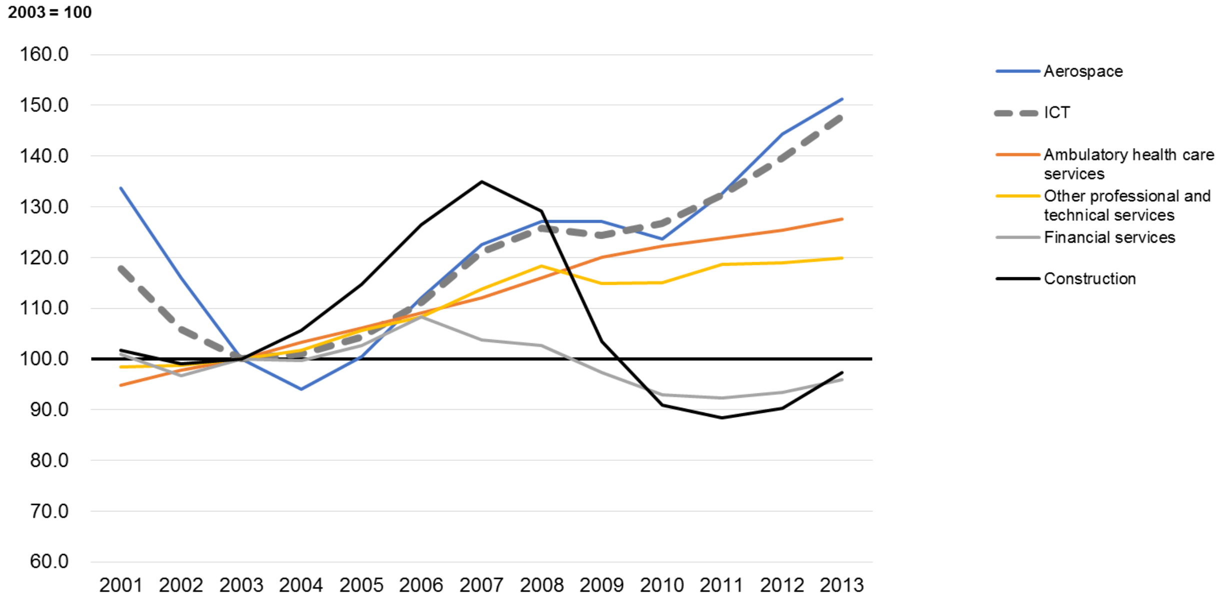
Exhibit 13. Growth Rates for ICT Employment by Major Categories, 2004-2013

Activity	Employment		CAGR,
	2004	2013	2004-2013
Software	39,100	53,800	3.6%
Business Services	23,100	44,100	7.4%
Telecommunications Services	26,500	22,000	-2.0%
Electronic Retail	5,900	19,300	14.1%
Internet Services & Publishing	3,500	12,900	15.6%
Manufacturing	12,600	10,900	-1.6%
Total, All Activities	**110,700**	**162,900**	**4.4%**

Source: U.S. Bureau of Labor Statistics, 2014; Community Attributes Inc., 2014.
Note: CAGR is Compound Annual Growth Rate

To provide context, **Exhibit 14** below compares ICT statewide employment growth with other major sectors of the Washington economy, indexed to year 2003. Among sectors presented, Aerospace and ICT were the fastest growing sectors from 2003 to 2013.

Exhibit 14. ICT Employment Growth Statewide Compared with Other Major Sectors, Indexed (2003 = 100)



Source: U.S. Bureau of Labor Statistics, 2014; Community Attributes Inc., 2014.

ICT and Tech Units in Other Sectors

Information & Communication Technology extends across nearly all major sectors of the state economy. There are many ICT activities housed within industries conventionally classified as something other than ICT. These activities include mobile applications development, data analytics teams, and computer hardware design and integration—essentially ICT teams within larger, non-ICT companies.

Employers across do not report how many employees work in these tech units across the economy, and it would be difficult to ask that of an employers. Sufficient data and regional economic models do exist, however, to allow for estimates of the workers in tech units economy-wide.

A tech unit, for the purposes of this analysis, includes a team of workers devoted to software and application development. This does not include basic layout of a company's web pages, but rather production and development of ICT products and services to advance a company's business. This definition relies on the existence of software developers and computer programmers as the critical occupation for a tech unit to exist. A business will hire a software engineer once it intends to use that position to develop new software and related products and services, either for direct internal use or integration with goods and services provided by the business (e.g., programmers developing new online commerce platforms for a retail business). **Exhibit 15** lists the ICT occupations identified as central to tech units across non-ICT industries, or tech unit Anchor Occupations.

Exhibit 15. Tech Unit Anchor Occupations

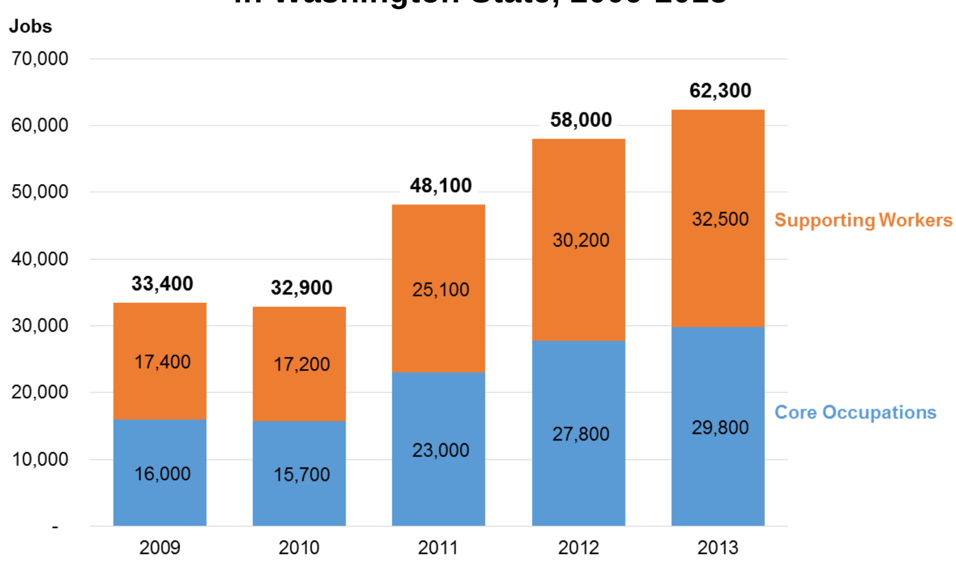
Occupation
Software Developers, Applications
Software Developers, Systems Software
Computer Programmers
(ICT) Electrical Engineers
Computer Network Architects
Computer Hardware Engineers
Computer and Information Research Scientists

Source: U.S. Bureau of Labor Statistics, 2014; Washington State Employment Security Department, 2013; Community Attributes Inc., 2014.

Good data exist to track these occupations across all sectors in the economy. The estimates of the additional employees it takes to round out a tech unit follow the ratios of these anchor occupations to all other employees throughout the ICT industries.

This approach results in total tech unit employment of 62,300 workers in 2013 (**Exhibit 16**). The rapid growth of tech units reflects changing dynamics of the state economy and labor force since 2000. During the dot.com bubble of the late 1990s and early 2000s, the majority of ICT activities occurred within software publishers and related businesses. However, with the rise of mobile apps and e-commerce, many traditionally non-ICT businesses have needed to expand their workforce requirements to developers and other high-skill ICT occupations.

Exhibit 16. ICT Tech Units Estimated Employment in Washington State, 2009-2013



Sources: U.S. Bureau of Labor Statistics, 2014; Washington State Employment Security Department, 2013; Community Attributes Inc., 2014.

Aerospace was the largest source for tech unit employment outside of ICT industries in 2013 (**Exhibit 16**). This owes to the large number of software programmers and systems engineers involved in avionics, on-board electrical and computer systems, and the integration of these components and systems. As aircraft have becoming increasingly reliant on computer systems and software, so has the share of the aerospace workforce involved in these activities.

The second largest source of ICT employment outside of ICT industries in 2013 was in Administrative and Support Services, which includes employment staffing agencies that provide contract programming and engineering work to Microsoft and other ICT firms. Professional services employed an estimated 8,200 workers in ICT and support activities in 2013. The professional services industry include life sciences research, engineering services, and other industries with higher intensities of R&D.

Examples of innovation at tech units in non-ICT sectors is the focus of section 5 of this report.

Exhibit 17. Top Industries for Tech Units Employment, 2013 (est.)

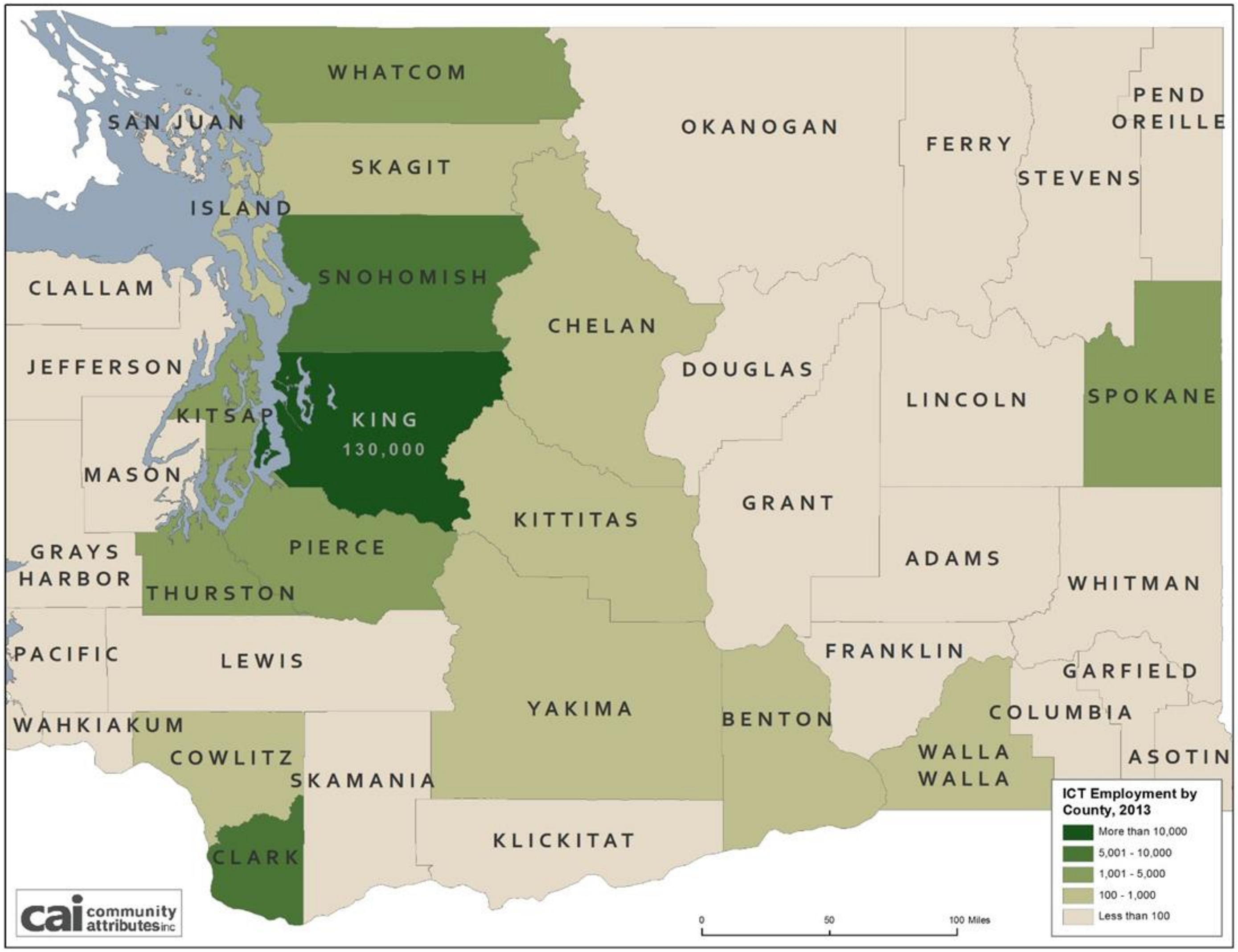
Rank	Industry	ICT Core Occupations	Supporting Employment	Total Tech Unit Employment
1	Aerospace	8,000	8,700	16,700
2	Administrative and support services	4,000	4,400	8,400
3	Professional and technical services	3,900	4,300	8,200
4	Financial services	3,000	3,300	6,300
5	Management of companies and enterprises	2,600	2,800	5,400
6	Merchant wholesalers, durable goods	1,600	1,700	3,300
7	Education (Local, State, and Private)	1,100	1,100	2,200
8	Hospitals and Ambulatory health care services	1,400	1,600	3,000
	Total, all non-ICT sectors	**29,800**	**32,500**	**62,300**

Source: U.S. Bureau of Labor Statistics, 2014; Washington State Employment Security Department, 2013; Community Attributes Inc., 2014.

ICT Jobs Across Washington

Exhibit 18 shows the concentration of ICT jobs by county across Washington (does not include tech units and self-employed). King County has long been the state's largest employment center by county, including for ICT employment. In 2013 King County had an estimated 129,700 workers in ICT businesses, which is

Exhibit 18. ICT Jobs in Washington by County, 2013



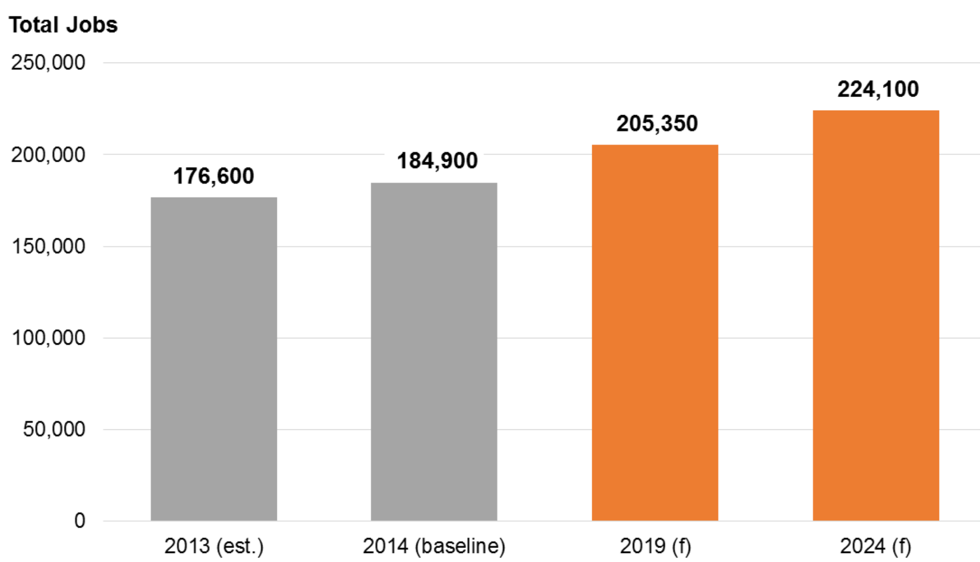
Sources: Washington State Employment Security Department, 2014; Community Attributes Inc., 2011.

80% of ICT jobs statewide (does not include tech units and self-employed). However, in recent years a growing number of ICT activities have been flourishing in other regions across the state. In 2013, an estimated 9,400 workers were employed in ICT businesses in Snohomish County, followed by 6,500 workers in Clark County (traditionally an important hub for semiconductor activities), Pierce County (4,900 workers), and Spokane (4,300 workers).

Employment Forecasts

The future growth of ICT depends on a variety of factors, domestic and global. Economists' forecasts suggest the ICT sector will grow from 176,600 jobs in 2013 (and 184,900 in 2014) to more than 200,000 jobs by 2019 and more 224,100 by 2024. ICT employment growth is expected to hold at 2.1% annual growth between now and 2019, with growth in software publishing at 1.7% (**Exhibit 19**). Statewide employment, according to OFM estimates, is forecasted to grow at an annual rate of 1.3% over the same period.

Exhibit 19. Forecast Jobs in ICT Core Industries, Washington State, 2019 and 2024



Sources: Washington State Office of Financial Management, 2013; Conway Pedersen Economics, 2014; U.S. Bureau of Labor Statistics, 2014; Community Attributes Inc., 2014. Forecast employment based on a blending of the OFM and Conway Pedersen forecasts.

Occupations

Industry employment described in earlier sections captured the number of people that work in companies devoted to ICT or working in ICT tech units within other industries. This section presents data and information on ICT occupations, or those job titles most associated with ICT activities. In all cases, people that have one of these occupations include people working at companies in ICT and also people that work in ICT occupations for firms not considered to be ICT firms (Boeing and Starbucks, for example).

Software Developers, including Applications and Systems Software Developers, together with Computer Programmers make up more than half of the share of Washington State's ICT occupations, as shown in **Exhibit 20**. Together these top occupations combine for 78,700 people in Washington that fill these occupations (in 2013). Three quarters of these two occupations are in ICT companies, and one quarter of them work in industries other than ICT. **Exhibit 20** presents all 17 occupations considered ICT occupations for this study. Their concentration among ICT companies ranges from 18% to 80%.

Exhibit 20. ICT-Related Occupations, Washington State, 2013

Essential & Core	Occupation Code	Occupation Title	Washington Employment: All Industries	ICT Industries	% in ICT Industries
Essential ICT Occuptations	15-1132	Software Developers, Applications	53,975	42,959	80%
	15-1131	Computer Programmers	16,014	11,496	72%
	15-1133	Software Developers, Systems Software	8,664	4,096	47%
	17-2071	Electrical Engineers (some)	5,891	971	16%
	15-1143	Computer Network Architects	4,314	991	23%
	15-1111	Computer and Information Research Scientists	1,080	634	59%
		Total Essential ICT Occupations	89,938	61,147	68%
Other Core ICT Occuptations	15-1121	Computer Systems Analysts	15,017	5,293	35%
	15-1151	Computer User Support Specialists	13,325	5,320	40%
	11-3021	Computer and Information Systems Managers	9,344	4,061	43%
	15-1142	Network and Computer Systems Administrators	8,881	2,373	27%
	15-1134	Web Developers	5,670	3,048	54%
	15-1152	Computer Network Support Specialists	4,588	1,531	33%
	15-1199	Computer Occupations, All Other	4,704	1,913	41%
	15-1141	Database Administrators	2,847	686	24%
	15-1122	Information Security Analysts	2,273	876	39%
	15-2031	Operations Research Analysts	2,073	220	11%
	17-2061	Computer Hardware Engineers	1,515	1,121	74%
		Total Other Core	70,237	26,442	38%
		Total ICT Core Occupations	160,175	87,589	55%

Source: Community Attributes, 2014; Washington State Employment Security Department Industry Occupational Matrix, 2012.

Exhibit 21 illustrates the next most-prevalent industry concentrations for ICT core occupations. Boeing and Aerospace employ the most ICT professionals outside of the ICT industry itself, followed by Management of Companies & Enterprises (corporate headquarters that have registered as such, as opposed to their company's industry) and Employment Services (temporary or contract employment services). Presumably Employment Services follows similar trends of sector engagement, meaning, for example, that workers in that sector are engaged at ICT companies for the most part, followed by Aerospace, and so on.

Exhibit 21. ICT Concentration by Occupation, Other Industry Concentrations, 2012

Industry	Workers	% of ICT Occupations
Aerospace	13,022	15%
Management of Companies & Enterprises	5,915	7%
Scientific Research & Development Services	4,952	6%
Employment Services	4,135	5%
Insurance Carriers	3,790	4%
Travel Arrangement & Reservation Services	2,422	3%
Management & Technical Consulting Services	2,178	2%
Data Processing and Related Services	2,093	2%
Education	2,091	2%
Commercial Equip. Merchant Wholesalers	2,069	2%
Electronic Instrument Manufacturing	1,619	2%

Source: Community Attributes, 2014; Washington State Employment Security Department Industry Occupational Matrix, 2012.

Field Perspectives: Occupational Versatility

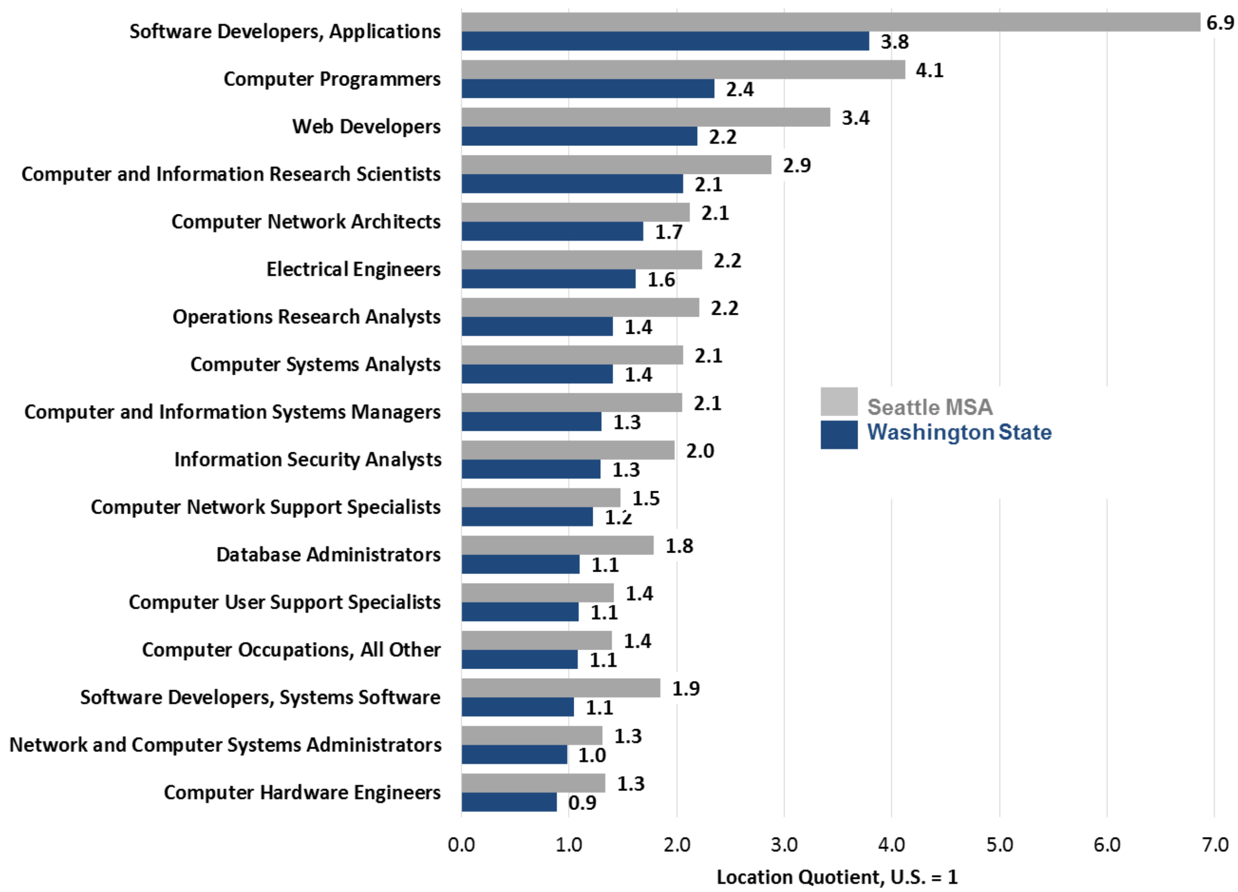
Industry leaders mentioned during interviews an evolution of traditional ICT roles. While the basics are still necessary, employers are looking for workers who have a broader range of skills. One interviewee stated he needs traditional application developers who can also interface with colleagues on the industry-specific technical pieces—what he called functional analysts, or business analysts.

To find these types of people, company recruiters are diversifying their search criteria and reaching out through non-traditional methods, such as social media. One interviewee mentioned utilizing LinkedIn for highly specialized people, then convincing them they need a change of pace.

Washington State Concentration of ICT Occupations

Exhibit 22 displays the relative concentration of all ICT occupations for Washington State as well as Seattle's Metropolitan Statistical Area (including Pierce, Snohomish, and King County) in 2013. A Location Quotient measures this concentration, which is a calculated ratio between a local economy and a reference economy. The U.S. concentration equals 1.0; any figure above that demonstrates a specialization of the occupation in the local economy. The location quotient of 3.8 in Washington (6.9 in Seattle's MSA) for Applications Software Developers is interpreted by saying that applications software developers are 3.8 times more concentrated in Washington than in the U.S. as a whole, and 6.9 times more concentrated in Seattle's MSA than nationwide. Other highly concentrated occupations include Computer Programmers (with a location quotient of 4.1 in Seattle's MSA and 2.4 in Washington) and Web Developers (with a location quotient of 3.4 in Seattle's MSA and 2.2 in Washington State).

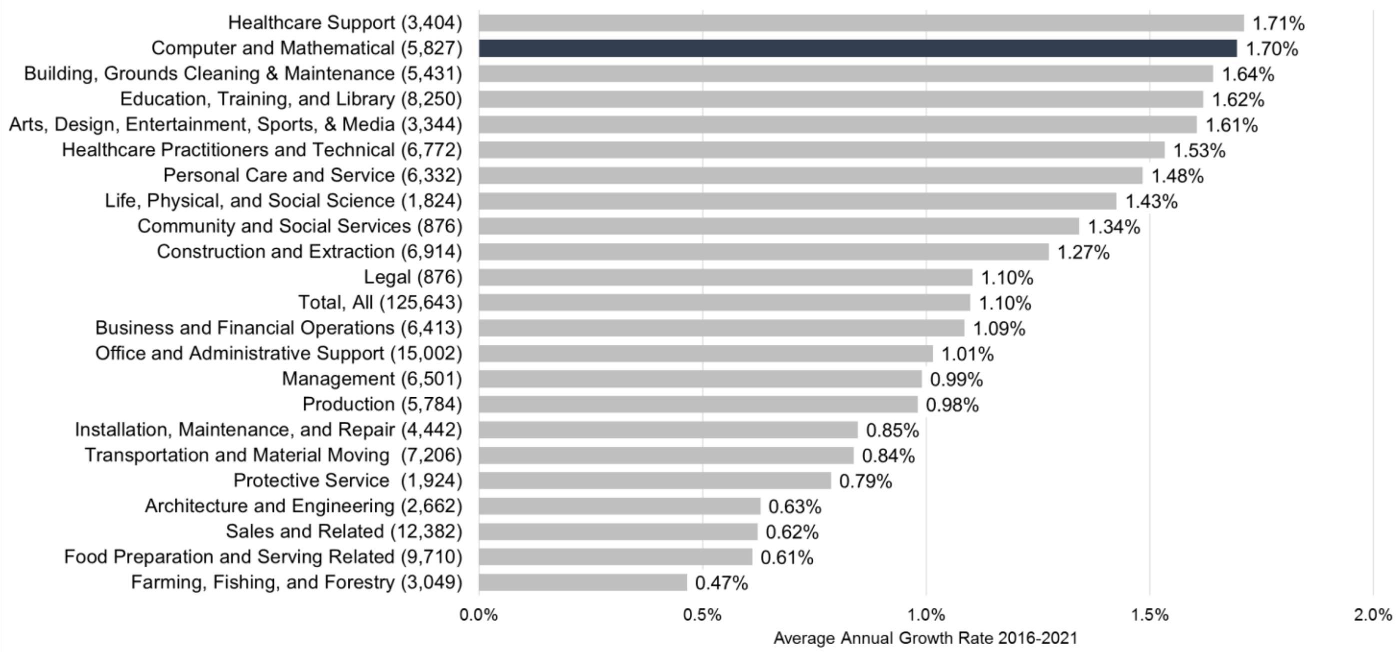
Exhibit 22. Occupational Concentration (Location Quotient), Washington State and Seattle MSA, 2013



Source: U.S. Bureau of Labor Statistics, 2014; Community Attributes Inc., 2014.

Washington's Employment Security Department forecasts that between 2016 and 2021, Computer and Mathematical Occupations will see annual growth second only to that of the Healthcare Support sectors (**Exhibit 23**), with 1.7% growth annually. This analysis examines a broad array of ICT occupations, from support occupations such as support specialists, to engineers and programmers.

Exhibit 23. Industry-wide Occupational Growth Rate and Projected Yearly Openings (parenthesis) by Occupation Group: Washington State, 2016-2021



Source: Community Attributes Inc., 2014; WA ESD, 2014. Occupations included in ESD's segment of Computer and Mathematical Occupations are not the same as, but are similar to the occupations included in this analysis.

Statewide, ESD projects that Washington State companies will need to fill 47,000 of these ICT occupations by 2022. ESD forecasts 6,680 economy-wide (all industries) ICT job openings ***each year*** between 2017 and 2022 in Washington State (**Exhibit 24**). These occupations have high-predicted growth compared to the average growth rate for all occupations (1.3%). Web developers, computer hardware engineers, and applications software developers have the highest predicted growth rates between 2017 and 2022, at around 2% annual growth.

Exhibit 24. Annual Projected Yearly Openings by ICT Occupation: Washington State, 2017-2022

SOC Code	Occupation	Average Annual Openings 2017-2022	Average Annual Growth 2017-2022
15-1132	Software Developers, Applications	2,171	1.9%
15-1151	Computer User Support Specialists	557	1.8%
15-1131	Computer Programmers	863	1.8%
15-1121	Computer Systems Analysts	614	1.6%
15-1133	Software Developers, Systems Software	305	1.6%
11-3021	Computer and Information Systems Managers	414	1.9%
15-1142	Network and Computer Systems Administrators	330	1.5%
15-1199	Computer Occupations, All Other	193	1.6%
15-1134	Web Developers	358	2.0%
15-1152	Computer Network Support Specialists	176	1.6%
17-2071	Electrical Engineers	203	0.9%
15-1143	Computer Network Architects	127	1.0%
15-1122	Information Security Analysts	79	1.3%
15-2031	Operations Research Analysts	74	0.9%
17-2061	Computer Hardware Engineers	65	1.5%
15-1141	Database Administrators	109	1.1%
15-1111	Computer and Information Research Scientists	42	1.6%
	Total	***6,680***	

Source: Community Attributes, 2014; Washington State Employment Security Department, 2012.

Wages by Industry and Occupation

Industry Wages Paid

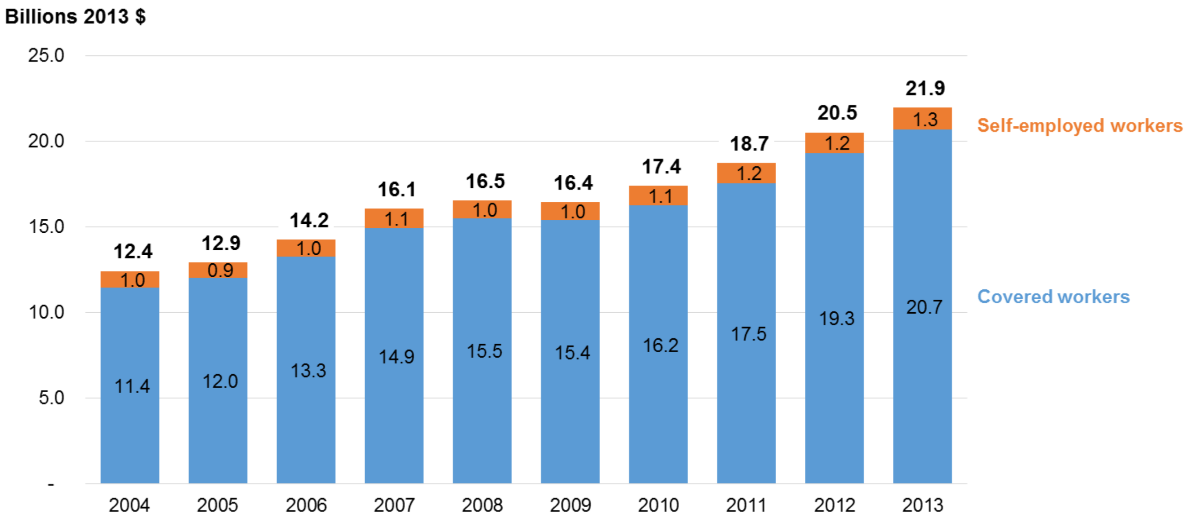
In 2013, the ICT cluster, including covered and self-employed workers, paid out an estimated $22.1 billion in wages, net of benefits (**Exhibit 25.**).[5] Among all jobs in ICT core industries, wages in 2013 summed to $20.7 billion.

The largest share of wages paid within this group came from Software Publishing ($10.1 billion), with an average wage of $188,500 before supplemental benefits. Business Services wages summed to $4.5 billion, with an average wage of $97,300 (**Exhibit 28**). However, this macro group has the most diverse set of industry activities, ranging from computer training, custom computer systems design, to cloud computing, with concomitant diversity in average wages. For example,

[5] In 2013 (latest available annual data), supplements to wage and salary income for NAICS 511 ("Publishing Industries, Except Internet") which includes software publishing averaged an additional 19% in income for workers. This is generally consistent across all industries in Washington. Applying this rate to covered employed results in total wage and salary disbursements plus benefits of $24.7 billion in 2013. Source: U.S. Bureau of Economic Analysis, 2014.

Custom Computer Programming Services (NAICS 541511) paid an average of $104,600 per worker in 2013, before benefits, followed by Computer Systems Design Services ($102,900 per worker). But within this same industry group, much lower average wages were paid out in 2013 in Consumer Electronics Repair and Maintenance ($46,100), Computer and Office Machine Repair ($49,600), and Communication Equipment Repair ($50,300).

Exhibit 25. Total Wages Paid to ICT Workers (2013 $, billions)



Source: U.S. Bureau of Labor Statistics, 2014; Washington State Employment Security Department, 2013; Community Attributes Inc., 2014.

Exhibit 26. Total Wages and Average Wage in ICT Activities, 2013 (millions $)

	Total Wages (millions $)	Average Annual Wage
Covered Workers		
Software	10,143	188,500
Business Services	4,382	99,400
Telecommunications Services	1,997	90,800
Electronic Retail	1,946	100,800
Internet Services & Publishing	1,332	103,300
Manufacturing	856	78,600
Self-employed	1,289	94,100
Total	**21,946**	**124,300**

Source: U.S. Bureau of Labor Statistics, 2014; U.S. Census Bureau, 2014; Washington State Employment Security Department, 2013; Community Attributes Inc., 2014.

Wages by Occupation

Occupations in ICT pay well compared with the median wage statewide across all occupations ($41,000), and in comparison to other industries. ICT wages also remain fairly stable during economically challenging times. As **Exhibit 27** shows, ICT wages increased over the five-year period between 2008 and 2013—that includes the recent the recession. In adjusted 2013 dollars, the annual median salary for the segment of computer and science mathematical occupations has increased from 2008 to 2013 by approximately $9,000, a compound annual growth rate of 1.96%. This percentage represents the highest growth rate in terms of real wages during that time, while the wage of the majority of occupational segments (13 of the 23 segments) declined.

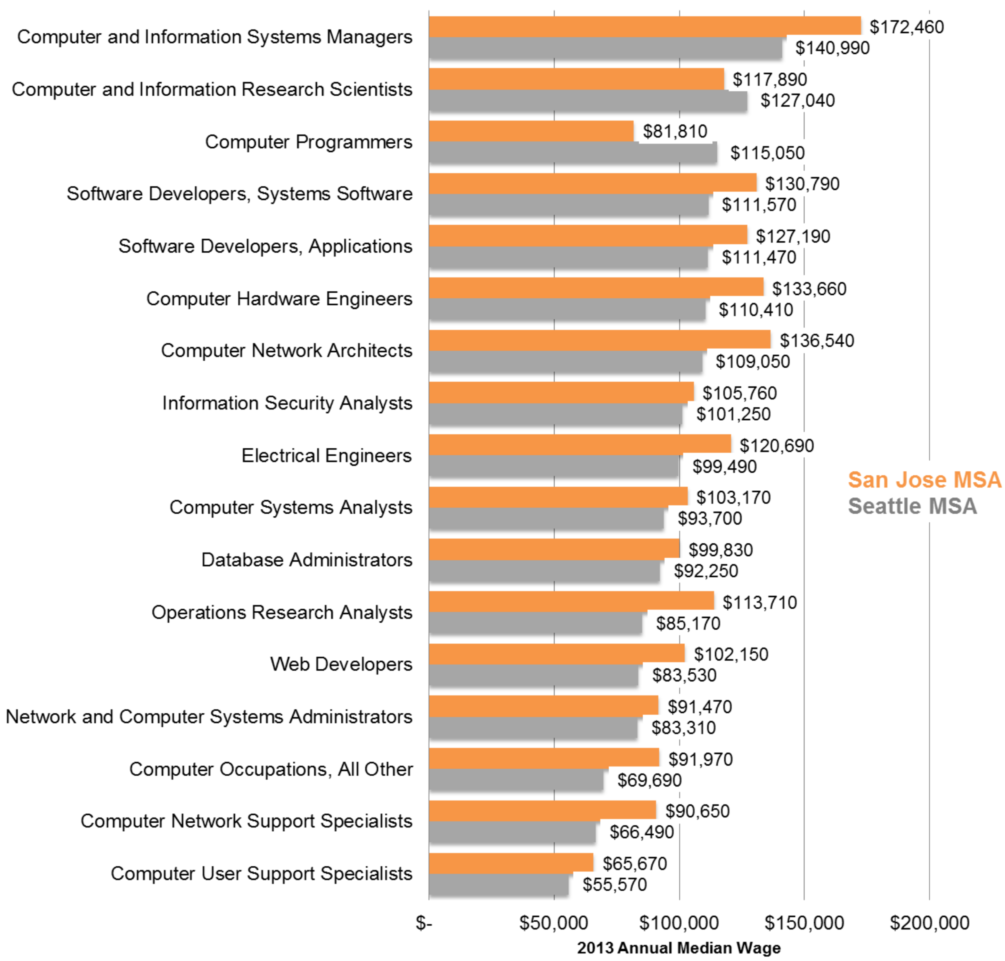
Exhibit 27. Annual Median Salary by Occupational Group, Washington State, 2013 and 2008 Comparison (2013 dollars)

	2008 (2013 $) Median Salary	2013 Median Salary	CAGR, 2008-2013
Computer and mathematical science occupations	$87,955	$96,920	1.96%
Architecture and engineering occupations	$80,046	$83,020	0.73%
Healthcare support occupations	$30,263	$31,370	0.72%
Legal occupations	$72,147	$74,530	0.65%
All Occupations	$40,325	$40,910	0.29%
Office and administrative support occupations	$35,359	$35,790	0.24%
Production occupations	$35,987	$36,360	0.21%
Healthcare practitioners and technical occupations	$71,216	$71,520	0.09%
Business and financial operations occupations	$67,527	$67,790	0.08%
Construction and extraction occupations	$51,275	$51,290	0.01%
Installation, maintenance, and repair occupations	$48,181	$48,060	-0.05%
Transportation and material moving occupations	$33,498	$33,330	-0.10%
Education, training, and library occupations	$48,213	$46,880	-0.56%
Building and grounds cleaning and maintenance occupations	$27,634	$26,750	-0.65%
Life, physical, and social science occupations	$65,168	$62,920	-0.70%
Sales and related occupations	$30,404	$28,970	-0.96%
Food preparation and serving related occupations	$22,765	$21,670	-0.98%
Management occupations	$108,881	$103,010	-1.10%
Personal care and service occupations	$25,545	$23,600	-1.57%
Farming, fishing, and forestry occupations	$26,498	$24,170	-1.82%
Arts, design, entertainment, sports, and media occupations	$49,685	$45,130	-1.90%
Community and social services occupations	$45,216	$40,740	-2.06%
Protective service occupations	$50,875	$44,240	-2.76%

Sources: Community Attributes, 2014; Bureau of Labor Statistics Occupational Employment Statistics, 2014

Exhibit 28 shows the annual median salary of all ICT occupations in 2013, for Seattle's Metropolitan Statistical Area (MSA)—which includes King, Snohomish, and Pierce counties—compared with the salary of these occupations in the San Jose, California MSA (which includes San Benito and Santa Clara counties). Most of these occupations garner a higher median wage in the San Jose MSA, but two (computer and information research scientists, and computer programmers) command higher wages in the Seattle MSA.

Exhibit 28. Annual Median Salary by ICT Occupation, San Jose, California MSA, vs. Seattle, Washington MSA Comparison, 2013



Source: Community Attributes, 2014; BLS Occupational Employment Estimates, 2013.

The highest paid occupations combine technical and area expertise with management, such as computer and information systems managers ($140,990 annual median wage in Seattle's MSA). Computer and information research scientists and computer programmers are the second- and third-highest salaried occupations at $127,040 and $115,050 annual median salary, respectively. Even computer user support specialists, the lowest-paid occupation in the cluster, has a median annual salary of almost $15,000 additional than the median wage for all occupation groups.

4. Indirect and Induced Economic Impacts

ICT businesses and employees have an extensive impact on the statewide economy. Business buy local goods and services, and the high wages paid to employee drive consumer spending and local business support, as well as charitable contributions and significant community support. In addition, the ICT industry creates tremendous fiscal impacts to state and local governments. This section discusses estimates of these broader impacts.

ICT Economic Multiplier Effects

Economic impact modeling estimates impacts of the ICT Cluster on statewide jobs, business to business spending, and labor income. Within each of these categories, the direct activities of ICT are modeled to estimate additional activities throughout the economy supported by ICT. The additional impacts include *indirect* impacts include business-to-business transactions, and *induced* impacts refer to labor income that is spent throughout the economy on goods and services.

The ICT cluster in Washington State—including both direct activities in ICT firms and workers in tech units across the economy—in 2013 supported an estimated total 878,400 jobs statewide. This total includes 120,300 jobs supported through business-to-business transactions and 519,200 additional jobs supported through employee spending, as summarized in **Exhibit 29**.

Total labor income statewide associated with ICT sums to nearly $57.8 billion annually (inclusive of benefits), while ICT-supported revenues summed to $179.6 billion. Importantly, the largest impacts from ICT cluster activities are induced through the wages spent by ICT workers throughout the economy.

Exhibit 29. Total Economic Impacts of ICT Activities in Washington State, 2013

	Total
Jobs	878,400
Labor Income (mils $)	57,805
Revenues (mils $)	179,759

Sources: Washington State Office of Financial Management, 2013; Community Attributes Inc., 2014.
Note: Estimates include both covered employment and the self-employed.
*Labor income totals include estimates of additional benefits per segment of the ICT cluster, based on national data published by the U.S. Bureau of Labor Statistics' Employer Cost for Employee Compensation program.

Overall, for every one direct job in ICT, an additional 2.68 jobs are supported throughout the economy, resulting in a jobs multiplier of 3.68. Every dollar of labor income is associated with another $1.30 in labor income across the economy (multiplier of 2.30). For business revenues, each dollar of ICT sales apportioned to statewide activity supports another $1.32 in sales across the economy, a multiplier of 2.32. Each million dollars in final sales supports 7.09 jobs across the state economy (**Exhibit 30**).

Exhibit 30. Economic Multipliers from ICT Activities, 2013

Total output per $ final demand	2.32
Total jobs per direct job	3.68
Total labor income per $ direct income	2.30
Total jobs per $ mil final demand	11.35

Sources: Washington State Office of Financial Management, 2013; Community Attributes Inc., 2014.

Economic Output Impacts

The economy-wide impacts of ICT on the economy vary by industry (**Exhibit 31**), reflecting a combination of each ICT segment's production function and employee spending patterns. More than $8.5 billion in "Other Retail" activities—which includes in-store purchases—nearly all of which reflects employee consumer spending (96.4%). Among banking institutions, or "Credit Intermediation and Related Activities," the ICT cluster supported more than $8.4 billion in financial business revenues through business-to-business transactions and ICT workers spending income on related services.

Employee spending is in fact the primary driver of ICT-supported business revenues statewide. Of the $102.4 billion in additional business revenues supported by ICT activities, 79% was through ICT employee spending across the economy.

Exhibit 31. Largest ICT Output Impacts (Indirect & Induced Combined) by Industry, 2013, mils $

Rank	Industry	Indirect	Induced	Total Secondary Impact, mils $
1	Other Retail	303	8,207	8,510
2	Credit Intermediation and Related Activities	1,918	6,527	8,444
3	Other Construction	2,937	4,010	6,948
4	Waste Management/Other, and Agriculture Services	873	6,048	6,921
5	Ambulatory Health Care Services	33	6,000	6,032
	All Sectors	**21,781**	**80,613**	**102,394**

Sources: Washington State Office of Financial Management, 2013; Community Attributes Inc., 2014.

Employment Impacts

Employment impacts from business-to-business and income effects were greatest among "Other Retail" activities (the addition of 90,400 jobs). There were 70,400 jobs in "Food Services and Drinking Places," including restaurants and bars, associated with the ICT cluster. Overall, of the 639,500 additional jobs supported statewide by the ICT cluster, 81.2% were supported through employee spending (**Exhibit 32**).

Exhibit 32. Largest ICT Employment Impacts (Indirect & Induced) by Industry, 2013

Rank	Industry	Indirect	Induced	Total Secondary Impact
1	Other Retail	3,100	87,300	90,400
2	Food Services and Drinking Places	6,600	63,800	70,400
3	Waste Management/Other, and Agriculture Services	6,400	47,100	53,500
4	Administrative/Employment Support Services	25,500	22,200	47,700
5	Nursing and Residential Care Facilities, Social Assistance	1,700	43,300	45,000
	All Sectors	**120,300**	**519,200**	**639,500**

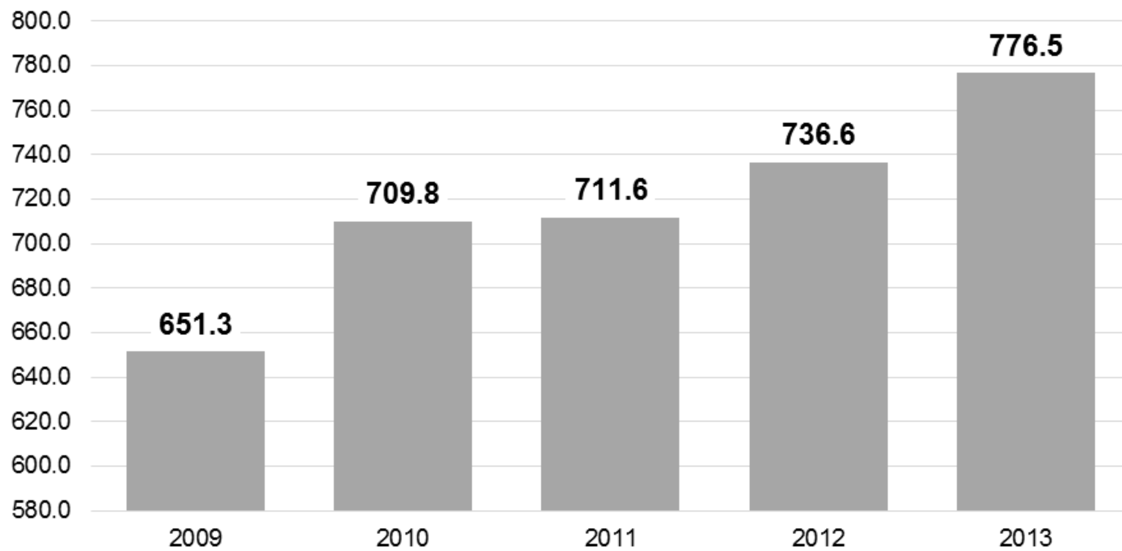
Sources: Washington State Office of Financial Management, 2013; Community Attributes Inc., 2014.

Tax Revenues

ICT businesses in Washington State paid $776.5 million in state taxes in 2013, up from $736.6 million in 2012, adjusted for inflation (**Exhibit 33**). More than two-thirds of these reported tax payments came in the form of state sales tax payments, with B&O payments constituting 28.3% of total payments (**Exhibit**

34). As shown in **Exhibit 35**, the largest source of payments by industry segment in 2013 was Telecommunications Services, with $381.2 million in payments, of which $283.7 million were in the form of collected state sales tax. Business Services directly paid $169.1 million, with nearly half in the form of B&O payments ($82.5 million), followed by $129.1 million in payments by Electronic Retail (of which 88.1% were state sales taxes).

Exhibit 33. Direct State Taxes Paid by Core ICT Activities, 2004-2013 (2013 $)



Sources: Washington State Department of Revenue, 2014; U.S. Bureau of Economic Analysis, 2014; Community Attributes Inc., 2014.

Exhibit 34. Reported Taxes Paid by ICT Cluster Businesses and Secondary Tax Impacts, 2013, by Tax Type (mils $)

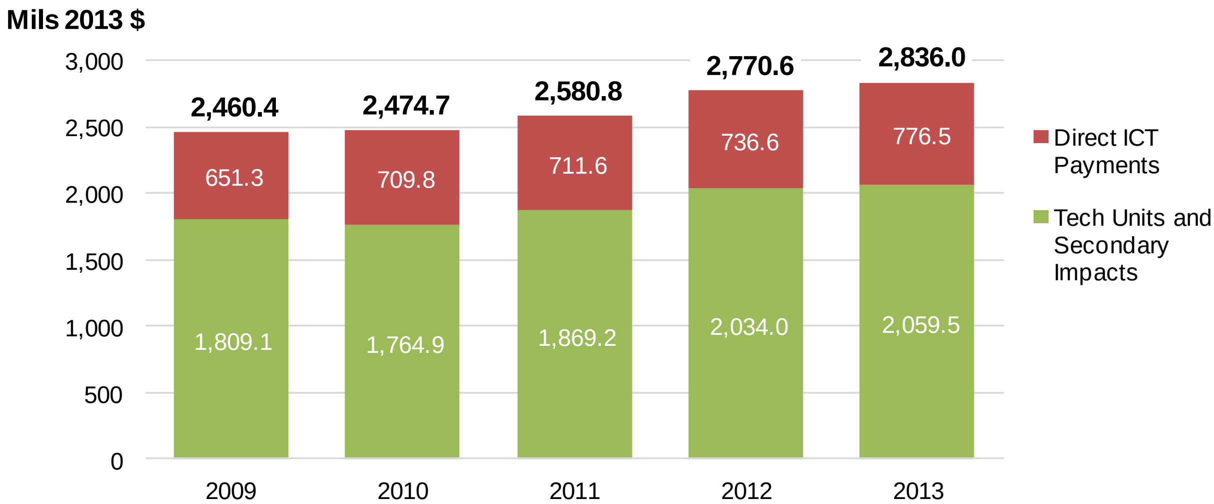
Tax Type	Direct Payments	Tech Units and Secondary Impacts	Total ICT-Supported Tax Payments
State Sales Tax	523.3	1,159.7	1,683.0
Business & Occupation	219.9	652.5	872.5
State Use Tax	33.3	94.5	127.8
Other Taxes (e.g., Utility Tax)	0.0	152.7	152.8
Total	**776.5**	**2,059.5**	**2,836.0**

Sources: Washington State Department of Revenue, 2014; Community Attributes Inc., 2014.

However, the broader fiscal contributions of ICT businesses are significant. Due largely to the high wages paid to ICT workers and subcontracting with other Washington State businesses, tax payments received from business activities *supported* by ICT activities are nearly double direct payments by ICT firms (**Exhibit 36**).

The largest type of tax receipts supported by ICT activities in 2013 were sales tax revenues; $1.7 billion was supported by ICT activities economy-wide in 2013, of which the majority—almost $1.2 billion—was through indirect and induced effects of business-to-business transactions and income spent by ICT-supported workers. Business & Occupation tax revenues supported by ICT totaled $872.5 million in 2013, of which $652.5 million were generated by way of multiplier impacts.

Exhibit 36. Total Fiscal Impacts of Core ICT Activities, 2004-2013, Direct Tax Payments and Additional Payments from Indirect and Induced Effects



Sources: Washington State Office of Financial Management, 2014; Washington State Department of Revenue, 2014; Community Attributes Inc., 2014.

Direct tax payments, adjusted for inflation, have increased from $651 million in 2009 (2013 dollars) to $777 million in 2013, a compound annual growth rate of 4.5%. Estimated tax revenues generated by activities supported by ICT grew 3.6% per year over this period.

The term "fiscal multiplier" as used in this study refers to the ratios of direct jobs, income, and revenues to total tax revenues collected by the state through the sum of activities supported by ICT through direct, indirect, and induced effects. In 2013, every one additional ICT worker was associated with $11,900 in state tax revenues. Every $1 million in labor income supported $112,900 in tax revenues, and every $1 million in sales supported $36,700 (**Exhibit 37**).

Exhibit 37. Fiscal Multipliers for Core ICT Activities, 2013

Total taxes paid per 1 additional ICT cluster worker	$11,900
Total taxes per $1 million in ICT cluster labor income	$112,900
Total taxes per $1 million output in ICT cluster	$36,700

Sources: Washington State Office of Financial Management, 2014; Washington State Department of Revenue, 2014; Community Attributes Inc., 2014.

Comparing the ICT cluster against other sectors in Washington helps illustrate the cluster's fiscal contributions. In 2013, each additional ICT worker was associated with $752,400 in output across the economy (factoring direct, indirect, and induced impacts). From this, an average of $11,900 in state tax revenues was associated with this one additional worker. This compares with $13,300 in revenues economy-wide from each additional aerospace worker and $11,300 per each additional hospital employee (**Exhibit 38**). The largest share of this total fiscal impact comes from state sales & use tax revenues, owing to the high salaries paid to many ICT workers and resulting share of income spent on taxable goods and services.

Exhibit 38. Sector Comparison of Statewide Impacts per Additional Worker

Economic Category	State B&O Tax	State Sales & Use Tax	Other State Taxes	Total Tax Impact
Credit Intermediation and Related Activities	13,700	11,600	700	26,100
Machinery Manufacturing	4,400	7,400	600	12,300
ICT Cluster	***3,700***	***7,600***	***600***	***11,900***
Water Transportation	3,500	7,100	1,100	11,700
Fishing, Hunting, and Trapping	3,500	6,900	1,000	11,400
Other Finance and Insurance	5,400	5,500	400	11,200
Aircraft and Parts Manufacturing	4,400	6,200	600	11,100
Ship and Boat Building	3,400	6,600	600	10,600
Wood Product Manufacturing	3,600	6,100	700	10,400
Hospitals	4,200	5,100	400	9,600
Fabricated Metals Manufacturing	2,800	4,800	400	8,000
Furniture Product Manufacturing	2,100	4,800	300	7,200

Sources: Washington State Office of Financial Management, 2014; Washington State Department of Revenue, 2014; Community Attributes Inc., 2014.

Philanthropic Activities

The philanthropic activities of ICT companies and employees in Washington have a significant impact on both local and national nonprofits. While 2013 saw total charitable giving in the US by individuals increase, it saw a 1.9% decrease in corporate giving (Forbes, 2014). That said, Washington's ICT cluster is home to several notable philanthropic companies and leaders.

In 2013, Microsoft was the top corporate philanthropist in Washington State, giving more than $36 million in cash gifts to local philanthropies like Boys and

Girls Clubs, Year Up Puget Sound, and Washington STEM. Microsoft matches individual employee contributions up to $15,000 per year with a $17/hour equivalence for volunteer time, accounting for roughly $250 million in additional philanthropy in Washington. In 2013, Microsoft employees set a new record for charitable giving, sending $113 million to over 19,000 nonprofits. Microsoft's total cash donations for fiscal year 2014 topped out at $1.067 billion, up from $907 million in fiscal year 2013.

All 12 members of Microsoft's Board of Directors engaging directly in philanthropic activities. For example, Chairman John Thompson is the most public and active supporter of Ducks Unlimited, a wetlands and waterfowl conservation group that restores grasslands, replants forests, and restores damaged watersheds. To say Microsoft management leads its employees by example in the field of philanthropy is an understatement; Microsoft Co-Founder Bill Gates has personally donated over $28 billion to charity, and his foundation, the Bill and Melinda Gates Foundation, is the world's wealthiest.

In October 2013, Amazon announced the launch of AmazonSmile, a website operated by Amazon that offers the same selection of products, but donates 0.5% of the price of eligible purchases to charitable organizations. Amazon's other philanthropic priorities include education and children. The company regularly donates Kindles, gift cards to schools and Amazon CEO and Founder Jeff Bezos has donated roughly $55 million to charities around the country.

Washington State is also home to several charitable organizations in the ICT sector. Computers with Causes, an organization that refurbishes donated computers for placement into educational environments, accepts a wide variety of computers. Large ICT companies that periodically replace employee computers make bulk donations to the organization, and enjoy tax benefits as a result. Similar programs exist for the full range of computers and electronics used by ICT companies.

5. Innovation and Entrepreneurialism

The ICT cluster is rooted in a long history of disruptive innovation and the development of new products, services, and business processes. Innovation and entrepreneurialism occur through a variety of channels and sources. Start-ups, an important component of the ICT cluster, can emerge out of university tech transfer offices, as spin-outs from larger companies, or through individual creativity. In many cases, younger firms were launched by former employees of Microsoft, Amazon, F5, Real Networks, or other larger ICT businesses in Washington. The examples below help illustrate the various institutions and sources of innovation and entrepreneurship across the state.

Multi-Generational Start-ups

There are thousands of examples of former employees of one successful company leaving to start their own company. A perfect example of this is the following sequence. Microsoft was founded in 1975 and grew to become one of the most dominant global software companies. RealNetworks was founded by Microsoft employees in 1994 and pioneered streaming media and online gaming, which transformed the internet and inspired new services such as YouTube, Spotify, and Candy Crush. Isilon was founded in by RealNetworks employees in 2001 and pioneered data storage systems, helping lead the way to cloud computing and attracting EMC to acquire Isilon for $2.2 Billion. Tech start-up Qumulo was founded in 2012 by Isilon employees, and is pioneering a suite of services for the new category of Big Data analytics.

Incubators & Accelerators

The start-up incubator is a pool of resources and mentors, designed to provide everything from low-cost office space to expertise from entrepreneurs who have been there before. A start-up accelerator typically offers only mentoring. Founder's Co-op is an example of an incubator. The Co-op has what it calls a "peer-to-peer" investment structure allowing limited partners with entrepreneurial and technology experience to invest in start-ups at the incubator. The Co-op's strategy is built off of the idea that funding is no longer the primary limiting reagent in the start-up equation, but access to talent and expertise is.

UpGlobal is an example of an accelerator. Better known as Start-Up Weekend—one of the six programs run by the company - UpGlobal is a not-for-profit that operates a series of seminars and events to coach entrepreneurs from a basic desire or idea; to forming a viable business plan; to financing and launching their company. UpGlobal operates in over 100 countries.

Other examples of the many influential start-up incubators and accelerators in Washington include Surf, Impact Hub, Northwest Innovation Resource Center, and Start-up Spokane.

UW Buerke Center Annual Business Plan Competition

The Foster School of Business houses a center for Entrepreneurship at the University of Washington. The UW Buerke Center for Entrepreneurship has become a nationally recognized, premier organization integrating classic curriculum and local entrepreneur expertise broadly into the university programs. The Buerke Center showcase is an annual business plan competition that provides coaching, mentoring, and advice to student led companies that compete over the course of several months for funding. Teams from many colleges and universities in Washington State enter this competition to vie for a significant financial prize.

The Buerke Center also launched another program—the Jones Accelerator—to provide additional mentoring and funding after the business plan competition. These two programs are an excellent example of how a university, in partnership with local entrepreneurs and venture capital, can develop a successful platform for start-ups to begin at the undergraduate level.

Corporate Investment

In some cases, innovation in ICT emerges from partnerships between small and large existing firms, oftentimes through a client/customer-service provider relationship. For example, the bulk of Verizon's ICT R&D is done with partners, linking innovators with a network that can get their product on the market. Verizon linked with a Kirkland-based company called INW that makes water sensors that go into lakes, wells, reservoirs, and ponds. Verizon developed a modem in partnership with INW to pull data from sensors rather than physically accessing sensors to pull data.

Innovation at AT&T looks very different than 20 or 30 years ago. The Digital Life products, including home security, are a strategic priority for the company along with new innovations that will bring Wi-Fi inside your car. R&D for both the Digital Life group and the "Connected Car" is done in Bothell. ICT employment there is growing, along with non-ICT occupations such as HR and sales.

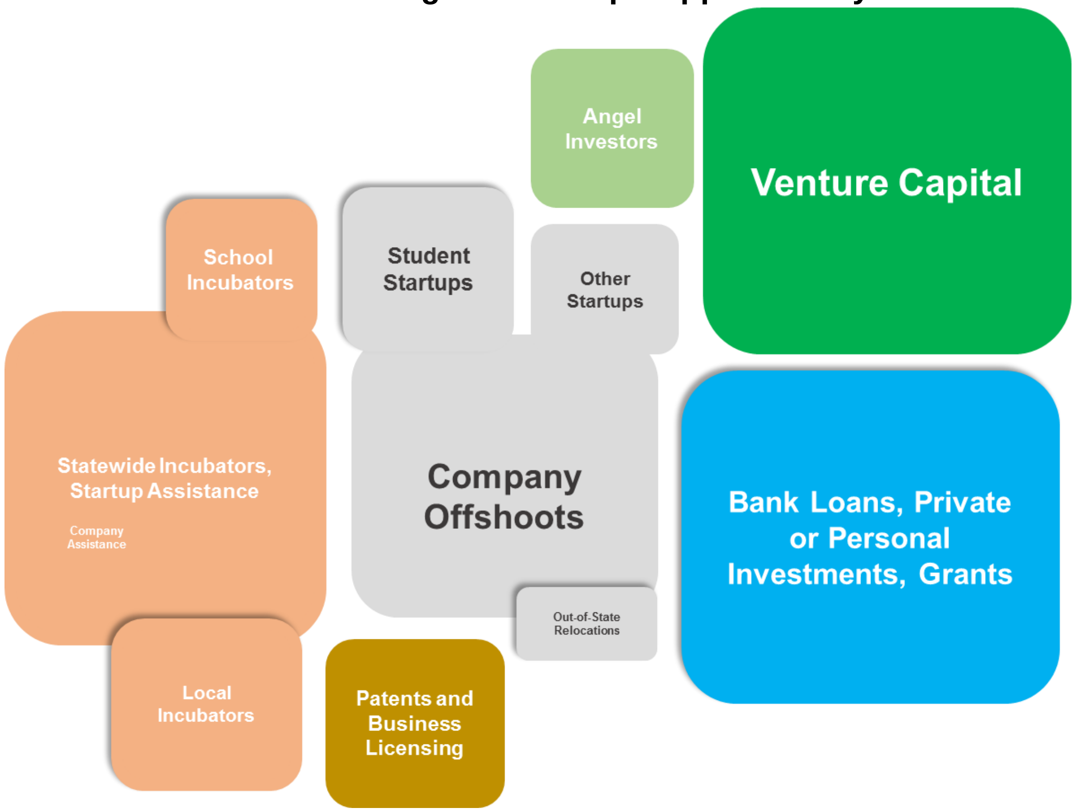
AT&T also boasts four "Foundries" around the U.S. which operate as R&D labs. Similar to the Nordstrom Innovation Labs, the AT&T Foundry innovation centers are fast-paced and collaborative environments where AT&T and technology providers team with developers to deliver the latest applications and services into the hands of customers more quickly than ever before.

The company reports that each Foundry (the original facility is in Austin, Texas) demands a $50 million dollar investment to start. Even so, Seattle may be in the running for the next location. Customer feedback is critical to the R&D cycle at each Foundry; AT&T showcases strategic projects (many of which originated from mobile and residential customers) and asks for customer input and suggestions on their blog.

Investments in Washington's ICT Companies

Start-ups play a critical role in the growth and vitality of the ICT cluster—much more so than other segments of the economy. The success of start-ups relies on an ecosystem that includes seed (angel) and venture capital, existing companies and educational institutions that drive innovation, and broader institutional support for companies to grow (and succeed or fail). **Exhibit 39** presents the key components of the start-up ecosystem.

Exhibit 39. Washington Start-up Support Ecosystem



Source: Community Attributes, 2014.

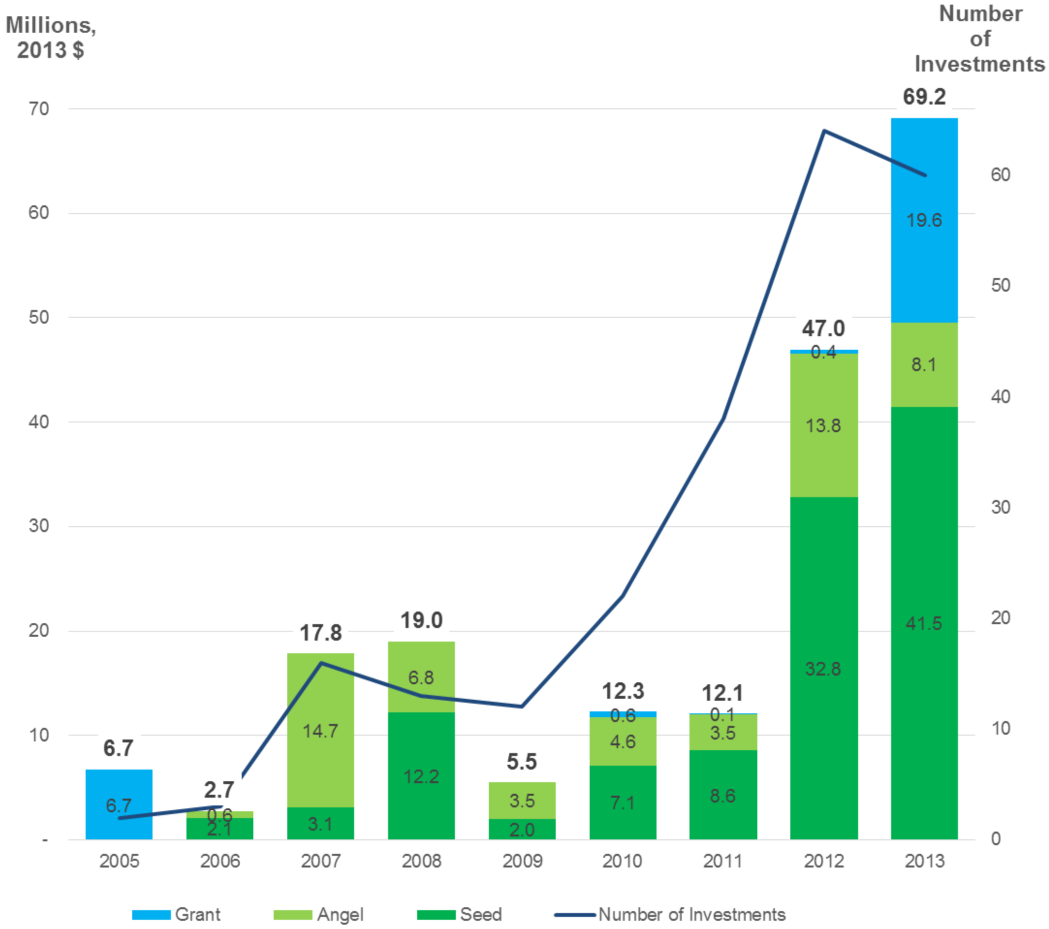
Exhibit 40 shows early-stage investment sources in ICT from 2005 to 2013. The recession clearly had a cooling effect from 2009 to 2011. However, since 2012 the early stage investments are at record levels.

Grant funding, which historically has rarely been a source of capital among ICT start-ups, was utilized less in the wake of the recession, but rose to more than $19 million in 2013.

Seed funding has increased rapidly in recent years, rising from just over $7 million in 2010 to more than $41 million in 2013. The number of seed investments increased as well, from 18 in 2010 to 51 in 2013.

Angel investments were similarly stable; 2011 and 2012, for example, both saw nine angel investments in ICT. In 2011, these investments totaled nearly $3.5 million, but rose to more than $13.8 million in 2012.

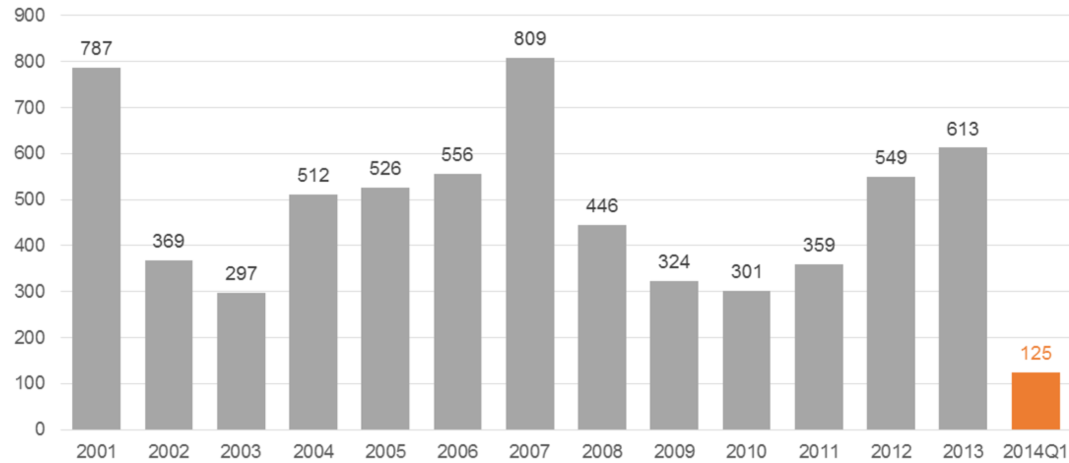
Exhibit 40. Early Stage Investments in ICT, Washington State, 2005-2013, Millions of 2013 Dollars



Source: Community Attributes, 2014; Crunchbase, 2014.

Venture capital investment data comes from the National Venture Capital Association based ICT investment categories, such as computers and peripheral equipment and IT services. Total investments in ICT from 2001 through the first quarter 2014 show that venture capital investments in ICT are no less volatile year to year than venture capital investments in general. However, the recent trend has been positive since 2010, with total ICT-related venture capital investments growing from $301 million (2010) to $613 million in 2013 (**Exhibit 41**).

Exhibit 41. Venture Capital in Washington-Based ICT by Year, 2001-2014Q1, Millions of Dollars



Source: National Venture Capital Association, 2014.

While total investments in the ICT sector for the past 12 years have cycled through a correction period after the Internet bubble of 2000 and a cooling period due to the recession of 2008, the total number of venture capital firms making those investments remained fairly consistent.

Interviews completed with two venture capital firms confirm that the Seattle market in particular is strong. According to one interviewee, "The business climate and momentum is as high as it's ever been in Seattle."

There are several drivers of the growth in ICT start-up formation and financings. First, the Seattle area has a strong legacy of gaming companies and a talent pool that has cycled through several iterations of product and company development. This is a core strength expected to last for at least the next decade. Key companies in this arena include Xbox, Nintendo, Valve, Big Fish Games, Pop Cap.

The next big driver of growth is cloud computing. Amazon Web Services launched this new segment, followed by Google and Microsoft. Oracle has now entered the area with a new engineering facility. Meanwhile, dozens of new start-ups have formed to build new products and services that address the shift of computing to the cloud.

Some private sector interviewees described a lack of mid-size ICT companies. "There are several billion dollar companies, but we don't have many $2 to 500 million companies." Another interviewee mentioned "Washington needs to map each system holistically. We're OK at the grass roots level, weak in the middle market and fine on anchors. We need time to fill in the middle."

Interviewees acknowledged that their engagement with ICT entrepreneurs happens at events like Start-up Weekend at UW Buerke Center and TechCrunch but the companies and/or leaders themselves are not good at self-managing this piece. Events that help facilitate more meaningful introductions and dialogue between entrepreneurs and venture capitalists is an area where improvement seems to be needed.

Exhibit 42 shows venture capital firms investing in ICT by segment. From 2011 to 2013, total investments increased by 70.7% while the number of venture capital firms making investments increased by 20.1%.

Exhibit 42. Number of Venture Capital Investments in Washington-Based ICT by Segment, 2011-2013

Segment	2011	2012	2013	Total
Computers and Peripherals	6	0	1	7
Electronics/Instrumentation	0	2	0	2
IT Services	18	23	25	66
Media and Entertainment	32	19	37	88
Networking and Equipment	4	3	5	12
Semiconductors	4	9	4	17
Software	51	64	75	190
Telecommunications	9	6	2	17
Total	124	126	149	399

Source: National Venture Capital Association, 2014.

Exhibit 43 paints a similar picture with regards to total companies receiving venture capital funding. The same time period that saw a 70.7% increase in total venture capital only saw a 25.4% increase in companies receiving funding. Taken together, this data suggests that both venture capital firms and the ICT companies they invest in are inelastic relative to total venture capital investments; when less funding is available, a similar number of firms is making investments in a similar number of companies as when venture capital is more available.

Exhibit 43. Washington-Based ICT Companies Receiving Venture Capital by Segment, 2011-2013

Segment	2011	2012	2013	Total
Computers and Peripherals	1	0	1	2
Electronics/Instrumentation	0	1	0	1
IT Services	10	10	9	29
Media and Entertainment	15	11	17	43
Networking and Equipment	2	1	1	4
Semiconductors	1	1	1	3
Software	32	39	49	120
Telecommunications	2	3	1	6
Total	63	66	79	208

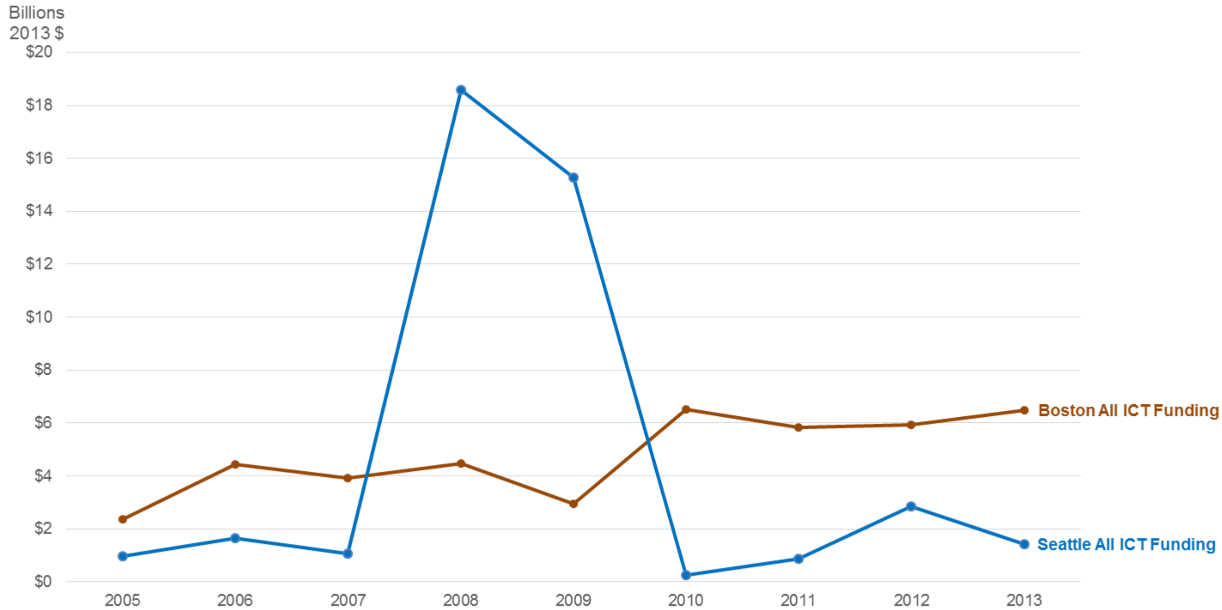
Source: National Venture Capital Association, 2014.

Exhibit 44 compares ICT funding in Seattle, the center of Washington's ICT cluster, with ICT funding in Boston, another major ICT hub. We deliberately do not compare Seattle to The Valley because the scale is not comparable. Boston is a better benchmark for Seattle. The two cities received nearly the same total volume of funding from 2005 to 2013: Seattle companies received more than $49.9 billion and Boston companies received more than $52.7 billion.

From 2005 to 2013, funding in Seattle—ICT and other—composes almost the entirety of funding in the state, making up $49.9 billion out of $52.5 billion in total funding. While Boston area companies received more stable funding over the time period, Seattle area ICT companies received both more funding than their Boston counterparts and a larger share of total area funding. 86% of Seattle area funding went to ICT companies during this time period, while 81% of Boston area funding went to ICT companies.

ICT investments in Washington increased substantially in 2008 and 2009. These jumps in investments were largely due to investments in the company ClearWire, a telecommunications operator that provides communications services to retail and wholesale companies in the United States and Europe. In 2008, the largest single investment in Washington was a $3.2 billion investment in ClearWire. The next year, the two largest investments were a $1.5 billion and $0.9 billion investment in ClearWire.

Exhibit 44. Seattle and Boston Investments in ICT as Share of Total Investments, 2005-2013, Billions of 2013 Dollars



Source: Crunchbase, 2014.

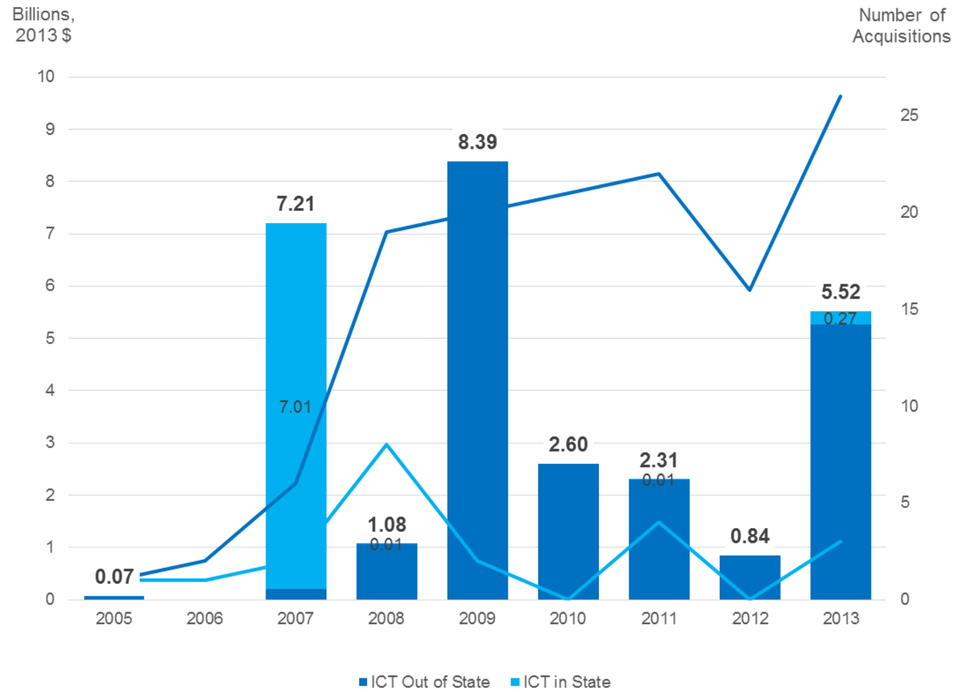
Investments in Washington's ICT cluster can also take the form of acquisitions. **Exhibit 45** summarizes the ratio of in-state to out-of-state acquiring companies by size of disclosed acquisition from 2005 to 2013. For this time period, every $1 in in-state ICT acquisitions was accompanied by $2.83 in out-of-state ICT acquisitions. The value of total acquisitions changed significantly over this period, ranging from 3 acquisitions of undisclosed values in 2006 to more than $8.39 billion in 2008. To compensate for incomplete value disclosure, the number of in-state and out-of-state ICT acquisitions overlays the chart.

Of the top ten acquisitions in Washington through 2013, six were ICT companies. The top acquisition by value, Snowblind Studios, was purchased by Warner Bros. in 2009 for $7.88 billion.

All told, acquisitions from 2005 to 2013 comprise $4.5 billion in acquisitions from California-based companies, $7.2 billion in acquisitions from Washington-based companies, $2.7 billion in acquisitions from Massachusetts-based companies, and $13.4 billion in acquisitions from other companies.

Many start-ups are founded with acquisition by a major company as an explicit end goal. The data for ICT companies in Washington suggests that, while the number of acquisitions is increasing, the total value of acquisitions does not show a similar trend.

Exhibit 45. In-State and Out-Of-State ICT Acquisitions, 2005-2013, Billions of 2013 Dollars



Source: Crunchbase, 2014.

University Start-Ups

As will be discussed in detail in the next section, the University of Washington and Washington State University combined accounts for a large portion of new workers in the ICT cluster. It logically follows that the two universities would account for a similar portion of ICT start-ups. Universities are well equipped to provide basic seed funding, patenting and technology commercialization, and provide mentorship and advice to university-based entrepreneurs (faculty and students). The University of Washington Center for Commercialization reports that over 250 start-ups have come out of the University. **Exhibit 46** provides examples of University of Washington and Washington State University start-ups that fit the definition of ICT.

Exhibit 46. ICT Start-ups from the University of Washington and Washington State University, 2011-2013

Year	Name	University	Description
2001	DiMeMa, Inc.	UW	Publisher of CONTENTdm, a digital management software designed for libraries. In 2003, the Online Computer Library Center (OCLC) acquired DiMeMa.
2004	Farecast	UW	A technology developed to predict fluctuations in airfare prices, which Microsoft purchased and rebranded as Bing Travel.
2005	GridStat	WSU	Smart grid research and development funded by grants from the Department of Energy, Department of Homeland Security, and the National Science Foundation.
2005	Pavia Systems	UW	Creates web-based employee training programs for companies in the asphalt industry.
2006	MapWith.US	WSU	Advanced geospatial technology that affords users the ability to create and customize online maps.
2006	Nimbic	UW	Provides 3D Full-Wave, electromagnetic simulation solutions for chip-package-board design, evaluation of signal and power reliability, and scalable cloud computing.
2006	Skytap	UW	Skytap Cloud caters to organizations and software designers, allowing them to work together to develop, refine, and assess new and established applications in the cloud.
2007	Ionographics, Inc.	UW	Specializes in Electrochemical Printing, a computer-aided process involving electrochemical microfabrication technology.
2007	TransformativeMed	UW	A leader in health information technology, TransformativeMed develops software that augments the value of current electronic medical record systems for hospitals and other healthcare providers.
2008	Adeona	UW	Produced the first system used to track the location of lost or stolen laptops that isn't reliant on a central, privately-operated service.
2008	Corensic	UW	Designs programming technology that enables developers and IT companies to construct more dependable software.
2008	Patient Stream	UW	Develops cloud-based applications that optimize healthcare procedures with the goal of expediting and streamlining patient care.
2010	Portage Bay Photonics	UW	Supported by grants from the Department of Defense and the United States Air Force, Portage Bay Photonics is in the process of developing advanced photonic devices with silicon inputs to increase the speed of optical systems, computers, and other communication devices.
2010	Soluxra	UW	Produces thermally-stable, advanced polymer-material inputs for telecommunications and optical computing devices that improve performance and reliability.
2012	CompSoftBook	UW	Developed and maintains an online assessment tool geared specifically towards evaluation of computer science and programming courses.
2012	RGB HATS LLC	UW	Released "Control-Alt-Hack", a card game aimed at making learning about computer safety and security more engaging for high school and college students.
2012	Rosetta@Cloud	UW	Caters to the pharmaceutical and biotech industries, offering molecular modeling in the cloud.

Source: the University of Washington, 2014; Washington State University, 2014.

The University of Washington boasts the top rank in national licenses signed for a university, and doubled its annual patent applications in 2013. The University of Washington's business incubator, known as the New Ventures Facility, was recently named the emerging incubator of the year by the 2014 University Business Incubators Global Index. From January to July 2014, the incubator alone helped launch 18 start-ups.

Washington State University provides similar advantages to its student and faculty entrepreneurs, and helped develop 13 new businesses at WSU facilities in 2013. At any given time, the university has roughly 100 patents available for licensing.

Start-Up Profiles

Out of the many ICT start-ups in Washington, several have attracted national attention and help highlight the diverse set of ICT activities that are receiving venture capital funds, carrying out successful IPOs, and helping to drive new job growth in Washington. Profiled below are four such companies.

Zulily

Zulily was founded in 2009 by Darrell Cavens and Mark Vadon, who worked together at Blue Nile for a number of years. The 72-hour flash sale site caters to mothers with young children, and offers deals on everything from toys to women's apparel to household goods with a site-wide average cost of twenty dollars or lower per product. After sales for items have ended, Zulily places bulk orders with the product merchants. Once vendor orders arrive at Zulily's fulfillment centers in Reno and Columbus, merchandise is ready to be shipped to customers. Zulily went public in 2013 with an initial valuation of 2.6 billion dollars, and is expanding quickly—the company recently moved to its sixth Seattle office, which houses over a thousand employees. A larger Reno fulfillment center is also in process, which will bring Zulily's total warehouse space to a million and a half square feet. The rapid growth is necessary to accommodate the site's ten million members, who generated 5.5 million total orders for First Quarter 2014, an increase of 91 percent year over year. The company's net sales for 2014 are expected to be between 1.15 and 1.2 billion dollars.

An interview with Zulily clarified what elements have been significant in driving success at Zulily. Executives at the company spoke directly about their unique business model (i.e. buying no inventory until a sale happens). They also said the company "deploys code at least 100 times a day." This kind of dynamic online environment has been critical to keeping web content fresh and interesting for their busy customers.

ExtraHop

Jesse Rothstein and Raja Mukerji, two F5 veterans, founded ExtaHop in 2007 with Madrona Venture Group, Meritech Capital Partners, and Andreessen Horowitz as investors. In 2008, ExtraHop released its Application Delivery Assurance (ADA) system, and became the first network management company to supply true application transparency and visibility without agents or overhead. This program allows IT organizations to pinpoint specific issues hindering performance as opposed to being limited to monitoring the entirety of a system, and having to manually search for malfunctions. The ADA system assists IT entities in predicting network traffic, troubleshooting recurring problems, and isolating slow routes by affording users real-time wire data analytics at a sustained speed of twenty gigabytes per second. Prior to the release of the ADA system, IT providers had to employ a series of configuration settings in conjunction with a multitude of excess staff in order to investigate system inefficiencies or failures. ExtraHop is based in Seattle, but has become a global leader in network interface diagnostics.

Big Fish Games

Paul Thelen established Big Fish Games in Seattle in 2002. Since then, the company has grown rapidly, acquiring offices in Oakland, California, Vancouver, Canada, Ireland, and Luxembourg with an 83.3 million dollar common stock financing for global growth from Balderton capital, General Catalyst Partners, and Salmon River Capital. Big Fish is the world's largest producer of casual games, and has distributed over two billion games from a developing inventory of more than three thousand unique PC games and three hundred distinctive mobile games. Big Fish has in-house production studios as well as 140 exclusive development partners. Its games are played in 150 countries in thirteen languages on nine platforms, including PC, mobile, Kindle, and Nintendo Wii.

Tableau Software

Born out of a Department of Defense project aimed at augmenting people's capacity to examine and comprehend data, Tableau Software was initially founded by Chris Stolte, Pat Hanrahan, and Christian Chabot in Mountain View, California in January 2003. Ten months later, the Tableau founders moved the company's headquarters to Seattle. Tableau's overarching goal is to make spreadsheets and databases accessible and understandable to the average person in an era where the quantity of available data are constantly increasing. Its software is simple to use, and delivers fast analysis of any dataset, allowing its users to increase their business intelligence. The company has a diverse customer base of more than 17,000 users in fields ranging from healthcare to banking to insurance to agriculture. Tableau went public in May 2013, and raised more than 250 million dollars. According to the company's 2013 financial report, revenue for the year was 232.4 million, an 82% growth over its revenue from 2012.

ICT Initial Public Offerings

ICT IPOs account for a disproportionately large share of total IPO value in Washington State. **Exhibit 47** shows all Washington company IPOs, divided into ICT companies and non-ICT companies.

Exhibit 47. Washington IPOs, ICT and non-ICT, 2009-2014Q2, Millions of Dollars

Date	Company	IPO	City
4/18/2011	Zillow	55.7	Seattle
4/2/2013	Tableau Software Inc.	248.4	Seattle
10/8/2013	Zulily	238.1	Seattle
6/16/2014	Trupanion, Inc.	122.9	Seattle
	Total ICT IPO Value:	665.1	
8/10/2009	InfrastruX Group Inc.	290.0	Seattle
10/5/2009	Symetra Financial Copr.	434.7	Bellevue
10/1/2010	Atossa Genetics Inc.	8.1	Seattle
5/6/2011	HomeStreet Inc.	64.7	Seattle
11/14/2011	ClearSign Combustion Corp	12.0	Seattle
2/14/2012	Atossa Genetics Inc.	8.1	Seattle
5/20/2013	NanoString Technologies	93.2	Seattle
3/11/2014	Papa Murphy's Holdings, Inc	87.2	Vancouver
3/19/2014	Alder BioPharmaceuticals, Ir	123.3	Bothell
4/17/2014	Taggeres Agriculture Corp	48.3	Kennewick
6/23/2014	Immune Design Corp	74.9	Seattle
	Total IPO Value:	1909.5	

Source: IPO Monitor, 2014; Community Attributes 2014.

ICT IPOs account for $765.1 million of the $2009.5 million total IPO value of Washington companies. The average IPO of an ICT company is $153.0 million, compared to $113.1 million for non-ICT companies.

Experts from the venture capital field commented on the slower pace of IPO's in 2012 and 2013 in the Seattle area. One interviewee said there have been fewer recent IPO's because start-ups have been bought before their valuation skyrockets. One person said the mergers and acquisitions (M&A) market in 2013 was the hottest it had been in recent years.

6. WORKFORCE SUPPLY ASSESSMENT

ICT Occupation Education Requirements

The Bureau of Labor Statistics surveys and publishes "typical education needed for entry" by occupation, as shown in **Exhibit 48**, from BLS's Employment Projections program, based on nationwide surveys. BLS describes typical education needed as the category that "best describes the typical level of education that most workers need to enter the occupation".[6]

Exhibit 48.
Education Attainment Level by Occupation, U.S. Bureau of Labor Statistics

Education		SOC Code	Occupation
Associates or		15-1151	Computer User Support Specialists
Some college		15-1152	Computer Network Support Specialists
Bachelor's	*	15-1132	Software Developers, Applications
degree	*	15-1131	Computer Programmers
		15-1121	Computer Systems Analysts
		11-3021	Computer and Information Systems Managers
	*	15-1133	Software Developers, Systems Software
		15-1134	Web Developers
		15-1142	Network and Computer Systems Administrators
	*	17-2071	Electrical Engineers
	*	15-1143	Computer Network Architects
		15-1199	Computer Occupations, All Other
		15-1141	Database Administrators
		15-1122	Information Security Analysts
		15-2031	Operations Research Analysts
	*	17-2061	Computer Hardware Engineers
Master's or Doctoral	*	15-1111	Computer and Information Research Scientists

Source: Community Attributes, 2014; BLS Occupational Employment Estimates, 2013.

[6] http://www.bls.gov/emp/ep_definitions_edtrain.pdf

The BLS and the National Center for Education Statistics (NCES, a part of the Census Bureau) also survey educators to ascertain the program names of degree programs that map to occupations.

For example, the list of degrees that the NCES shows to suit a career as a Software Developer are shown in **Exhibit 49**. Nationwide, the list demonstrates that there is a many-to-many relationship between degree programs and occupations in ICT (as in all fields). The full list of all degrees and programs suitable for a degree in all essential ICT Occupations is shown in the next section, along with graduates from Washington-based institutions.

Exhibit 49. Education Requirements Example: Degree Programs or Majors Suitable for a Software Developer Career

Program/Major
Artificial Intelligence
Information Technology
Informatics
Computer Programming/Programmer, General
Computer Programming, Specific Applications
Computer Science
Modeling, Virtual Environments and Simulation
Computer Engineering, General
Computer Software Engineering
Computer Software Technology/Technician
Bioinformatics
Medical Informatics

Washington-Based Education and Training

The full list of all degrees and programs often associated with ICT Occupations is shown in **Exhibit 50**, along with the number of people that graduate from Washington-based institutions with those degrees in 2013. A smaller set of degree programs are considered suitable by industry hiring managers for essential ICT jobs and is shown in the upper section of Exhibit 50.

Accredited higher education institutions produced a total of 4,864 students in 2-year and higher programs *intended to prepare a student for entry into the ICT sector*. However, according to industry hiring managers and recruiters, most of these programs are not suitable for essential ICT job openings.

Of the 4,864 graduates in 2013, there were 2,384 graduates with 2-year degrees who are not qualified for those jobs. Of the remaining 2,480 students graduating in 2013 with 4-year degrees or higher, the majority of programs – while leading to other employment – do not develop the skills or experience required for the leading ICT firms to hire them into essential ICT jobs.

In 2013, the entire Washington university and college system graduated 1,239 students with these degrees, of which only 979 were awarded a 4-year degree or higher. As shown in subsequent sections, this total is far short of the demand.

Exhibit 50. Majors and Programs Suitable for Washington ICT Occupations by Number of Graduates, Washington, 2013

Rank	Program/Major	Associate Degree and Certificate Progams	Bachelor's Degree	Master's Degree and Higher	Total Graduates
1.	Computer and Information Sciences, General		356	163	519
2.	Computer Science	14	274	30	318
3.	Computer Programming/Programmer, General	246	2		248
4.	Computer Programming, Specific Applications		59	16	75
5.	Computer Engineering, General		65	1	66
6.	Computer Software Engineering		4	9	13
	Core Degree Programs Subtotal	**260**	**760**	**219**	**1,239**
1.	Computer Systems Networking and Telecommunications	691	35	1	727
2.	Electrical and Electronics Engineering	26	347	123	496
3.	Web Page, Digital/Multimedia and Information Design	416	18		434
4.	Management Information Systems, General		309	18	327
5.	Information Technology	1	286	28	315
6.	Computer and Information Systems Security/Assurance	187	42	6	235
7.	Operations Management and Supervision	18	192		210
8.	Computer Support Specialist	176			176
9.	Web/Multimedia Management and Webmaster	139			139
10.	Computer Graphics	108	26		134
11.	System, Networking, and LAN/WAN Management/Manager	106			106
12.	Network and System Administration/Administrator	90			90
13.	Data Processing and Technology/Technician	79			79
14.	Data Modeling/Warehousing and Database Administration	60			60
15.	Management Science		37		37
16.	Computer Systems Analysis/Analyst		26		26
17.	Computer Programming, Vendor/Product Certification	21			21
18.	Modeling, Virtual Environments and Simulation	6			6
19.	Mathematics and Computer Science		5		5
20.	Bioinformatics		1		1
21.	Operations Research		1		1
	Other ICT Degree Progams Subtotal	**2,124**	**1,325**	**176**	**3,625**
	Total All ICT Degree Programs	**2,384**	**2,085**	**395**	**4,864**

Sources: Community Attributes, 2014; National Center for Education Statistics, 2012.

The University of Washington graduates the most candidates in programs that are suitable for many ICT occupations, with 1,118 graduates in the school year of 2012/2013 (of which 141 were reported to NCES for the Computer Science program), as shown in **Exhibit 51**, presenting the number of graduates of ICT-related programs, by institution and level of education. Note that of the total 1,118 graduates less than half are suited to essential ICT occupations. By comparison, Washington State University graduates the second-most candidates in the university and college system with 487 graduates that same year, again with only a small subset suitable for essential ICT occupations.

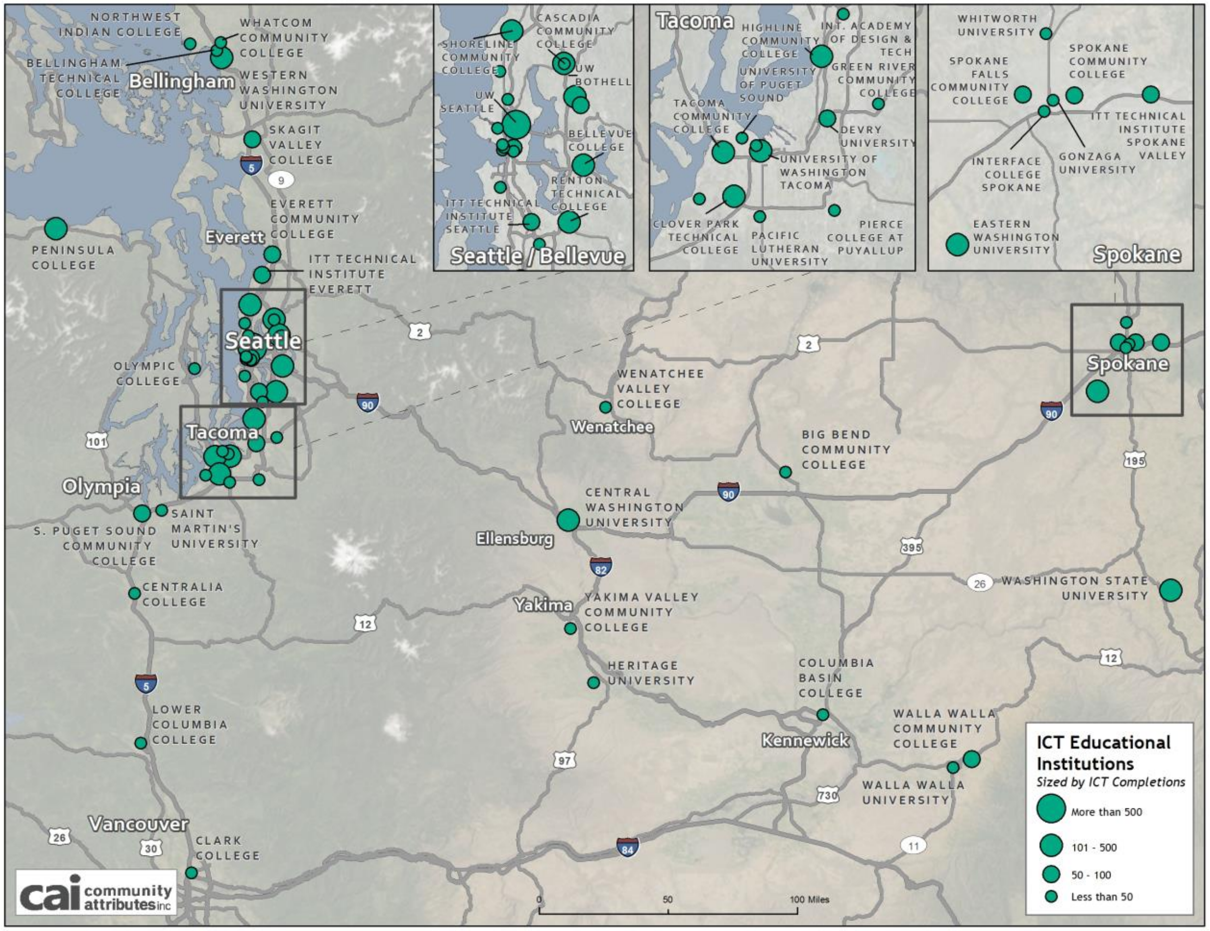
Exhibit 51. Top Ranking Institutions Sorted by Graduates with ICT oriented Degrees: Washington, 2012/2013

Educational Institution	Associate Degree and Certificate Progams	Bachelor's Degree	Master's Degree and Higher	Total Graduates
University of Washington				
Seattle Campus		566	232	798
Tacoma Campus		166	19	185
Bothell Campus		107	28	135
University of Washington (All Campuses)		839	279	1,118
Washington State University		436	51	487
Edmonds Community College	278			278
Bellevue College	185			185
Peninsula College	163			163
Western Washington University		149	1	150
Tacoma Community College	142			142
Eastern Washington University		132	9	141
Central Washington University		134		134
Renton Technical College	127			127
Lake Washington Institute of Technology	126			126
Clover Park Technical College	114			114
Highline Community College	111			111
Walla Walla Community College	96			96
ITT Technical Institute-Seattle	62	24		86
DeVry University-Washington	7	69	8	84
Spokane Community College	84			84
Everett Community College	79			79
DigiPen Institute of Technology		61	16	77
South Puget Sound Community College	67			67
Spokane Falls Community College	58			58
ITT Technical Institute-Spokane Valley	43	12		55
ITT Technical Institute-Everett	44	8		52
Seattle Central College	52			52
Skagit Valley College	52			52
Clark College	50			50
The Art Institute of Seattle	9	37		46
Seattle University		32	12	44
31 other Institutions	435	152	19	606
Total	***2,384***	***2,085***	***395***	***4,864***

Sources: Community Attributes Inc., 2014; National Center for Education Statistics, 2014

Exhibit 52 illustrates these same ICT completions by institution, mapped across the state of Washington. While the western side of Washington contains the largest concentration of these educational institutions graduating students for ICT, graduates are distributed widely across the state, from Vancouver to Bellingham and Seattle to Spokane.

Exhibit 52. Educational Institutions in ICT Sized by Completions, Economy-wide, Washington State, 2012/2013



Source: Community Attributes, 2014; National Center for Education Statistics, 2014.

Educational Needs for Essential ICT Occupations

As described earlier in this report, a few essential ICT occupations form the innovation foundation of the ICT Cluster in Washington State, which are as follows:

- **Software Developers** (all types)
- **Computer Programmers**
- **Computer Engineers**
- Computer **Network Architects**, and
- **Computer and Information Research Scientists**

The degree programs required to serve these occupation, as identified by the NCES and BLS are as follows:

- Artificial Intelligence
- Computer and Information Sciences
- Computer and Information Systems Security/Information Assurance
- Computer Engineering, General
- Computer Engineering, Other
- Computer Hardware Engineering
- Computer Programming
- Computer Science
- Computer Software Engineering
- Computer Software Technology/Technician
- Computer Systems Analysis/Analyst
- Computer Systems Networking and Telecommunications
- Electrical and Electronics Engineering
- Electrical, Electronics and Communications Engineering, Other
- Information Science/Studies
- Information Technology
- Modeling, Virtual Environments and Simulation
- Network and System Administration/Administrator

The BLS choose degree titles that are nationwide in nature, and not all programs by these names are offered in Washington institutions. Nationally, demand for these training programs is strong. According to local companies contacted for this study, the market for workers with these skills and at least a Bachelor's degree has never been more competitive. Compensation, ability to impact important projects, and a dedication to professional and skills development are all important factors which companies use to recruit and retain the best ICT talent. Google, Microsoft, and Amazon all have internship programs with colleges that are designed to identify and prepare students who may have future success at top companies.

ICT University and College Programs in Washington

University of Washington

The University of Washington's challenging curricula and internship programs with industry produce some of the best local talent for top ICT companies in Washington, especially regarding students who choose training and careers in engineering.[7] The University is a close recruiting partner for Washington technology companies, the majority of whom are located in Western Washington. Developing and maintaining expertise in the field is a large part of UW's success. In 2012, the University recruited four new faculty members in the fields of big data and machine learning, who are considered to be some of the brightest in the world of computer science.[8] The UW graduates a little more than 200 students each year with undergraduate degrees in Software Engineering and Programming.

The capacity of the UW program is a key focus area to increase the supply of graduates to fill essential ICT occupation openings. The numbers of incoming freshmen who intend to major in computer science & engineering at the University of Washington have increased sharply since 2010,[9] and while the number of UW Engineering graduates has increased, capacity remains a paramount issue for public universities (and the ICT workforce) in Washington as state funding for higher education fails to keep pace with demand.[10]

Other Washington Universities

Students at Washington State University and other state universities are also recruited for Washington's top technology companies, though in smaller numbers. Integrating the curricula of these programs and graduates to meet industry needs is another key focus area to increase the supply of graduates to fill essential ICT occupation openings. Some universities are working with industry to do that, including WSU and the other public state universities, Eastern Washington University, Western Washington University, and Central Washington University. Private universities prioritizing ICT include Northeastern University in Seattle, and Gonzaga University, Whitman College, and others.

Enrollment at Washington State University's computer science and engineering programs is on the rise. As a result of state investments, WSU plans to double its

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[7] Interview with Jeremy Brigges, Microsoft University Recruiting Manager, October 2014.
[8] Long, Katherine, UW recruits superstars of computer-science world. *The Seattle Times*: http://seattletimes.com/html/localnews/2018546054_computerscience28m.html
[9] http://news.cs.washington.edu/2014/05/19/intended-majors-of-uws-2014-incoming-freshmen-its-cse-baby/
[10] Tuition in Washington's public universities increased more from 2008 to 2013 than in any other state except Arizona: http://www.spokesman.com/stories/2014/may/05/public-universities-washington-had-second-highest-/

faculty in CS and CE from 13 to 14 now to 30 instructors over the next three years. In addition, a new Bachelor's degree specifically in Software Engineering is being proposed for both the Pullman and Everett campuses. Presently, only Computer Engineering and Computer Science are offered as a major at WSU.[11] After graduation, about 65% of CS and CE graduates from WSU receive job offers and approximately 15% go on to earn graduate education. In 2013, at least 40 undergraduate students secured entry-level positions with Schweitzer Engineering Labs (Pullman), Boeing, Micron, Microsoft, Isilon and Puget Sound Energy.[12]

Community and Technical College Programs in ICT

Community and technical colleges in Washington State produce 35% of the degrees associated with ICT occupations. Community colleges throughout Washington provide ICT classes and programs. Many such programs are viewed as a ramp up to complete a Bachelor's degree at a four-year institution. Many are also seen as vocational training to expand one's marketable skills. Graduates may apply their skills within existing occupation paths or may use the training to gain employment in an ICT occupation. The State's community college network plays an important part in providing training and education for students that meet this description.

Seattle Colleges (one school, three campuses plus the Seattle Vocational Institute) offers two and four-year degrees in several ICT fields. A new evening degree program (Application Development) began in the fall of 2014 and culminates in a Bachelor's of Applied Science degree. Seattle Colleges' website reports, "When compared to traditional Bachelor's programs, bachelor of applied science degrees more heavily incorporate hands-on learning, focused on a particular industry or discipline. Added bonuses are emphasis on internship opportunities, credit for prior learning and workplace experience." There are 25-30 students admitted each year and the program is designed for completion in two years pending prerequisites.

Whatcom Community College in Bellingham offers a well-known AS degree in Computer Information Systems (CIS) that began in 1996. With emphasis on network security, support and network administration, this degree program includes two faculty. One unique feature of their approach is the seamless integration of all 90 CIS course credits into a new four-year degree program at Western Washington University. This commitment to partnering with WWU is a growing reflection that graduates from WCC are in a better position to gain

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[11] Interview with Dr. Behrooz Shirazi, Professor and Director of Engineering and Computer Science Department, WSU, October 2014.
[12] Interview with Dr. Behrooz Shirazi, Professor and Director of Engineering and Computer Science Department, WSU, October 2014.

employment in ICT with a 4-year degree. The WCC program has grown 50% in the last five years, perhaps because of WCC's designation as an Academic Center of Excellence from the US Department of Homeland Security and the NSA. In the next few years, WCC would like to add two more full-time faculty or adjunct professors to keep up with projected growth.[13]

Certificate Programs, Online Learning and Other Training Programs

Other training avenues such as professional certificate programs and local and non-local online represent a significant number of workforce training avenues. At the University of Washington alone, 50 such certificate programs are offered in ICT from the basics (programming languages and database architecture) to the advanced (machine learning and data science) as well as all the support needed for careers in these areas (project management, software testing and marketing).

Massive Open Online Courses (MOOC), such as Coursera, partner with universities worldwide and provide students with access to programs and training available in ICT, available online and for free or low cost. The curriculum for these courses is broader than what is available locally and are becoming a popular alternative to the more traditional in-person certificates for ICT professionals to learn new skills. Recognition of these programs varies from employer to employer. While they are able to teach technical skills, students do not gain the interpersonal skills and collaboration taught in traditional programs—abilities that are highly desirable to employers.

Yet another example of a successful training program is the new SEATech Skills Center in Walla Walla. Opened in 2013, Walla Walla High School's innovative skills center was founded to prepare students for post-secondary education and success in high-skill, high-demand careers. SEATech provides advanced career and technical education programs based on rigorous academic standards in digital media technology, health sciences, sustainable energy technology, and advanced manufacturing technology. The Center acts as a launching pad for many young students into highly successful academic and professional careers.

Unemployed Workforce

The next section of this report will examine labor shortages in ICT by occupation. This section rounds out setting the stage for that analysis first, by profiling unemployed ICT workers.

[13] Interview with Janice Walker, Workforce Education Director at Whatcom Community College, October 2014.

According to an August 2014 report from Washington's Employment Security Department, Washington's jobless rate was at its lowest since August of 2008.[14] The presence of companies like Microsoft, Amazon, and Boeing have helped boost the wage level of new jobs replacing those that were lost during the recession. The report cites high job growth from the professional, scientific and technical sectors.

Exhibit 53 displays unemployment claims by ICT occupation for Washington State in 2013 across all industries. Computer and information systems managers had the most claims (702 claims), followed by computer user support specialists (595 claims), and applications software developers. (543 claims).

Exhibit 53. Unemployment Claims by ICT Occupation: Washington State, 2013

Occupation	Unemployment Claims
Computer and Information Systems Managers	702
Computer User Support Specialists	595
Software Developers, Applications	543
Software Developers, Systems Software	361
Network and Computer Systems Administrators	306
Computer Systems Analysts	302
Computer Programmers	201
Computer Occupations, All Other	177
Computer Network Architects	134
Electrical Engineers	117
Computer Hardware Engineers	83
Database Administrators	80
Operations Research Analysts	70
Computer and Information Research Scientists	30
Total	***3,700***

Source: Community Attributes, 2014; Washington State Employment Security Department, 2013.

ICT In-Migration and H-1B Visas

People come to Washington- State from all over the U.S. and from all over the world to pursue a career in Information & Communication Technology. Washington's ICT companies attract talent to the state and talent migrates to Washington in order to participate in the cluster. Companies welcome out of state talent because they want the best workers they can find to contribute to their businesses. Top tier companies welcome out of state talent because they have more openings in essential occupations than they can fill with local talent (the subject of the section that follows this section).

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[14] Garrick, Coral, Job growth in state eclipsing go-go '90s; jobless rate falls. *The Seattle Times*: http://seattletimes.com/html/businesstechnology/2024301101_unemploymentjulyxml.html

One well-known source of workers for Washington's ICT cluster includes international workers on H-1B visas. H-1B visas are the single largest source of foreign workers nationwide. U.S. Congress caps H-1B visas at 65,000 new visas nationally per year; note that 6,500 of these are reserved for Chilean and Singaporean nationals, per trade agreements with these countries. (H-1B visas are not the only visa through which foreigners are able to work in the U.S. The TN visa allows citizens of Canada and Mexico to work in the United States for periods of up to one year.) The Department of Labor certified 23,124 applications in 2012. **Exhibit 54** shows top certified H-1B visas by company.

Exhibit 54. Top Certified H-1B Visas Certified, by Company (IT Occupations): Washington State, 2012

Company	Certified H-1B Visas (IT Occupations)	% of Total
Microsoft	2,020	29%
Infosys Limited	1,102	16%
Amazon	434	6%
HCL America	179	3%
Wipro Limited	150	2%
Deloitte	94	1%
Other Companies	3,092	44%
Total	***7,071***	***100%***

Source: Community Attributes, 2014; Myvisajobs.com report of certified H-1B Visas, 2014. IT Occupations are not the same as, but are similar to, the list of ICT occupations included in this study.

H-1B visas are initially granted for a duration of up to three years, but they can be renewed for up to another three years. Another 20,000 of these visas for foreign nationals with a master's degree or higher are exempted from the cap, and even more are exempted for those working in research facilities associated with universities, non-profits, or the government. Demand for H-1B workers fluctuates along with economic cycles. During times of high job growth (2007 and 2008) the cap was reached within one week. During the recession, it took eight to nine months to reach the cap.[15] In 2014, it took less than a week to hit the cap.[16]

Exhibit 55 shows the number of certified H-1B visas in IT occupations in Washington State, including new employment requests, renewals, amendments,

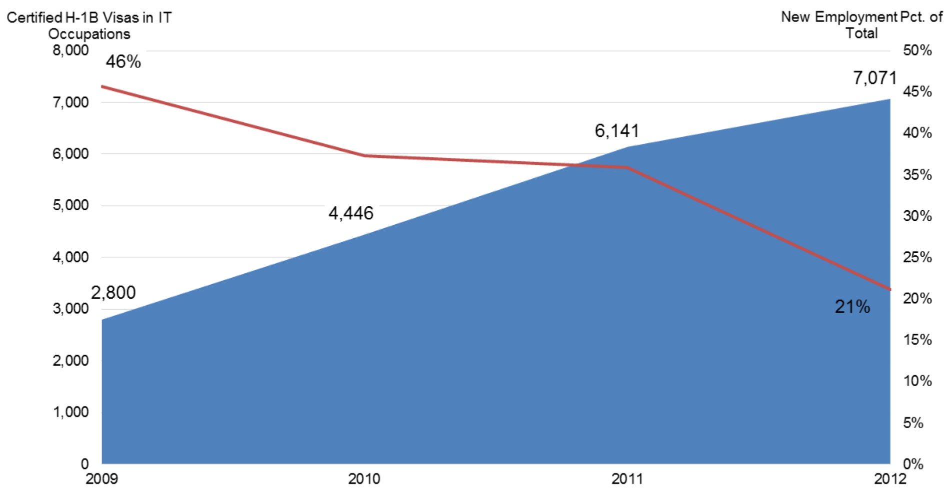
[15] Brookings, "The Search for Skills: Demand for H-1B Immigrant Workers in U.S. Metropolitan Areas", July 18, 2012, available at http://www.brookings.edu/research/reports/2012/07/18-h1b-visas-labor-immigration#overview.
[16] Brookings, "H-1B Visa Cap Applications Show Need for Immigration Reform", April 16, 2014, available at http://www.brookings.edu/blogs/techtank/posts/2014/04/16-h1b-visa-immigration-reform-west

and continuations from 2009 to 2012 (the left Y-axis) contrasted with the share of that total coming from new employment requests (the right Y-axis).[17]

Overall, while certified H-1B visas of all renewal types[18] have increased from 2,800 in 2009 to 7,071 in 2012 (an increase of more than 150%), new employment requests as a share of total certified H-1B visas have declined over that period from 46% in 2009 to 21% in 2012. In all years, the majority of certified H-1B visas in Washington came from various types of renewals, amendments or continuations to existing visas rather than new employment requests.

For employers who also sponsor H-1B employees for permanent residence, the lengthy backlog in employment-based green cards has also increased the need for extending H-1B visas. With green card backlogs in excess of 10 years in some employment-based categories at the time of this report (see http://www.travel.state.gov/content/visas/english/law-and-policy/bulletin/2015/visa-bulletin-for-january-2015.html), employers must apply for ongoing extensions of H-1B status to ensure the ongoing employment eligibility and availability of employees caught in that backlog.

Exhibit 55. Certified H-1B Visa Applications in IT Occupations, New Employment Share of Total: Washington, 2009-2012



Source: Community Attributes, 2014; Myvisajobs.com report of certified H-1B visas. Includes amended petitions, changes in employment and employer, renewals, and petitions for new employment. . IT Occupations are not the same as, but are similar to, the list of ICT occupations included in this study.

[17] "IT Occupations" from this source of data are not the same as the list of occupations included in this workforce assessment, but are similar.

[18] Renewal types includes amended petitions, changes in employment and employer, renewals, and petitions for new employment.

Occupational Forecasts Workforce Supply Assessment

The occupational forecasts shown in the ICT Cluster Data Profile (**Section 3**) can be compared to graduates of degree programs to understand labor shortages or surpluses by occupation, as shown in **Exhibit 56**.

The greatest shortages are in Software Developers (2,009 per year, not including unemployed), Programmers (433), Support Specialists (aka Help Desk) (396), Systems Analysts (242) and Systems Administrators (200). The annual total shortage of supply versus demand is in **excess of 3,000 workers**.

Note that occupations in this arena are in general not fungible; the surplus in one occupation cannot typically serve the shortage in another without substantial retraining. **Exhibit 55** also illustrates the opportunity for the State to partner with industry and community college leadership to invest in retraining the under and unemployed to help solve part of the talent shortage faced by the industry. For example, 396 unfilled jobs in the Computer User Support Specialist (aka Help Desk) occupation might be filled by retraining some of the 595 unemployed workers with prior experience in that field but whose technical skills are not current.

Exhibit 56. ICT Occupations Openings and Available Graduates and Unemployed, Washington State, 2017 – 2022

Education		SOC Code	Occupation	Annual Demand (2017-22)	Supply (2013 Graduates)	Gap (Surplus or Shortage)	Additional Supply (UI Claims)	Gap with Unemployed
Associates or		15-1151	Computer User Support Specialists	557	161	(396)	595	199
Some college		15-1152	Computer Network Support Specialists	176	354	178	0	178
Bachelor's	*	15-1132	Software Developers, Applications	2,171	162	(2,009)	543	(1,466)
degree	*	15-1131	Computer Programmers	863	430	(433)	201	(233)
		15-1121	Computer Systems Analysts	614	372	(242)	302	60
		11-3021	Computer and Information Systems Managers	414	639	225	702	927
	*	15-1133	Software Developers, Systems Software	305	181	(124)	361	238
		15-1134	Web Developers	358	641	283	0	283
		15-1142	Network and Computer Systems Administrators	330	130	(200)	306	106
	*	17-2071	Electrical Engineers	203	496	293	117	410
	*	15-1143	Computer Network Architects	127	324	197	134	332
		15-1199	Computer Occupations, All Other	193	161	(32)	177	145
		15-1141	Database Administrators	109	221	112	80	192
		15-1122	Information Security Analysts	79	393	314	0	314
		15-2031	Operations Research Analysts	74	38	(36)	70	34
	*	17-2061	Computer Hardware Engineers	65	17	(48)	83	35
Master's or Doctoral	*	15-1111	Computer and Information Research Scientists	42	144	102	30	132

Source: Community Attributes Inc. (2014)

Note: * indicates Essential Occupations

7. INDUSTRY PERSPECTIVES

Community Attributes completed more than 25 telephone and in-person interviews between May and November, 2014. Industry leaders and stakeholders provided valuable insights, comments and suggestions in several critical areas of inquiry. However, the findings and comments from the group are not exhaustive of the diverse perspectives of the ICT cluster. Interviews yielded great insight and opinion on what's transpiring on the ground with start-ups, growing and midsize companies, and mature ICT employers in Washington State.

Interviewees representing a variety of employers and company sizes lauded Washington as a state attractive to ICT employers for reasons including affordability and lower commute times when compared to the Bay area, mild weather, access to recreation and outdoor activities, political progressivism, and lack of a state income tax. According to interviewees, these assets translate into real benefits for Washington's ICT employers, who are better able to recruit and retain a highly talented workforce and contribute to regional economic vitality. In spite of a high quality of life to retain and recruit ICT workers here, high wages and a steady growth rate in core ICT occupations, interviewees spoke to three main hurdles to their industry in Washington State: the lack of an established training pipeline that starts early in education, an unstable regulatory environment in state and the disconnect between the total supply of ICT graduates and workers in both technical and support occupations coupled with an acute need for more qualified candidates in software programming and engineering specifically.

Almost all participants were asked identical questions about assets and challenges for the ICT cluster here in Washington State, the competitive environment for ICT compared to peer cities and perceptions of what is needed to improve the business climate.

In the following paragraphs, the qualitative analysis will focus in these three common response categories:

- Regional assets and challenges
- Competitive environment (Seattle vs. Silicon Valley vs. all other).
- Business climate challenges

Regional Assets and Challenges

Participants spoke at great length about the assets and resources available to ICT companies in the region. Regardless of company size or the percentage of ICT occupations within the company, interview participants frequently commented on the following assets that have made the Seattle/King County and Washington State market desirable for ICT workers and businesses:

- Affordability;
- Lower commute times compared to the Bay Area;
- Mild weather;
- Recreation and healthy/outdoors activities;
- Diversity/social tolerance; and
- No state income tax.

Recruitment and retention strategies were dominant issues among almost everyone interviewed for this project. The assets discussed above play crucial roles in ICT businesses' ability to attract and retain workers in the state. The state's assets above help ICT companies succeed at:

- Recruit and retain a talented workforce;
- Contribute to regional economic vitality; and
- Maintain and grow the start-up culture in ICT.

ICT leaders said the assets column is overflowing with good news and perks that workers understand. In fact, one company leader stated, "We tell people we're interviewing from out of state that if it doesn't work out with us, they'll find a job in Seattle with someone else in no time. There are so many new tech companies here. A 22-year-old can look around and see that tech in Seattle isn't just Microsoft anymore."

The region's major higher educational institutions are also perceived as assets to fostering a healthy ICT cluster. Conversations relating to higher education mostly revolved around the region's two- and four-year programs with an emphasis on degree programs, instructors and students at the University of Washington. Company leaders emphasized the need for a pipeline linking high-ranking ICT-related education programs to open internship slots as well as full-time positions. Higher education leaders spoke about the value in having ICT workers on campus to teach current undergraduate and graduate students.

A participant from DigiPen characterized their recent growth by saying, "We've never seen more interest in our school or a higher number of applications." Other assets mentioned by multiple interviewees included:

- University of Washington
- Other four-year universities and specialized training programs like DigiPen
- Graduate ICT programs
- Two-year undergraduate and certificate programs
- Programs like WIN Reactor
- Private sector college internship programs
- A City of Seattle address

Some interviewees mentioned the direct impact of ICT wages on the regional and state economy. These participants were able to relate direct ICT wages and other induced benefits to other businesses and industries, such as real estate and consumer retail. One company leader said their average wage across all ICT occupations exceeded six figures.

Finally, several assets identified linked the emergence and maturity of ICT workers in Washington. Some common storylines appeared during this discussion. Participants mentioned the following assets as continuing to drive innovation and success in the tech industry:

- Microsoft's role in spawning leaders of new start-up companies
- Explosive growth by Amazon
- Seasoned dot-com entrepreneurs staying in the area through the Recession, maintaining the region's depth and industry knowledge
- Other successful non-ICT retailers developing and deploying ICT products and services, such as Nordstrom and Starbucks hiring software developers.
- Businesses view the ICT cluster as a "founder's culture," where engineers, not MBA's, are running tech companies

In discussing partnerships between private sector businesses and higher education, the 2012 Amazon grant funding of two academic/research positions at the University of Washington's Computer Science Department was specifically called out as an example of innovation that will ultimately create tangible assets plus a sustainable ICT legacy here in Washington.

Each interview also allowed and encouraged participants to describe challenges for the ICT cluster. In most cases, participants created two categories of ICT workers (entry-level and seasoned managers/executives) and talked about the significant challenges affecting each one. For ICT companies, the main challenges connected to their entry-level ICT workforce were outlined in three areas, including:

- **Roles & Responsibilities**—a lack of clarity around who is coordinating private sector employers and higher education institutions/ICT programs
- **Training/Content**—coming to consensus on what entry-level workers in various ICT occupations need to know
- **Pipeline Development**—building an early (starting in high school) and growing pipeline of ICT workers in high-demand occupations.

Internship programs in ICT were mentioned as a priority initiative. There are formal internship programs for ICT students at UW, but not at WSU. Many businesses understand the connection between summer interns and workforce competitiveness. A large and productive internship program not only supports the interns and their learning, but it also reduces time spent hiring entry-level workers who don't know how the company works.

When the discussion turned to more seasoned ICT employees (i.e. those with 10+ years of experience), a unique set of barriers materialized to reveal new insights, including:

- **Pipeline Development**—working to ensure that more innovative ICT companies grow and get started in Washington to retain talented workers. One interviewee said, "Yes, we have a great quality of life for certain. But it's still a challenge to recruit and retain managers and above from the east coast or sunny climates." There is significant concern that talented workers can be recruited to more sophisticated tech markets with a larger pool of employers.
- **Training/Content**—demonstrating the benefits to employers of investing in training programs and using in-house trainers and mentors to deliver content. One interviewee stated, "Engineers don't know what they don't know about business. It's important to find experienced entrepreneurial mentors to help you build a team, describe how you build culture."
- **Making the Case for Worker Retraining**—identifying which workers need skill refreshers and what programs are best geared toward providing targeted classes or certifications.

Finally, participants mentioned the challenges facing ICT business owners and venture capitalists working in the ICT industry. The most notable barriers for these populations included:

- A relatively **small, inexperienced field,** with specific mention of the small number of **seasoned ICT CEOs, and VP-level** employees. The cluster is dominated by a few companies resulting in a smaller pond with less mobility.
- **An unstable and uncertain regulatory environment**, creating "armchair investors" and risk-averse VC leaders in ICT.
- **An expensive market for entry-level labor**, making it unreasonable for some entrepreneurs to start or scale up their business. One participant noted, "It still costs a lot of money to scale up. We need more investors who are focused on 'the middle,' companies who have their Series B funding but aren't going to flip to Google. " Another said, "In the last start-up I was in, we hired a programmer from Indiana because we couldn't afford developer talent here without making them a major stakeholder in the company, or unless they were "retiring" from Microsoft.
- **Access to funding events** also present a challenge. One interviewee mentioned, "Here you have one event a week or month but in the Valley

there's five a day. At any given time there's a place to meet and come up with synergies."

In **Exhibit 57**, some of the common themes (i.e. education, the ICT Market in Washington (micro level) and the ICT Market (macro level) are displayed.

Exhibit 57. Summary of Perceived Barriers to Growth within ICT

	Entry-level ICT Employees	Seasoned ICT employees	ICT entrepreneurs/ funders
Education/Training/ Skills	STEM training and other K-12 programs aren't creating enough of a pipeline No consensus what role two- and four-year colleges should play educating entry-level ICT workers The University of Washington alone can't supply the existing and projected need Universities and colleges can and should be doing more to recruit women into ICT programs	Need more in-house programs and employers who will develop and coach their emerging ICT workforce Skills need to be constantly refined to avoid the skills gap. What is the role of two- and four-year colleges in worker retraining?	N/A
ICT in Washington (micro level)	Entry-level skills are becoming increasingly disparate and complex. Expectations are changing	Not many ICT companies in Washington State.	Small companies limit their risk-taking because of expensive taxes, like Washington's B&O burden Most ICT executives in Washington have not experienced the entire funding loop, so the number of experienced CEOs is small Perception that Seattle has more armchair investors here versus Silicon Valley where people are rolling the dice

			and taking risks
ICT Market (macro level)	Perception is that demand is still outpacing supply. Need more homegrown Computer Science majors graduating from 4-year colleges. Employers in "producer" segment (Amazon) need different skills than employers in "consumer/retail" segment.	Strong competition for experienced workers in ICT, especially software engineers and leaders at the VP level Perception that ICT workers from Silicon Valley are more talented or more innovative	Compared to other tech hubs, there aren't many venture capital companies in Washington and the total VC investment per year is less now than it was 10 years ago Very dynamic marketplace. Recent grads are changing jobs every two to three years It's difficult to hire intelligently and be able to afford it. This benefits the employee, but is a burden on employers Impression that there are few federal or state incentives for ICT companies

Sources: Community Attributes, 2014.

Competitive Environment

Interviewees made numerous asset comparisons with Silicon Valley, including affordability, diversity, start-up culture, talent pool, and the availability of capital. Other peer markets mentioned, although less commonly, include Austin, Boston, New York, Singapore, Toronto, and Vancouver, BC. In the last three years, Portland has benefitted from ICT company growth as well.

Compared to Silicon Valley, the ICT market in Seattle was consistently described as more stable in that workers don't hop between occupations as often and stronger in engineering. However, it's hard to find the right candidates, especially in software programming.

Silicon Valley is perceived as having a stronger bench of sales, marketing and business development talent. Some interviewees also mentioned that companies in Silicon Valley are clearer about their role and vision. This is possibly because of the larger and higher quality marketing and communications workforce in ICT specifically. One interviewee said, “Business in the Bay Area are coached from Day 1 how to talk about their businesses, how to write about their business plans and how to talk about ICT more broadly. Here in Seattle, that doesn’t happen or else the CEO’s aren’t paying attention to that kind of guidance and coaching.”

Competitiveness was also put in the context of what Seattle and peer markets do to create an ecosystem for ICT to thrive even in non-ICT businesses. Multiple participants said how ICT and innovation was perceived to flourish in richly diverse economies. When a market like Silicon Valley is a US market leader in financial services or consumer packaged goods, ICT businesses grow and healthy innovation continues. In comparison to “mature” Silicon Valley, the Seattle area and Washington State in general was routinely described as “new” “young” or “scrappy.”

On the other hand, Washington’s “youth” and “scrappy” culture has been effective producing ICT start-ups that are caused by “creative disruption.” Creative disruption was described as what happens when the stock price at a legacy ICT company like Microsoft or Real Networks drops over a period of time. The stock decline gives entrepreneurs room to consider other alternatives and “what if” scenarios. As a result of this recurring pattern, dozens of start-ups have found their footing and continue to grow or they are successfully acquired.

Business Climate Challenges

Interviewees offered policy ideas and suggestions to drive innovation and new opportunities in the ICT cluster. Feedback topics included transportation infrastructure, tax incentive programs and other effective policy issues that aid companies in their decision to grow in Washington or prioritize other states.

Questions in this series also produced a “wants and needs” list from many companies. Here are some of the most important insights about what solutions are needed to improve Washington’s business climate for ICT.

- Many companies repeated variations on this theme, “Washington boasts great quality of life, but at the end of the day, we make our decisions about where to grow based on availability of workforce, business climate (tax policy and land use policies) and infrastructure.”
    - High energy costs could prevent data centers from relocating to or expanding into Washington
    - B&O taxes are onerous for small companies
- State leaders are not well-versed in the start-up story because there is little presence in Olympia among small and mid-size ICT companies. ICT companies are not heavily regulated like other industries, so they don’t spend money on lobbyists to develop a common messaging platform. As a result, ICT company workers feel that “Washington doesn’t do anything for ICT; compared to what they did to keep Boeing in the state.” ICT leaders say it’s a cycle of “benign neglect.”

- Regional transportation infrastructure and transit continues to bring challenges. ICT companies can't grow if reliable utility infrastructure isn't available; this is especially true and concerning to companies in suburban and rural areas where outages are more common and there are fewer utility substations.
- One interviewee mentioned fighting non-compete enforcement as it would result in a spike in entrepreneurialism. For small companies, the threat of legal action is enough to shoot down new ideas, stifling innovation.

Workforce Insights from Employers

Companies and local and state governments anticipate shortfalls of competitive labor in ICT due to a variety of factors, including rapid product innovations that require evolving skill sets; a more complex, technical environment; an aging workforce; offshore outsourcing; and newly emerging industries. Companies interviewed for this study confirm that demand for software engineers and programmers exceeds the ESD demand figure of 2,485 (both Software Developer categories added together). A search on Indeed.com for the keyword "software developer" in Washington State returns 3,214 jobs alone. A key take-away is that the combined total of annual CS degrees from UW and WSU equals approximately 10 percent of the ESD forecasted demand for Computer Programmers and Software Developers.

The 1-on-1 interview element of this study was designed to understand hiring concerns from employers' perspectives. In completing nearly 30 interviews, targeting a wide range of employers, there was an opportunity to learn more from ICT employers about Washington's start-up ecosystem, trends in ICT innovation and hiring. Most of the interviews were completed between July and September, 2014 but a handful of employers were interviewed in November to specifically respond to projections of supply and demand in ICT.

Employers were asked to comment and provide insights into their experience recruiting ICT workers in Washington. The most common themes and labor outlook comments are as follow:

- Top priority ICT occupations are software developers and software engineers
- Employers prefer to hire qualified ICT workers from in-state; priority hard-to-fill positions in ICT often open up to out-of-state candidates by necessity
- Training and skills of **new graduates** often are not a match for current ICT positions
- Too many 2 and 4-year schools teach curricula that is not a match for current ICT positions which creates an overreliance on graduates from UW

- Too many **experienced** ICT workers are not a match for current ICT positions if they have outdated skillsets or have not worked in a start-up environment
- Washington's pool of ICT workers may not be a match for non-ICT firms that are growing quickly, hiring from scratch and learning "as they go" what skills and educational background will be a good fit

The priority occupations at most of the companies interviewed for this project include core ICT occupations such as software engineers and java developers where there is a projected gap between supply and demand. Many interviewees said, "Even though we're an engineering town and that's our niche, it's getting more difficult every year." Other 'difficult-to-hire' occupations here are user design/interface, product managers and marketing. Leadership positions (manager and above) are also challenging to hire for; this will be explained further in the paragraphs below.

In reviewing the supply of new graduates in ICT, many employers that recruit in-state were critical of students' lack of applied knowledge in their fields. It was common to hear, "It's not my choice to recruit out of state, but I can't find enough CS grads here." Another ICT employer said, "The biggest challenge is that students aren't coming out of universities with applied knowledge. They might have a great academic record, but they can't solve business problems. The robotics graduates are probably the best in this area, but other graduates definitely need our "boot camp. As a result of what we're seeing, there is a lot of conversation internally about training our interns in this way from the get-go."

Employers also want to see a stronger K-12 foundation for ICT occupations. In response, one of DigiPen's priority initiatives is to start a private K-12 program specifically focused on STEM fields.

Many employers are beginning to realize that partnerships with higher education are critical to a strong and well-trained pipeline of ICT workers and admit to needing a sharper focus on more resources in establishing formal internship programs with schools besides UW. Large ICT employers and smaller start-ups were alike in this. One large ICT company is exploring a certification program with schools in eastern Washington and Western Washington University in an attempt to assure that graduates from these smaller schools are teaching the skills that are important to them. Another ICT company said their intern class of six for 2013-2014 was larger than in any previous year. In general though, many small ICT companies don't partner with universities at all and use personal referrals, LinkedIn and third-party recruiters to identify qualified workers. It was also common for smaller ICT companies to "treat every search as a national search" to expand the field of qualified candidates. Hiring for software developers is further challenged if the company is headquartered outside the Puget Sound region or even on the Eastside outside of Seattle. One employer in Eastern Washington told us, "On average, takes six months to place engineers.

It's already a challenge to hire just a couple of them. So while volume of interested candidates is low, if we wait long enough, we'll come across a high quality candidate with strong desire to be in our area but we really have to play a waiting game. And in some cases, we can't take on as much work as we want to."

Employers can calculate the impact and consequences when UW awards 250 Computer Science degrees each year, out of more than 4,300 total degrees that are suitable for ICT. In short, employers say it's the UW graduates that are in short supply, and most of the other institutions' graduates are not deemed competitive with out of state applicants. Employers are also aware that smaller class sizes in ICT are desirable and encourage collaborative problem solving and enable better teaching in topics such as business analytics. There was consensus that this learning environment makes a candidate more qualified for technical and support positions right out of an undergraduate programs, therefore, a solution to limited capacity is not simply to increase class sizes. Finally, employers acknowledge the dilemma of shrinking state funding for public institutions. Less funding or fewer instructors might mean students aren't trained in multiple programming languages. One ICT employer said, "Most of our open positions require a Bachelor's degree and we need developers that code in C or C++. Unfortunately, that's not a focus anymore at UW, so then we have to hire from other colleges." The bottom line: employers and educators agree that in order to train more young workers and expand the pool of qualified candidates, internships and direct partnerships that bring together employers and competitive colleges and universities to develop theoretical and applied curriculum are a growing priority.

Some employers are not certain the existing supply of experienced ICT workers is a fit for their open positions because some experienced ICT workers haven't updated their skills or completed new training. Educators are also aware of this challenge, "The reality is that skills age very fast." Other experienced candidates might have the right skills background but they don't apply or don't want a leadership role. There were also multiple mentions of slow-churn among experienced workers in ICT. People said, "Talent is also very loyal here…people don't just jump if a company is in a bit of trouble which means the most valuable candidates are going to have to be convinced they need to change jobs. This takes time, patience and resources."

Another perspective on the supply of experienced workers is that not many candidates have been through multiple start-up experiences. Several companies stressed the appeal and importance of start-up experience and are frustrated with the limited experience among Seattle candidates even if the candidate's academic credentials or other experience is a match. One person explained, "At our small start-up, deep ecosystem support is a problem, and what I mean is there's not a huge pool of experienced start-up mentors in the Seattle area who have been there from top to bottom."

Non-ICT firms like Nordstrom and Starbucks, were also invited to comment on their recruiting practices and experiences hiring ICT workers because this subset of companies in Washington provides such an interesting comparison to demand within traditional ICT companies. One company explained some of their present hiring challenges in ICT this way, "Recruiting is hard because we need to bootstrap this, and because we have not traditionally been hiring ICT workers from Washington. We don't have the network of people here yet to hire within and yet we don't have all the pieces in place because recruiting technologists is so new for us."

8. CONCLUSIONS

Washington State's ICT Cluster consists of companies devoted to innovation and advancing the State's competitive advantages in ICT, as well as ICT professionals and innovators that span all industries in Washington, including Aerospace, Retail and all others. The ICT cluster provides 238,900 jobs, including many very high wage jobs and also well-paying jobs accessible to workers with a broad range of skills. Labor income statewide associated with ICT summed to nearly $61.4 billion for 2013, while ICT-supported revenues summed to $187.2 billion. The industry continues to grow and forecasts suggest adding 6,680 annual jobs between 2017 and 2022.

The state's entrepreneurial efforts are well supported by early stage investments. Challenges exist to match latter stage funding efforts with local funders, but both related sectors want to find more opportunities to foster successful start-ups in Washington.

Labor shortages exist primarily in top-tier talent at the State's leading ICT companies. The University of Washington is perceived as the only institute in the State graduating significant numbers of students ready to contribute in software engineering and programming positions at the leading ICT companies based in Washington. Future needs and plans address expanding capacity at the University of Washington and improving the quality of other Washington state colleges and universities.

Appendix A. Workforce Assessment Methods

Supply Calculations

The workforce assessment calculates the supply for two cohorts: unemployed workers and recently trained candidates such as college graduates. Combining these two data sources for the overall supply calculation provides a more comprehensive snapshot of qualified candidates based on both educational attainment and previous work experience.

This study assumes that unemployed workers are eligible and qualified for positions they previously held and are as competitive in the marketplace as recently trained candidates. This may not always be the case; however. Rather than attempting to estimate relative competitiveness, the study clearly distinguishes the two sources of supply in associated exhibits for easy reference. Industry experts can determine whether the unemployed are comparably competitive to trained candidates for particular occupations in each sector.

Unemployed Workers

The analysis estimates supply of unemployed workers based on a monthly average of continued unemployment insurance claimants for 2013. Claims data are reported each month at the same time of month by occupation title, and then averaged for the year to reduce variation in claims resulting from seasonality. Data for unemployment claimants categorizes workers by previous occupation using the BLS Standard Occupational Classification Codes (SOC).

Trained Candidates

Trained candidates include college graduates and other individuals that completed post-secondary training at Washington higher education institutions in the year 2011-2012. Estimates of trained candidates are based on completions data published by National Center for Education Statistics (NCES) IPEDS, which identifies the number of students that complete specific instructional programs at various award levels (such as post-secondary certificate, Bachelor's or master's degree) at each Washington higher education institution. Data of completions comes by program major (Classification of Instructional Programs, or CIP). For each instructional program, NCES identifies relevant occupations that trained candidates may be eligible to fill, which allows the model to translate candidates by CIP into those eligible by occupation.

APPENDIX B. ECONOMIC IMPACT ANALYSIS

The primary tool for estimating the broader impacts of the ICT cluster in Washington State was the Washington State Input-Output (I-O) Model for year 2007, published in 2012. The model provides a data-rich rendering of the state economy across 52 sectors. The transactions table, which underpins the I-O model, provides estimates of intermediate purchases, sales, and final demand across all modeled sectors. The complex analysis of the model, published online by the Washington State Office of Financial Management, allows analysts to model the impacts of economic activities when output, labor, wages, and first round direct purchases/requirements are known.

In order to apply the input-output model for multiple years of analysis, implicit price deflators were used to adjust previous year totals to 2013 (the most recent modeling year). Direct requirements for ICT were estimated by applying the calculated shares of purchases for ICT by sector to each year of output, derived from the 2007 transactions table.

As discussed above, the economic impacts of ICT in Washington include direct, indirect, and induced effects, the total impact being the sum of these impacts. Analysis begins with a transactions table, constructed from multiple data sources by Beyers and Lin (2012). This table captures all transactions between and within industries and final demand, the latter including personal consumption expenditures (i.e., household consumption), domestic and foreign exports, investment, and federal, state, and local expenditures. Total output in an economy is thus the sum of inter- and intra-industry purchases, also referred to as intermediate transactions, and final demand. The input-output transactions table is governed by an important accounting identity requiring that all purchases in an economy must equal all output. Within the transactions matrix, the sum of each column represents all purchases by an industry or source of demand, and will equal the amount sales and output by that activity.

For example, in the latest transactions table, the input-output sector "Software Publishing and Internet Service Providers" in 2007 purchased nearly $5.3 billion in non-labor inputs from other industries in Washington. Added to this, the sector paid $9.7 billion in wage and salary outlays (including non-wage benefits), plus $8.3 billion in other value added activities (e.g., profits, dividend payments) and $10.1 billion in imported (domestic and foreign) inputs; these amounts total $33.4 billion, exactly equal to total sales, or output, by the aerospace industry in Washington (**Exhibit A1**).

Exhibit A1 Example of Input-Output Transactions Table

		Software Publishers & Internet Service Providers		Intermediate Sales	Personal Consumption Expenditures	Private Investment	Government Expenditures	Exports	Total Final Demand	Total Output
…										
Software Publishers & Internet Service Providers	…	306.3	…	2,698.2	434.2	82.6	1,474.9	28,663.0	30,654.6	***33,352.8***
…										
Total Intermediate Purchases		**5,289.3**								
Labor Income		9,658.2								
Other Value Added		8,289.7								
Imports		10,115.7								
Total Purchases		***33,352.9***								

Sources: Washington State Office of Financial Management, 2012; Community Attributes Inc., 2013.

The columns of a transactions table thus represent production functions for each modeled industry. Direct requirements coefficients, also referred to as technical coefficients, are the share of total purchases for each input. For example, in 2007, according to 2012 Washington Input-Output Model, the Software Publishing and Internet Service Providers industries in Washington purchased $240.4 million in goods and services from the industry category "Architectural and Engineering /Computer Systems Design and Related Services," translating into a direct requirements coefficient of 0.0072, or 0.72% of all purchases made by Software Publishing and Internet Service Providers based in Washington State ($240.4 million / $33.4 billion).

Once a matrix of direct requirements is calculated, a series of equations are used to relate changes in demand in one sector of the economy to changes in gross output to across the entire economy. Inter-industry transactions, denoted "O," is equal to a vector X of gross output per industry multiplied by the matrix of direct requirements, denoted "A."

(1) $O = AX$

The vector of gross output per industry, X, is the sum of inter-industry output (transactions) and final demand. In the above example, $41.7 billion in total output in aerospace is equal to $842.8 million in inter-industry sales plus $40.8 billion in final demand.

(2) $X = O + D$

Combining equations (1) and (2) results in industry gross output equaling the sum of industry output multiplied by direct requirements plus final demand:

(3) $X = AX + D$

Rearranging this equation:

(4) $D = (1-A)X$, and

(5) $X = D(1-A)^{-1}$, the $(1-A)^{-1}$ inverse matrix referred to as the "Leontief Inverse."

Finally, input-output modeling is primarily used to assess economy-wide changes given a change in one or more activities, resulting in equation (6):

(6) $\Delta X = (1-A)^{-1}\Delta D$

Fiscal Impacts of ICT

ICT fiscal impacts of ICT firms and tech units were estimated through the use of what are referred to as effective tax rates. Effective rates represent total direct tax payments against reported gross business income (GBI) per industry sector, based on the North American Industry Classification System (NAICS).

The first step is to estimate the output supported through indirect and induced effects by the ICT cluster. Next, these output totals are adjusted to GBI based on historic ratios of GBI/output per sector as estimated in the 2007 Washington State Input-Output Model transactions table. After secondary GBI estimates are completed, the calculated effective tax rates per tax type and industry are applied to arrive at additional tax revenues supported by the ICT cluster statewide through indirect and induced mechanisms.

APPENDIX C. LIST OF EMPLOYERS AND INSTITUTIONS INTERVIEWED

Amazon.com
AT&T
Big Fish Games
DigiPen
Expedia
F5 Networks
Facebook
Founders Co-Op
Glympse
Impinj
Isilon Systems
Madrona Capital
Microsoft
WIN Reactor Entrepreneurs
Nordstrom
Open Eye
PNNL
State of Washington Board of Community and Technical Colleges
Tableau
Trace Register
University of Washington
Usermind
Valve
Verizon Wireless
Whatcom Community College
Washington State University
Zulily